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dated: 07.11.2014

Request for Proposal
(Vol. – II)

For

Appointment of Smart Grid Implementing Agency
for Implementation of Smart Grid Pilot Project

Last Date of submission of RfP is 28th Nov, 2014 upto 3 p.m

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1. Section A: Existing Systems for Integration

1. Introduction

Global energy scenario is witnessing key changes in terms of shift of focus towards green energy and sustainable growth and SMARTGRID is getting evolved by integrating end-to-end, advanced communications infrastructure and information systems into the electric power system. Objective of Smart Grid is to use advancements of information and communication technology to make the power grid more efficient, reliable, secure and resilient while minimizing costly investments in new centralized generation capacity. One of the main points about Smart Grid is an increased level of observation and control of a complex power system to facilitate distributed and renewable energy generation. This can only be achieved by an increased level of information sharing between the individual components and sub-systems of the power system. Standardization plays a key role in providing the ability of information sharing which will be required to enable the development of new applications. Smart Grid can provide consumers near real-time information on their energy use, support pricing that reflects changes in supply and demand, and enable smart appliances and devices to help consumers exercise choices in terms of usage of energy. Utilities can better manage the grid in terms of increased visibility of network, improved billing and realization efficiency, increased availability of grid and access of power to rural areas.

The Smart Grid is integrating the electrical and information, communication technologies in the complete power system value chain enabling every point for generation and every point as controllable consumption.

Ministry of Power has taken up the initiative for establishing Smart Grid in India for increasing power availability, reducing AT&C losses and optimal utilization of resources for sustainable growth. MoP is planning to develop Smart Grid in India in stages by taking up pilot Smart Grid projects as suggested by India Smart Grid Task Force. Pilots will be evaluated for techno commercial benefits, technology evaluation and then scaled out into full projects.

This section gives information on the existing systems at APDCL in order to assist the Bidder to understand the existing environment and also plan the integration of the Smart Grid Solution with the legacy system. Different IT & Operations Technology (OT) systems have been implemented under various initiatives of APDCL to monitor and operate power system network and to manage different business process and daily activities. Following sections give details on the existing infrastructure owned by the utility or under implementation, which shall be integrated and operated with the proposed Solution under the Scope of Work.

Following systems shall be integrated under the Scope of Work:
   a. SCADA system under implementation for monitoring and operation of distribution substation and distribution assets like RMUs at Guwahati.
   b. Proposed ERP system to be implemented in APDCL.
   c. R-APDRP-IT System (under implementation) in APDCL.
2. SCADA System in Guwahati under APDCL
There are 36 Substations of Guwahati city under RAPDRP project. The SCADA/ DMS system is under implementation stage and some of the statics of the project is as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>XLPE U/G Cable</td>
<td>23.66 km</td>
</tr>
<tr>
<td>Ring Main Units (RMU)</td>
<td>62 numbers</td>
</tr>
<tr>
<td>Sectionalizer</td>
<td>174 numbers</td>
</tr>
<tr>
<td>Conversion of existing RMUs to motorized</td>
<td>0 numbers</td>
</tr>
<tr>
<td>Fault Passage Indicators (FPI)</td>
<td>212 numbers</td>
</tr>
<tr>
<td>Sub-Station Covered (RTUs)</td>
<td>36 numbers</td>
</tr>
<tr>
<td>SCADA Implementation Agency</td>
<td>M/s. Chemtrols Industries Ltd.</td>
</tr>
<tr>
<td>SCADA Consultant</td>
<td>M/s. Tata Consulting Engineers Ltd.</td>
</tr>
</tbody>
</table>

3. Proposed ERP at APDCL
ERP (Enterprise Resource Planning) system is to be implemented at APDCL to keep a record of the consumer data.

4. R-APDRP IT System under implementation
The Ministry of Power, Government of India has sanctioned R-APDRP PART-A IT implementation projects schemes in all the 7 Utilities of 7 NE States. The implementation project contract is already awarded to M/s TCS, IT- Implementation Agency (ITIA). The system implementation is in progress. The solution will have the flexibility and ability to adapt to changes for compliance with the internal and regulatory policies, and for quick time-to-market with high service commitments to consumers. The infrastructure components for the solution will be located in the centralized Data Centre at Guwahati, Assam for all NE States and backed up by the Disaster Recovery centre located at Agartala, Tripura.

The sanctioned scheme mainly comprises of the following functional items:
- Meter data acquisition
- Energy audit
- New connection
- GIS-based customer indexing and asset mapping
- Disconnection and dismantling
- GIS-based integrated network analysis module
- Centralized customer care services
- Management Information System (MIS)
- Web self service
- Identity and access management system
- System security requirement
- Development of commercial database of consumer
- Metering
- Billing
- Collections
- Asset management
- Maintenance management
R-APDRP proposes an integrated single platform-based system, which caters to various business stacks through a single window. IT users will need to authenticate it to access the applications. Based on the users’ profile the user will be shown the applications for which he is authorized. The portal will provide the common front-end for all applications, providing the solution for all the Modules including the optional modules.

In addition to the proposed software functional modules, ITIA is providing following facilities to utility as a part of implementation:

- Establishment of Data Centre at Guwahati city;
- Establishment of Disaster Recovery Centre at Agartala, Tripura;
- GPS based GIS survey in the identified towns under R-APDRP; and
- Establishment of LAN, MPLS-VPN and other networking in the identified towns.

5. **Integrations with existing IT systems and proposed SCADA/ DMS System**

As explained in the earlier sections, there are different IT/ ERP/ R-APDRP systems existing in utility. The proposed smart grid solution under this Scope of Work shall share data with these applications. Opportunities of utilizing the existing or planned infrastructures of the Utility shall be explored and utilized during implementation of SCADA/ DMS system. The proposed architecture for integration of smart grid functionalities with existing system shall be as follows:

![Diagram of Proposed Integration](https://example.com/diagram.png)

6. **Integration of proposed SCADA/ DMS with R-APRDP IT System**

The upcoming SCADA/ DMS system shall exchange data with IT system using CIM/ XML and IEC 61968 series of standards. The Solution shall utilize an IEC 61968 and IEC 61970 compliant interface. The Solution shall enable export of all data via a CIM/ XML interface and shall utilize modeling appropriate as per IEC 61968. This data exchange with the Solution shall be done...
using SOA/ ESB Enterprise Services Bus already provided by ITIA, over Open XML Models defined by CIM/ XML.

Data exchange between IT system and SCADA/ DMS shall be over model neutral messaging services, while CIM/ XML model-based data exchange for real-time or historical data shall be used. The following standards as applicable will be used to achieve the above requirements: Messaging interfaces shall be based on model neutral interfaces based on the IEC 61970-40X series for access to real-time and historical data, and use the IEC 61968-3 and IEC 61968-9 standards for messaging interfaces that are model-dependent for network operations and metering, respectively. Moreover, implementation shall be based on the EPRI specification document, “Enterprise Service Bus Implementation profile (1018795)”, which defines the implementation profile for IEC 61968 using technologies commonly found on an Enterprise Service Bus.

Any non IEC-61968-1 compliant interface part of the adapter may interact with SCADA/DMS over:

- ICCP
- OPC
- ODBC

6.1 GIS data exchange between IT and SCADA/ DMS:

The GIS survey of the entire city distribution is conducted and saved as a part of IT implementation. The updated GIS data is available in the IT GIS server. The same GIS data is using for the SCADA/ DMS application. The data exchange shall be in a common modem (CIM/ XML) data exchange format. The coding used for each distribution asset shall be same in all the application (IT, ERP, SCADA/ DMS) in order to avoid the use of adaptors for exchanging the data. Sample Data which should be exchanged/ transferred from GIS to SGIS are Consumer information, Asset information (Pole, LT/HT Line, DTR, RMU, Sectionalizer, AB Switch etc), with geographical data, and Electrical hierarchy of consumer to Pole to DTR to Feeder to Sub-Stations.

6.2 Breaker status data exchange:

All the substation/ RMU Breaker status, tripping details, tripping time and date will be available in the breaker status table associated with the SCADA/ DMS application database. This data shall be exchanged with the customer care system of the IT part in the Solution. This exchange shall be on demand or by exception exchange. This information exchange is in a common model format like CIM.

6.3 Daily energy data:

The daily energy data of each feeder shall be stored in the SCADA/ DMS database. This data will be shared with the billing system of IT part. This Exchange shall be on demand or on a daily basis.

6.4 Load priority table:

The SCADA/ DMS have load feeder data containing breaker name, number of consumers connected to each breaker and load priority. This database shall be shared by IT and SCADA/DMS. The load priority information shall be updated by SCADA/DMS and consumer data shall be updated by the IT.

6.5 RAPDRP MDM data exchange with Smart Grid Control Centre:

All the Feeder/Consumer meter data has to be exchanged with the Smart Grid Control Centre. This will be on demand or by exception exchange. This information exchange is in a common model format like CIM.
6.6 CRM data exchange with Smart Grid Control Centre:
All the Consumer information stored for existing consumers, new consumer, consumer information updating, consumer meter information, consumer meter change, and consumer status data has to be exchanged with Smart Grid Control Centre. This will be on demand or by exception exchange. This information exchange also is in a common model format like CIM.

6.7 Billing data exchange with Smart Grid Control Centre:
The entire Consumer billing information stored in billing data has to be exchanged with Smart Grid Control Centre. This will be on demand or by exception exchange. This information exchange also is in a common model format like CIM.

6.8 Smart Grid Integrated System data with Centralized Customer Care Centre:
The daily meter data of each feeder/Consumer shall be stored in the Smart Grid Control Centre database. This data will be shared with the CCC system of RAPDRP IT part. This Exchange will be on demand or by daily.

6.9 Smart grid control centre data with Energy Audit System:
The daily meter data of each feeder/consumer shall be stored in the smart grid control centre database. This data will be shared with the energy Audit system of IT part. This Exchange will be on demand or by daily.

7. Integration with Billing system
A new MBC system with ToU/ CPP and Dynamic Pricing provisions may be required (refer Optional Items in the modified BoQ) for catering to the Consumers of Smart Grid Pilot area. The new MBC system shall be integrated with the existing MBC system for seamless operations.

8. Integration with Renewable Resources
As a part of the project, APDCL wishes to integrate various renewable resources available (like 100KW solar panel mounted on APDCL's headquarter, renewable resources available at various other locations). APDCL shall intimate the chosen bidder about the locations of renewable resources in due course of time during project implementation.
II. Section B: General Requirements

1. General Responsibilities and Obligations

System Integrator (SI) is to adhere to the time schedule agreed in the project plan, supply quality services and material that are scalable and meet the standards requirement. APDCL personnel will identify the single point of contact (Project Manager) and ensure readiness of facilities in time bound manner for the project.

2. Cooperation

SI has the overall responsibility to manage the implementation of the Smart Grid System. In order to successfully implement the Smart Grid Pilot, the cooperation of the Parties as well as certain third party vendors will be required. APDCL will make its Project Manager and related facilities/resources reasonably available to meet the project requirement. The SI will make its Project Manager and related personnel available to meet with or consult with APDCL’s personnel on matters pertaining to this project. The APDCL’s Project Manager will be the primary coordination and control point for all APDCL activities related to this project.

3. Access to APDCL’s Facilities

APDCL shall provide the SI's personnel and third party vendors with safe and reasonable access, space for data centre, working space and facilities, including air conditioning, light, ventilation, electric power and outlets. The SI personnel shall comply with all applicable rules, regulations and requirements relating to visitors on the premises of APDCL.

4. Responsibilities for the Implementation Plan

The SI shall be responsible for development of detailed project implementation plan. The implementation plan shall be modeled such that it provides Power Supply for the activation of equipment & System before delivering of Hardware at Site, Data base development, Commissioning of new system, interface with existing system etc. The Implementation plan includes the activities of both the SI and APDCL, showing all key milestones and clearly identifying the nature of all information and project support expected from APDCL and nodal agency. In consultation with APDCL, SI shall finalize the detailed Implementation plan following award of the contract.

The timelines to be considered in the proposal are as follows:

a) Submission of detailed project plan for pilot for approval.

b) Submission of Assessment report of existing Utility environment with baseline measurements of KPI.

c) Selection of Sub-vendors and their approval.

d) Procure/manufacture equipment.

e) Type Testing.


g) Equipment Installation.

h) Submit Regulatory Changes proposal

i) Site Acceptance Testing
j) Design of software applications
k) Software Testing
l) Documentation
m) Design Interface to existing applications wherever required
n) Integrated system testing
o) Submit proposed Organization Structure and team skillset requirement
p) Submit redesigned Business Processes for review
q) Conduct Training
r) Run Pilot
s) Evaluation of Pilot

SI to also indicate which of the devices can be sourced from multiple vendors. The system should rely on open, published international/Indian Standards. SI should design the system with redundancy for devices and systems which are mission critical for this project. The design will be submitted by SI to APDCL for review and the suggestions will be incorporated to meet the objectives of project. Successful implementation of project will be responsibility of SI.

Licensing and Source Code: SI must transfer all the licensing rights to APDCL for software wherever applicable. The same shall be listed as part of deliverables and shall form part of documentation plan.

5. Contractor's Responsibilities and Obligation

The contractor shall be responsible for all cables and wiring associated with the equipment provided both inside and outside buildings under the scope of this project. The Contractor shall also be responsible for determining the adequacy of the local power source for the equipment and for cabling to it, with adequate circuit protective breakers, as required. In addition, the Contractor shall be responsible for shielding equipment and cabling to eliminate potential interference to or from the equipment and for earthing of all cabinets and shields as required for system.

SI/Contractor's obligations include, but are not limited to, the following:

i. To provide a working system that meets or exceeds the functional and performance requirements of these specifications without affecting the operation of the existing systems.

ii. To perform equipment engineering and design specific to each location including review of, and conformance with local environmental and earthing considerations.

iii. Installation of field devices, hardware, software and communication system.

iv. To develop O&M guidelines.

v. Overall integration of equipment/subsystem

vi. Integration of existing & new meters

vii. Integration with central control system
viii. Buying and maintaining of spares identified under AMC along with main items to ensure system availability during installation and maintenance period.

ix. Project management, project scheduling, including periodic project reports (weekly/monthly basis) documenting progress during the contract period. This shall include impact and comparative analysis and reports for the Smart Grid components.

x. To provide engineering and technical assistance during contract warranty and maintenance period.

xi. To identify all additional equipment and services necessary to ensure compatibility between new and existing equipment.

xii. To implement all minor civil works necessary for installation of proposed equipment and provide the details of such work to APDCL.

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

xiv. 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.

xv. To conduct factory and site testing of all hardware and software.

xvi. To provide Type Test report to APDCL and if required, conduct type test.

xvii. Testing protocol integration with the existing system.

xviii. To provide a Quality Assurance Plan and access to the manufacturing process, as required.

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

xx. To provide storing, maintenance of storing area and security including full responsibility for protection from theft and fire for all items to be supplied. The warehouse may be temporary storage area to be constructed by SI or the same may be taken on rent in APDCL’s premises.

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

xxii. Supply all required spare parts, maintenance aids and test equipment, software maintenance and testing tools.

xxiii. Training of the APDCL’s personnel.

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

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

xxvi. To test restoration of the system form the backup provided.

xxvii. Availability of service, spare and expansion parts for the supplied items for the complete system operating life i.e. 15 years for meters and 7 years for rest of the systems from the operational acceptance of the system as per detailed in various parts of the specifications. Auxiliary Power Supply comprising of UPS for 8 hours battery backup along with all necessary distribution.
The SI is to comply with the safety rules. Detailed descriptions of the Contractor's obligations, in relation to individual items and services offered, are delineated in other sections of this specification.

6. Exclusions from SI/Contractor’s Scope

The contractor shall be responsible for providing all the hardware & software, development of database and services required for commissioning of the project except

i. Buildings
ii. Air Conditioning
iii. Fire fighting system
iv. A.C input power supply

7. APDCL’s Responsibilities and Obligations

The APDCL will provide the following items and services as part of this Project:

i. Overall project management
ii. 3 Phase 415V AC Source power at (nominal) 230 volts, except auxiliary power supply included in the scope of this Project.
iii. Review and approval of the Contractor's designs, drawings, and recommendations.
iv. Existing system network and device data
v. Review and approval of test procedures.
vi. Participation in and approval of Type Test, factory and site acceptance tests, as defined in Clause 12 of Section-D of this document.
vii. Review and approval of training plans.
viii. Providing support and access to facilities at the sites.
ix. 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.
x. Coordination of the Contractor's activities with the APDCL's concerned departments.
xii. Arranging appropriate shut down to facilitate erection testing and commissioning of System 
xiii. Any statutory clearance/entry permit as required.
xiv. Releasing funds to SI as per agreed terms of Payment.
xv. Approvals/Suggestions for change in submitted documents/reports will be given to SI in time bound manner.
xvi. Regulatory support/changes as required.
8. Overview of the Proposed Project

The availability of uninterrupted and quality power is an important requirement for sustained industrial growth and consequent influence on society. Supply to a large area is affected, many a times, even though the fault is localized. In the absence of reliable power supply the consumers, primarily industries resort for own captive generation. Further, high AT&C losses remain a major challenge for most of the utilities that can be reduced by improving visibility of the network, load balancing and proper network planning with properly sized transformers and distribution equipment. The loss reduction will also reduce electricity costs and improve system reliability.

The primary objective of the APDCL Smart Grid Pilot is Peak Load Management. APDCL aims to achieve this via several interventions such as Industrial and Residential AMI, integration of Distributed Generation (Solar and availability of back-up DG Sets) and Outage Management applications. APDCL expects that Power Quality Monitoring will be a by-product of the deployment of the above functionality and the same infrastructure will help APDCL collect power quality data from the end-points that will help improve the Quality of Service parameters of APDCL and provide valuable data for planning purposes.

APDCL intends to implement a Smart Grid Pilot Project (the “Project”) having its total project cost of 29.94 Cr. (Twenty Nine Crore and Ninety Four Lakh only) in a mix of its residential, commercial, industrial and agricultural consumers at three of its service areas:

i. Paltanbazar,

ii. Ulubari and

iii. Narengi Subdivisions of Guwahati city, with focus on:

- Better peak load management
- Better asset utilization/ reduction in asset failure/ crew management,
- Reduction of current level of Aggregate Technical and Commercial (AT&C) losses,
- Innovative use of ICT to improve overall performance and customer participation/satisfaction.

The broad scope of the Project includes:

- AT&C Loss Reduction
- Peak Load Management
- AMI for Industrial, commercial & residential consumers
- Outage Management
- Load Forecasting
- Demand Side Management and Demand Response
- Power Quality Management
- Renewable Energy Integration

9. System Architecture

SI is to submit proposed system architecture for the given Pilot Project for review from APDCL architecture will include the available technology options, criteria for selecting the proposed technology, the technical specifications of the products to be installed and the functional
description of IT applications, designed to meet the given functionalities. Due consideration is to be given for selecting technology that is interoperable, evolvable and scalable in future. SI is to describe the evolvability of the proposed solution to accommodate new features and functions. SI is to classify each element of system design as critical or non-critical from customer’s/Employer/Utility’s perspective. Optimization of asset utilization and operating efficiency of the electric power system. Software applications should facilitate interface to other systems through web services.

9.1 Performance Requirements of Solution

SI is to clearly indicate the performance parameters of the proposed solution in terms of size, scalability, latency, response time, user interface features. Devices and systems which are mission critical to the delivery of project objective should have sufficient redundancy to meet the specified availability of the IT, surveillance and communication system as 99% and desired response time. The suggested performance parameters for some functions are as given below:

<table>
<thead>
<tr>
<th>User Interface Requirements</th>
<th>Response time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any real time display and application display on workstation console, Complete display &amp; data values shall appear on screen</td>
<td>Within 2 sec after acknowledgement of request</td>
</tr>
<tr>
<td>Manual Data entry of the new value shall appear on screen</td>
<td>Within 2 sec</td>
</tr>
<tr>
<td>Display update rate</td>
<td>Every 2 sec for 4 displays together</td>
</tr>
<tr>
<td>Response time for display of Alarm and event after receipt in system</td>
<td>Within 1 sec of receipt in system</td>
</tr>
<tr>
<td>Alarm and event acknowledgement</td>
<td>Within 2 sec</td>
</tr>
<tr>
<td>Requests for printing of displays (to be acknowledged with an indication of request is being processed)</td>
<td>Within 2 sec</td>
</tr>
<tr>
<td>Requests for generation of reports (to be acknowledged with an indication of request is being processed)</td>
<td>Within 2 sec</td>
</tr>
</tbody>
</table>

The software execution rates, response times and performance requirements shall not deteriorate during the peak load conditions. The following conditions as applicable shall define the additional peak level of system activity:

i. **System Alarms**
   a. 300 alarms in a scan cycle starting the five-minute period (50% status changes and 50% analog limit violations)
   b. 200 alarms per minute for five minutes.
   c. 50% of the alarms shall be acknowledged within the five-minute period (automatic acknowledgement is unacceptable).
ii. **Display Requests**: 6 display requests per minute per console.

iii. **Supervisory Control**: 4 Supervisory control actions per minute.

iv. **Communication System Disturbances**: 10 disturbances within the five minute period.

### 9.2 Security

SI shall comply to the standard security requirements and include the following details as part of its proposal:

**i. Security Architecture:**

a. SI to explain how their solution will meet ITU-T/CERT-IN/Other security standards/guidelines regarding Security requirements for systems providing end-to-end communications.

b. Mitigation plan designed for Service impacting attacks (e.g. DOS, DDOS, etc.).

c. SI to explain the capabilities that are incorporated in their solution for mitigating service impacting attacks.

d. SI to explain the capabilities that exist in their proposed solution to revoke passwords, authentication tokens, and encryption keys.

e. SI to explain the Intrusion Detection System (IDS) and Intrusion Prevention System (IPS) proposed to mitigate attacks, and detect traffic anomalies for the proposed solution.

**ii. Security Requirements**

a. SI to explain the operation of solution relative to ITU-T/CERT-IN/Other security standards.

b. SI to explain the reason of selection of proposed security performance solution for the management and control network.

c. SI to explain the proposed mechanism of securing (e.g. encrypt) all Management and Control traffic. (e.g. IPsec, SSL, etc.).

d. SI to specify the encryption options for the Management and Control traffic both for IP and http traffic currently available with your solution.

**iii. Access Control**

a. Access to entities on the Management and Control network (e.g. MDMS) must be secured. SI to specify the token based (e.g. Secure ID) authentication system that they are proposing for this solution with reason.

b. In the proposed solution of SI, authentication is to be used to secure the local asynchronous or Ethernet port on the Grid Elements as well as the network and web access interfaces.

c. SI to describe the method of single sign-on, in the proposed solution, if incorporated.

d. SI to describe any options available for the proposed solution to support single sign-on.
e. SI to explain the use of https for secure web access.

f. SI to explain the encryption algorithm used to encrypt all passwords stored and used by the solution

g. SI to explain that whether token based authentication can be used instead of passwords universally in the proposed solution.

h. SI to explain about the authentication options which will operate with the proposed solution.

i. SI to explain that how failed login attempts, and login account lockouts are logged in the proposed solution.

j. SI to explain the method used to consolidate and archive failed login attempt logs.

k. SI to explain whether the archived and current logs be used by the security management system to view a long term perspective of a situation

l. All methods of insecure access shall be disabled (e.g. rlogin, FTP, etc.).

m. All methods of file sharing (e.g. CIFS) shall be disabled on all systems in your solution.

n. The network management protocol used for network management will have a community name string at least 8 characters long and requiring at least one uppercase letter, one lower case letter, a number, and a special character in the community name string and password. No default will be available for these strings, and they must be entered to install or update the software.

iv. Security Management

a. Security management systems are being proposed by SI and reason for the same.

b. Communications security (specifically authentication, authorization and confidentiality) between Grid Elements and Management Systems on the Management and Control network shall be configured and operate as if it were on an “Untrusted Network Segment” even where physical access to network media is limited.

c. Management and Control network direct login security shall be based on authentication (e.g. Secure ID).

d. Bidder to describe the process for notifying the customers of vulnerabilities within the proposed products and their potential impacts.

v. Security Patches

a. Software delivered over the Internet, including security patches shall be encrypted and signed (e.g. PGP, MD5, etc.).

b. Bidder to specify how security requirements and encryption keys shall be maintained.

c. Bidder to specify the method of patch distribution over the Internet and the encryption method and verification method.

d. Software updates and security patches shall be applied while the system is in operation and shall not require a reboot (e.g. applied to one processor in a dual processor configuration). A secure (e.g. https) remote method of initiating a rollback to the
software prior to the update or patch shall be provided.

e. Bidder to describe the method proposed to securely apply software updates and patches.

f. Bidder to specify the method proposed to securely initiate a rollback to the software state prior to an update or patch.

vi. Vulnerability Management

a. The vendor must certify the solution to be free of backdoors, Trojan horses, viruses, worms, and other vulnerabilities specified as high risks by CERT organization at the time of operational acceptance.

b. The vendor solution will be required to pass a vulnerability assessment prior to operational acceptance which will test for any CVE “high” risk vulnerabilities.

c. Vendor to explain the vulnerability testing performed as a part of the solution security testing.

d. At what points in the proposed solution development and deployment cycle are security vulnerability assessments performed.

9.3 Technical proposal

The following items shall be included in the Technical Proposal by SI:

i. Executive Summary

ii. Project Implementation Schedule

iii. Table of Compliance as mentioned in Clause 9.6 of this section.

iv. System Architecture and description, Security Architecture, Tentative BoQ, Specifications of items

v. QA/QC program as described in Clause 3rd of Section VII

vi. Business Process which may need redesign

To facilitate the proposal evaluation, the Table of Compliance, System Architecture and design will serve as the primary source of information. The proposal must also be supplied in an editable format (e.g., word processing, spreadsheet). Non-editable formats (e.g., Acrobat .PDF) will not be accepted for these documents.

9.4 Executive Summary

The Vendor shall provide an executive summary, presenting the essence of the proposed system and services.

9.5 Project Implementation Schedule

The Vendor shall provide a preliminary version of the project schedule, including documentation submittal dates, showing major system delivery/implementation activities and indicating milestone events with the interdependencies between events.
9.6 Table of Compliance

The Vendor shall prepare a Table of Compliance. Non-Compliance is defined as non-availability of functions as described in any section, paragraph or sentence that is not fully compliant with the specification. The Vendor shall use the form given below to present its table with the associated compliance symbols described as follows:

**Table of Compliance**

<table>
<thead>
<tr>
<th>Section Page/Para/Line</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>

Where:

Section = Specification Section

Para/Line = Paragraph or line number in section. If entire section, this field is left blank

Symbol =

C - Comply  Vendor complies

A - Alternate  Vendor proposes Functional Equivalent

CL - Clarification  Vendor needs to clarify/state assumption for its compliance

X - Exception  Vendor does not propose the functionality specified

Description = Explanation for the deviation from the specification.

Unless a specific section, paragraph, line or word is listed in this table, it is clearly understood that vendor fully complies with the specification requirement.

10. Field Installation Procedure For AMI

**Installation of Advanced Metering Infrastructure (AMI)**

Provisions to be followed for installation of Advanced Metering Infrastructure (AMI) such as Smart meters at consumer & DT end with its accessories such as Data Concentrator Unit (DCU) and other elements used in the communication in the Utility distribution network: Installation shall be done in such a way to ensure proper two way communications, achieving maximum signal strength and coverage of adequate number of meters under a DCU, avoiding any danger in normal conditions, so as to ensure:

- personnel safety against electric shock
- personnel safety against effects of excessive temperature
- equipment safety against spread of fire
- equipment protection against solid objects, dust & water

Contractor shall be responsible for proper storage of all the materials at their own cost, until the system is undertaken by the Employer. The Contractor shall bear the cost of any of the materials lost or damaged during storage and erection. Contractor shall setup required number of stores in
consultation with Employer. During the installation of AMI System, it is advisable to the contractor to prepare a schedule of work. Same has to be submitted to the utility for approval. Request for shut down if required any shall be given well in advance.

Indian standards/commonly prevalent industry standard and practices shall be followed during installation.

A. Installation of Smart Meter

- Replacement of existing energy shall be carried out by Contractor according to the following procedure:
  - Remove old meter
  - Record last meter reading
  - Handover to APDCL in concern sub-division store

- Old energy meters are to be removed in presence of APDCL personnel who must be given conveyance support by the contractor. Last meter reading shall be authenticated by APDCL representative.

- Smart Meter Cabinets shall have to be fixed on meter board which should be made up of high quality Fiber Glass (Reinforced) Plastic material. The board shall have to be preferably transparent in color with dimension of suitable size for the meter with meter box and thickness not less than at least 30 mm. All material (FRP) for the boards must be new, unused, not rebuilt or reconditioned, and shall not incorporate reconditioned or salvaged parts or components. The FRP boards must be fabricated using the superior quality raw materials & machinery and should conform to the latest editions of the standards applicable, if any.

- Employer has the practice of installing meter in meter Box. New polycarbonate meter box matching with smart meter shall be installed. Once the meter is mounted on meter board, no access to the terminals shall be possible unless the meter case or cover is broken through. The meter box door shall have two hinge on one side and sealing arrangement on other side.

- All accessories required for installation of FRP board and meter box shall be provided by the contractor.

- For new connections service cable till the meter installation point shall be provided by employer, however new meter along with board and meter box shall be provided by contractor.

- Contractor has to install the smart meter on new meter board/box.

- For fastening equipment and fittings to buildings only galvanized steel screws or screws made of non-corrosive material of strength shall be used.

- After meter installation, customer identification no., meter ID its hardware & software configuration, name plate details & make, type i.e. 1 phase or 3 phase, etc. shall be recorded and updated in DCU/MDAS/MDM by the Contractor. All meters falling under one DCU shall
be commissioned and checked for proper communications in presence of employer.

- **Location:**
  The meter shall be preferably located in a building, outside living area, suitable for physical inspection without entering into consumer’s living area. However, Meter shall be installed as per prevailing utility practice, in case of some old meters are installed against the prevailing practice of the utility, contractor shall shift the meter to a new location in line with utility practice, all the necessary wiring and civil work involved shall be done by the contractor.

- **Civil Works:**
  Civil works associated with the installation of the smart meters such as pointing, grouting, mortar touch-ups, carpentry, etc., are to be done by the contractor. Erection of supporting structure for the stability of meter case is to be done by the contractor only with the approval of the site-in-charge.

**B. Installation of Data Concentrator Unit (DCU)**

DCU will collect the data from the smart meters and send to MDAS at the utility control center.

- **Location:**
  - Contractor shall finalize the location of DCU to meet the specified performance criteria. DCU have to be installed at certain nodes such that the reception of the signal is maximum, affirming the requirements of the specification.
  - Mounting of DCU can be on wall or distribution poles, or separate supporting structure based on the requirement. Pole mounting/wall mounting is to be done with proper galvanized iron flats/strip to pole designed for weight of DCU. It is to be locked and protected for secured access of the O&M people. DCU must be protected against ingress of water/moisture/dust/insect. Any damage or discrepancies to the DCU and its components such as sensors, displays, alarm systems, etc. have to be replaced by the Contractor.

- **Installation Quality**
  - The employer shall check on the quality of installation by checking performance of the sensors, wiring methods, alarms, communication to control centre & time lag in data acquisition & to certify for acceptance to contractor.
III. Section C: Functional Requirements

1. AMI FOR RESIDENTIAL

Objective: Remote meter reading for error free data, network problem identification, Load profile, Energy Audit and signal for partial load curtailment.

The system will also allow to test technology, evaluate meter functionality, communications capabilities, error free data for billing and billing system integration, engineering performance, computer systems and software needed to manage and maintain meter network and supply. The major components of this pilot project would be:

i. Smart Meters
   - Installation
   - Development of Smart Meter Network
ii. Master Station/Control Centre/Central Computer System
iii. DCU/ Modems
iv. Last mile connectivity
v. Head End System
vi. Meter Data Acquisition System that will capture:
   - Usage with Time stamp
   - Voltage
   - Current
   - Events and generate alarms
vii. Meter data Management System
   - Billing Application based on TOU/CPP
   - Energy Accounting
   - Load Analysis/Business Intelligence
viii. Analytics and reports
ix. Network and Communications
x. Customer Outreach and Education

1.1. Smart Meter

AMI meters for the project are advanced solid state digital devices capable of recording hourly and sub-hourly data that includes energy consumption (in configurable interval ) and may include voltage and power factor information. Smart meters enable two-way communication between the meter and the Control center system. The specification of Smart Meters for various types of meters is in relevant Annexure.

The smart metering system shall calculate both TOU and CPP rate based consumption. The meters shall have the following minimum features:

i. Store and communicate requested data as per programmed interval.
ii. Detect, resolve abnormal & tamper events and store the same with alert to APDCL personnel.
iii. Inbuilt memory to store all relevant meter data, events for a minimum of 65 days.
iv. Facilitate both prepaid and postpaid metering.
v. Shall be configurable remotely including remote firmware upgrade.
vi. Support remote load management by sending load curtailment signals that can be direct display/SMS/Web application.
vii. Record violation of sanctioned load as per parameters set by APDCL.
viii. Load Reconnect / Disconnect switch – Requirements shall be:
   - All smart meters shall have a supply Disconnect / Reconnect switch / contactor for full load.
   - The AMI system shall support remote disconnect/reconnect of customer supply only via the supply contactor.
   - When the smart meter performs a disconnect operation, all outgoing power circuits from the meter shall be disconnected.
   - To confirm the current state of a meter, the AMI system shall support "On-Demand" remote polling of the meter to determine whether the supply is open or closed/whether meter is energized or not. The meter shall provide clear local visual indication of the status (open/closed) of the Supply contactor, consumption, last bill details.

1.1.1. Other Smart features:
   - Multiple load profile recording Tariff-based Prepayment
   - Multi-energy recording
   - Unidirectional Meters (Lead/Lag) and Full quadrant energy measurement (import/export, lead/lag)
   - Net or gross measurement options
   - Dedicated co-generation and off-peak meter variants
   - Energy measurement inclusive or exclusive of harmonic content
   - Configurable event logging
   - Tamper detection
   - AMI notification
   - Broad modular communication options
   - Supply capacity limiting
   - Under voltage/over voltage recording
   - Under frequency/over frequency recording
   - Under frequency load control
   - Multiple load control relay configurations
   - Independent load control schedules
   - Boost function
   - Group load control
   - Manual and emergency load control override
   - Managed supply restoration
   - Managed load energization
   - Over the air firmware upgrade

1.1.2. Smart Configuration:
   - Flexible configurations to support customized needs.
   - Highly configurable load profile, time of use, demand metering and prepayment.
   - Measurement profiles, load control schedules and multi-element options.
1.1.3. Last Mile connectivity

AMI will be implemented for close to 5878 customers in Paltanbazar, 9070 customer in Ulubari; 135 customer in Narengi this includes industrial, commercial and residential customers. AMI will be implemented using a mix of wireless technology like RF and/or PLC and/or ZigBee and /or Wi Fi and / or GPRS and/ or WiMax or any other solutions. RF and/or PLC/ ZigBee will have to be used in Mesh topology so that data reliability is taken care of. The Mesh network will also have to be self-healing and self-forming network.

The requirement for the AMI and the last mile connectivity is as below:

- The Communication between the meters and the head end system should be bi-directional as the Meters should be able to receive the control commands. The Meters should also be able to receive and process configuration commands.
- The system should be able to integrate with the billing system for bill generation for all the customers.

1.1.4. DCU/ Modems:

DCU will collect the data from the meters via RF/PLC/ZigBee and transmit the same to the head end system in an encrypted and compressed form via GPRS or any other suitable communication media. The successful bidder will provide the protocol between the DCU and the Head end system to APDCL.

The successful bidder will also provide the protocol between the Meter and the DCU. The Consortium is expected to use both single and three phase meters of a particular make in the entire project area. The selected Bidder needs to prove interoperability of the AMI system either at DCU level or at MDMS level.

1.1.5. Head End System:

Head End System, is the critical interface to the field devices, which shall support Meter Data Acquisition, Two way communication, poll meters for data collection, send remote firmware upgrades / programmable parameter inputs to meters, send Load Curtailment signals, Connect/ Disconnect and send of pricing and other signals as generated from the MDMS/Other applications to the Smart meter.

1.1.6. Master Station/Control Centre

Master station /Control centre will be located in the space provided by APDCL. All hardware for MDMS will be installed in this premise and the operator(s) will be seated in this centre to manage the Smart Grid system through their desktops.

1.1.7. Meter Data Acquisition System

Meter Data Acquisition System, is the critical interface to the field devices, which shall support Meter Data Acquisition, Two way communication, poll meters for data collection, send remote firmware upgrades/programmable parameter inputs to meters, send Load Curtailment signals, Connect/Disconnect and sending of pricing and other signals as generated from the MDMS/Other Applications to the Smart meter. This will interface with MDMS over SOA/Web services, and the data exchange models and interfaces shall comply with CIM/XML / IEC 61968/62056.
There would be 2 ways in which data would reach the Head end System.

- **Push:**

  This would mean that the meter / DCU would send the data to the HES. The HES would acknowledge the receipt of the data. In case the Meter / DCU is not able to send the data to the HES, the Meter/DCU would store the data and re-transmit the same to the HES whenever the connectivity is available. The Metering system should also send the reason for the failure of transmission. The following functionalities of push interval and respective parameters are as below:

<table>
<thead>
<tr>
<th>Consumer Base</th>
<th>Push interval Mins</th>
<th>Parameters required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>15’</td>
<td>kW, kWh, V, I, Pf, F, Date&amp;Time</td>
</tr>
<tr>
<td>Commercial</td>
<td>15’</td>
<td>kW, kWh, V, I, Pf, F, Date&amp;Time</td>
</tr>
<tr>
<td>Residential</td>
<td>1440*</td>
<td>kW, kWh, V, I, Pf, F, Date&amp;Time</td>
</tr>
<tr>
<td>Feeder</td>
<td>15</td>
<td>kW, kWh, V, I, Pf, F, Date&amp;Time</td>
</tr>
</tbody>
</table>

* Incase the consumer participates in Demand Response, the data needs to be transmitted to the server in 1 min. Tamper events should be transmitted to the HES within 1 min of the event taking place. Non-critical event can be sent along with the regular data or a max of 4 hours.

- **Pull:**

  This is when the HES would request for data from the Meter. The following data should be provided by the meter as and when requested from HES:

  1) Meter Information
  2) Load Survey
  3) Tamper information
  4) Billing Data/ Billing History.

### 1.2. Meter Data Management System

It is the heart of AMI. MDMS shall be a single repository of all meter data. SI shall design this system based on open standards and using SOA principals. It will facilitate the following:

#### 1.2.1. Billing System

A billing system capable of handling the billing of time based rates and existing APDCL’s billing rate will be required to be deployed. SI has to describe the billing system design.

#### 1.2.2. Energy Accounting :

This module shall support the following functions:

i. Generate report of Loss analysis for different groups and categories of consumers on daily basis.
ii. Generate report of AT&C loss calculation on weekly basis.
iii. Generate report for accounting and auditing at Feeder level, Distribution Transformer level and DCU level.
iv. Create graphical representation of all results that can be displayed on monitor and printed as per requirement.

#### 1.2.3. Load Research

The proposed load research application shall be using the data of project area LT network, this should provide the following functions for analysis:

i. LT load requirements in short term and long term
ii. Consumer load pattern
iii. DTR loading and balancing
This will help the APDCL in forecasting their load for short term, as well as plan network augmentation in long term. The data shall also be analyzed to aid in the day to day operation.

1.2.4. System Requirements

The meter data management should be able to calculate the requisite billing determinants for time based rates which shall go as an input to APDCL’s existing billing system. The minimum requirements of MDMS are listed below:

i. Rule based Validation, Estimation & Editing (VEE) of consumption data.

ii. Detect & publish abnormal consumption events and patterns.

iii. Schedule based and on-demand reading from meters.

iv. Receive tamper events from meters and take appropriate action including sending alerts.

v. Receive power loss/restoration events from meters and take appropriate action like alarm generation or work order for maintenance crew.

vi. SI to describe how the system will receive, store and present data from non-meter sources, includes customer equipment, distribution automation devices, RE sources, Network components configurable for different pricing plans, and TOU/CPP.

vii. Enterprise class reporting engine. E.g. from Oracle, Microsoft, IBM etc.

viii. SI to describe the scalability of the project with respect to the system requirements (in terms of number of additional meters and number of additional parameters for each meter) without performance degradation with suitable hardware upgrade.

ix. Load analysis / research for decision support.

x. Process and generate billing for customers of pilot project area.

xi. Designed with adequate Cyber Security and Controls

xii. Provide an interface to consumer portal

xiii. Provide an interface with already existing IT systems of APDCL— GIS, IT-applications so as to minimize data duplicity.

1.2.5. Alternative Data Collection:

If AMI is not able to collect data through DCU due to any reason, there should be provision of data collection through Hand Held Unit (HHU)/Common Meter reading Instrument (CMRI) via Optical Port of the Meter which should be integrated with the MDM system.

There should be a RS-232 port in all the meters in addition to the optical port for data collection.

1.3. AMI Network and Communications

1.3.1. AMI System Design:

i. The proposed solution (including the communication network and equipment) should be scalable to support future customer growth at the rate of 10% each year for the next 10 years.

1.3.2. Detailed design of the communication infrastructure of AMI system should be provided, which should include but not limited to communication technology, communication packet sizes, data rates, communication protocols, error detection and correction techniques, network data capacities, and bandwidth and margin at full system load.

1.3.3. Time Synchronization:

SI is to include Time Synchronization system for all components of Pilot Project, which require real time synchronization.
1.3.4. **Public Network:**

In case of use of public network for communication, information regarding following parameters must be made available:

i. Details of the network usage in terms of cost of operation and extended life of the system.

ii. Security

iii. Reliability

1.3.5. **Expected operating life and performance reliability:**

i. System operating life: It is expected to be 15 years for meters and 7 years for rest of the system.

ii. System Reliability: The system must have sufficient fault tolerance, redundancy, failover, self-healing to guarantee system information requirements. A systematic failure analysis of all the elements must be done and ensure that there is no single point of failure which leads to more than 2% of data disruption for not more than 24 hours.

iii. Predictive/preventative reliability: Tracking and reporting performance of all elements of the AMI system to ensure system reliability and proactively identify potential situations that could become system problems.

1.3.6. **Technical obsolescence:**

The system elements 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 options described in detail. The mitigation shall not be limited to periodic update from OEM/System supplier.

1.3.7. **Equipment sitting:**

The criteria and flexibility in physically siting all the equipment must be listed prior to deployment of the system.

1.3.8. **IT Infrastructure and System Integration:**

i. SI to describe the head end system/ Data concentrator functionality in detail.

ii. The solution provider’s head end system/ Data Concentrator should fully support all functionality described in the scope of work.

1.3.9. **Interoperability criteria:**

i. The proposal should specify the points of interface, where this part of the system interacts with other R-APDRP modules, like GIS, SCADA, DMS, portal, existing metering, billing and other IT applications.

ii. The project should use standard communication protocols and describe the protocols used for the system.

1.3.10. **Customer Interface:**

The system shall provide periodic updates to the customers via media (i.e. website, SMS, e-mail, meter displays etc.). The same shall be clearly defined by the Bidder. The system shall support all the above media and delivery shall include at least three out of above.

1.4. **Analytics and Reports**
Business Intelligence tools shall be supplied to generate analytics and reports. SI is to suggest and design the reports in line with redesigned business processes and the details of such reports are to be included in the technical proposal. The SI needs to suggest and design reports for:

i. Time frames like weekly / daily / monthly / yearly.
ii. Objects, objects executed (actual) or combination of both in MS Excel or Web (Internet Explorer).
iii. Exporting to Excel, ASCII files, PDF and HTML or third party reporting tools (Crystal Reports)
iv. User based templates be created & used for reports:
   - For calculations, filters and exceptions during reporting to be scheduled to run in batch.
   - Scheduling to run the reports event-based or time based.
   - Delivering the reports to the online users through email, portal, and report server.
   - Providing metadata objects to be viewed during reporting.
   - Provide for saving the report /queries for repetitive execution as and when required by the users.
   - Analysis of historical & consolidated data across systems
   - Monitoring the performance of data warehousing system

1.5. **Network Management**

The Bidder shall provide a Network Management System with the following functions:

i. The network monitoring system shall help the computer system operators to easily identify the problem areas and hence to take necessary corrective action remotely or manually.

ii. The meter and the DCU and communication equipment in the network need to be monitored and tracked continuously in addition to the other IT networks.

iii. The Network Management System shall have visibility of the accessibility of each of the end equipment, communication devices, and other intermediate components in the network to give the operator real-time status and alarms in case of any of the nodes and channels being unreachable.

iv. The equipment to be monitored shall include data concentrators, backbone connectivity, last mile connectivity, end points, etc.

v. The monitoring data shall be stored for 1 month and shall include lost data packet.

1.6. **Network and Data Security**

The following items need to be considered for adequate security at different levels i.e. systems, data, network and security and SI needs to provide:

i. Systematic description of how data security is maintained from the meters to the system head end. All elements of the proposed system shall support protection of data, confidentiality, data integrity and operational security. Physical security to prevent on-site tampering to be ensured.

ii. System should enable creation and maintenance of accounts, passwords and functionality access levels, along with log details.

iii. Description of the in-built anti-virus capabilities provided in connection with all proposed software platforms and solutions.

iv. Description of methods to detect and prevent attacks including but not limited to denial of Service and Intrusion.

1.6.1. **Access Control:**
i. There shall be an identity and access management system which shall control and log the access control of all users to the smart grid systems.

ii. The identity and access management system shall be able to define the access control levels of each user based on roles, responsibilities or hierarchy.

iii. The identity and access management system shall be able to define which user can access which function of the individual systems. For example, the identity and access management system shall define which user can initiate a load disconnect function for a particular consumer, and therefore rest of the unauthorized users will not be able to perform load disconnect function.

iv. The identity and access management system shall be integrated with rest of the Centralized Computer Systems.

1.6.2. Network Security:

i. Since Centralized Computer System has to access external environment through GPRS and so it is important to have adequate network security systems.

ii. There shall be intrusion detection and prevention systems deployed at the central layer.

iii. There shall also be firewalls which will be a separate system from the intrusion Prevention system.

iv. The firewall shall control the demilitarized zones in the data centre and control room, and also the systems and ports which will be open to public network/ VPN.

v. If fixed IP and operator VPN is not available/possible and Dynamic IP is being used, then the devices shall support SSL/IP-Sec. or allied VPN and the data shall be encrypted before send / received on GPRS/CDMA last mile network, for devices consisting of Smart Meter Network.

1.6.3. Systems and Data Security:

i. The systems deployed shall have the application scanning, hardware scanning tools in order to identify any vulnerability so as to mitigate any potential security threats.

ii. The application databases shall have exclusive security tools in order to prevent any potential internal attacks like SQL injection etc.

iii. The data shall be encrypted wherever supported by existing systems/devices/technology.

1.7. Customer Outreach and Education

The customer data acquired will be the basis of the design of suitable outreach programs to be executed by APDCL with the help of the successful bidder if necessary to address the issues captured in the survey exercise. These programs will be focused to the class(es) of consumer(s) and will aim at creating awareness of the pilot and its benefit. The programs shall cover road shows to attract customer voluntary participation, booklets for general distribution, compilation of consumer survey data, workshops etc. In all these the successful bidder is only expected to design and assist in preparation of documents and APDCL will actually execute the programs. The expertise of the SI should be made available during these interactions. This method shall aid in the process of successful implementation of Demand Side Management for reduction of peal load.

1.7.1. Consumer Portal

The successful bidder needs to design Consumer portal on standard off the shelf product that can be easily managed by APDCL personnel after completion of Pilot project. Consumer Portal is one of the most important components of Smart Grid. The objective of Consumer portal is to
provide high quality experience for the customers and business associates that will provide them a user friendly portal and will make it easy for them to communicate with APDCL through the web instead of direct phone calls or visits. This portal will also act as a source of information for the customers regarding policies and procedures. This in turn will improve customer satisfaction and reduce work load on the employee.

This portal will host the web application for:-

i. Display of Load profiles selected based on organizational hierarchy of APDCL.

ii. Display of Reliability Indices selected based on organizational hierarchy of APDCL.

iii. Bill payment services.

iv. Other Information Sharing requirements based on standard Information Architecture.

v. The system integrator is expected to investigate the option of using existing consumer portal which is a part of R-APDRP for seamless integration with smart grid system.

1.8. In-home Display Devices (IHD)

In-Home Display provides easy access to energy data in the home to inform and empower the consumer on their electricity usage via a high resolution graphical back-lit display.

The display Indicates:

i. Consumption in terms of energy and money with day, week, month and yearly comparative graphical displays.

ii. Power/energy consumption with alert and status indicators.

iii. Multi-rate energy registration, time and calendar information; updated via the Zigbee/ RF communications.

iv. IHD shall be compatible with smart metering solutions with Zigbee/RF enable meters.

v. IHD shall support Zigbee/RF Smart energy Profile.

vi. Below are the basic features to be supported by IHD:

- High resolution Colour graphical touch-screen display
- Zigbee/RF low power mesh radio for wireless operation
- Instantaneous energy: (Kwh: Import / Export, Net , money, etc)
- Historical data report(Kwh):hourly, 24hrs, 7 days, monthly and 12 months periods
- Period Comparison (Kwh)
- Fully portable, wireless and battery powered
- User selectable consumption thresholds
- Password protection for accessing setup parameters

1.9. Other Functional requirements:

i. The AMI meter shall store interval data on 15 min basis for at least 35 days.

ii. The system shall support interval lengths of 15 / 30/ 60 minutes

iii. The AMI Meter/Device shall log all internal meter clock time corrections or adjustments.

iv. The AMI Meter/Device shall support remotely programmable interval lengths.

v. The ability to keep a log of the “On Demand requests”, including those that have been downloaded.

vi. Meter shall be capable to support remote programming from AMI system as defined below –

   a) Time Of Usage (ToU)
b) Survey Integration Period change

c) RTC Set

vii. Meter shall support the Over the Air Firmware upgrade for meter firmware with proper security and notification to AMI System

viii. Tampering events: Utility detects tampering or theft at customer site.

ix. The AMI Meter/Device shall notify details when meter is not communicating.

x. The AMI Meter/Device shall notify when meter bypasses.

xi. The AMI Meter/Device shall notify the physical tamper conditions.

xii. The AMI Meter/Device shall notify when meter is removed and not reinstalled.

xiii. The AMI Meter/Device shall notify analytics based theft detection, with data aggregated from multiple nodes, including the feeder.

xiv. The AMI Meter/Device shall send all the events to the MDM system.

xv. If the AMI Meter/Device cannot communicate the event directly, it shall log the event and forward it to MDM once the communication is established.

xvi. If the AMI Meter/Device is removed and re-installed, the usage pattern of the meter shall be compared with the historical usage pattern.

xvii. If any discrepancy is found, a notification shall be created for a utility representative or process to analyze the tampering event and take appropriate action (for example, to create a service order to investigate).

**Time Sync:** Project implementing consortium will make sure that appropriate measures are taken to keep all the components time synced to make sure that the data integrity is not compromised.

2. **AMI for industrial**

**Objective:** Load profile for peak load management, network problem identification, Energy Audit, Load curtailment in place of load shedding.

AMI will help in improving billing efficiency, demand side management for reduction of energy use, provide the utilities and consumers with better outage management, provide load profile data, and quality data to improve power quality that can be charged a premium price and to gauge customer perception and APDCL benefits.

This project will be similar to AMI for Residential pilot but will have a more sophisticated meter for capturing additional parameters like for power quality and demand control by way of load curtailment from remote end.

The major components of this pilot project would be:-

i. **Smart Meters**
   - Installation
   - Development of Smart Meter Network

ii. **Master Station/Control Centre/Central Computer System**

iii. **Meter Data Acquisition System that will capture:**
   - Usage with Time stamp
   - Voltage
   - Reactive Power

iv. **Meter data Management System:**
   - Billing Application based on TOU/CPP
• Energy Accounting
• Load Analysis/Business Intelligence

v. Analytics and reports.

vi. Network and Communications.

vii. Customer Outreach and Education.

2.1. Smart Meter—3 Phase

AMI meters for the project are advanced solid state digital devices capable of recording hourly and sub-hourly data that includes energy consumption (in considerable interval) and may include voltage and power factor information. The smart metering system shall calculate both TOU and CPP rate based consumption. The meters shall have the following minimum features:

i. Measure and Compute electrical parameters as per standards available.

ii. The meter shall have a provision for at least 6 time zones and 4 tariff registers.

iii. Communicate requested data as per programmed interval.

iv. The programmable parameters shall be:
   • Real Time Clock – Date and Time
   • Demand Integration Period: It is the duration over which the maximum demand is averaged.
   • Profile Capture Period: It is the load survey period for capturing and logging the electrical parameters.
   • Billing Dates.
   • TOU time.
   • Prepaid tariffs (for future use)

v. Detect, abnormal & tamper events and store the same with alert to APDCL personnel.

vi. Inbuilt memory to store all relevant meter data, events for a minimum of at least 65 days.

vii. Shall be configurable remotely including remote firmware upgrade.

viii. Support remote load management by sending load curtailment signals.

ix. Record violation of sanctioned load as per parameters set by APDCL.

x. The following groups of data shall be captured:
   • Electrical Parameters – as per IS 15959.
   • Power Quality parameters – Over Voltage and under Voltage, monitoring of load unbalance.
   • Abnormal events.

xi. Load Reconnect / Disconnect switch—Requirements shall be:
   • All smart meters shall have a supply Disconnect / Reconnect switch / contactor for part/full load.
   • The AMI system shall support only remote disconnect / reconnect of customer supply via the supply contactor.
   • When the smart meter performs a disconnect operation, all outgoing power circuits from the meter shall be disconnected.
   • To confirm the current state of a meter, the AMI system shall support "on-demand" remote polling of the meter to determine whether the supply contactor is open or closed/whether meter is energized or not.
   • The meter shall provide clear local visual indication of the status (open/closed) of the Supply contactor, consumption, last bill details.
2.2. Master Station/Control Centre

Master station /Control centre will be located in the space provided by APDCL. All hardware for MDMS will be installed in this premises and will be manned by round the clock operator(s) who will manage the Smart Grid system through their desktops like managing the AMI end points, communication network, scheduling and collection of meter readings, coordination of customer and meter changes.

2.3. Meter Data Acquisition System

Meter Data Acquisition System, is the critical interface to the field devices, which shall support Meter Data Acquisition, Two way communication, poll meters for data collection, send remote firmware upgrades/programmable parameter inputs to meters, send Load Curtailment signals, Connect/Disconnect and sending of pricing and other signals as generated from the MDMS/Other Applications to the Smart meter. This will interface with MDMS over SOA/Web services, and the data exchange models and interfaces shall comply with CIM/XML / IEC 61968/62056.

2.4. Meter Data Management System

It is the heart of AMI. MDMS shall be a single repository of all meter data. SI shall design this system based on open standards and using SOA principals. It will facilitate the following:-

2.4.1. Billing System

A billing system capable of handling the billing of time based rates and existing APDCL’s billing rate will be required to be deployed. The Bidder is to include the details of billing application in the proposal.

2.4.2. Energy Accounting

This module shall support the following functions:

i. Generate report of Loss analysis for different groups and categories of consumers on daily basis.
ii. Generate report of AT&C loss calculation on weekly basis.
iii. Generate report for accounting and auditing at Feeder level and DCU level.
iv. Create graphical representation of all results that can be displayed on monitor and printed as per requirement.

2.4.3. Load Research

The proposed load research application shall be using the data of project area LT network. This should provide the following functions for analyzing:

i. LT load requirements in short term and long term
ii. Consumer load pattern
iii. DTR loading and balancing

This will help APDCL in forecasting their load for short term, as well as plan network augmentation in long term. The data shall also be analyzed to aid in the day to day operation.

2.4.4. System Requirements

The minimum requirements of MDMS are listed below:

i. Rule based Validation, Estimation & Editing (VEE) of consumption data
ii. Detect & publish abnormal consumption events and patterns
iii. Schedule based and on-demand reading from meters
iv. Receive tamper events from meters and take appropriate action including sending alerts
v. Receive power loss/restoration events from meters and take appropriate action, like alarms or generating work order for maintenance crew.
vi. The Bidder shall describe how MDMS will receive, store and present data from non-meter sources, including customer equipment, distribution automation devices, RE sources, Network components configurable for different pricing plans, including TOU/CPP.
vii. Record import as well as export of energy from consumer premises separately and also net calculation on day/week/other period basis.
viii. Provide enterprise class reporting engine/BI tools. e.g. from Oracle, Microsoft, IBM etc.
ix. The Bidder shall describe how the proposed system will scale to accommodate the increased number of meters and increased amount of data from each meter without performance degradation with suitable hardware upgrade.
x. Load analysis / research for decision support.
xi. Process and generate billing for customers of pilot project area.
xii. Designed with adequate Cyber Security and Controls
xiii. Provide an interface to consumer portal.
xiv. Provide an interface with already existing IT systems of APDCL – GIS, IT-applications.
xv. Provide an interface to communication system.

2.5. AMI Network and Communications

2.5.1. AMI System Design:
i. The proposed solution (including the communication network and equipment) should be scalable to support future customer growth at the rate of 100% in 7 years.
ii. Detailed design of the communication infrastructure of AMI system should be provided, which should include but not limited to communication packet sizes, data rates, communication protocols, error detection and correction techniques, network data capacities, and bandwidth and margin at full system load (defined as quarter-hourly requests for most recent 5 and 15 minute interval data for all meters).

2.5.2. Time Synchronization:
The Bidder is to include Time Synchronization system for all components of Pilot.

2.5.3. Public Network:
In case of use of public network for communication, information regarding the following parameters must be made available:
i. Details of the network usage in terms of cost of operation and extended life of the system.
ii. Security
iii. Reliability

2.5.4. Expected operating life and performance reliability:
i. System operating life: It is expected to be 15 years for meters and 7 years for rest of the system. The system is further expected to remain operational, with upgrades / replacement, for another 7 years.
ii. System Reliability: The system must have sufficient fault tolerance, redundancy, failover, self-healing to guarantee system information requirements. A systematic failure analysis of all the elements must be done and ensure that there is no single point of failure which leads to more
than 2% of data disruption for not more than 6 hours.

iii. **Predictive/preventative reliability**: Tracking and reporting performance of all elements of the AMI system to ensure system reliability and proactively identify potential situations that could become system problems.

### 2.5.5. Technical obsolescence:
The system elements 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 options described in detail. The mitigation shall not be limited to periodic update from OEM/System supplier.

### 2.5.6. Equipment siting:
The criteria and flexibility in physically siting all the equipment must be listed prior to deployment of the system.

### 2.5.7. IT Infrastructure and System Integration:

i. The Bidder to describe the head end system/Data concentrator functionality in detail.

ii. The provider’s head end system/Data Concentrator should fully support all functionality described in the scope of work.

### 2.5.8. Interoperability criteria:

i. The proposal should specify the points of interface, where this part of the system interacts with other elements, like GIS, SCADA, DMS, portal, existing metering, billing and other IT applications.

ii. The project should use international standard communication protocols. SI is to describe the protocols to be used in the proposed system.

### 2.5.9. Customer Interface:
The system shall provide periodic updates to the customers via media (website, SMS, e-mail, meter displays etc.). The same shall be clearly defined by the Bidder. The system shall support all the above media and delivery shall include at least three out of above.

### 2.6. Analytics and Reports

Business Intelligence tools shall be supplied to generate analytics and reports. SI is to suggest and design the reports in line with redesigned business processes and the details of such reports are to be included in the technical proposal. The SI needs to suggest and design reports for:

i. Time frames like weekly / daily / monthly / yearly.

ii. Objects, objects executed (actual) or combination of both in MS Excel or Web (Internet Explorer).

iii. Exporting to Excel, ASCII files, PDF and HTML or third party reporting tools (Crystal Reports)

iv. User based templates be created & used for reports:

   - For calculations, filters and exceptions during reporting to be scheduled to run in batch.
   - Scheduling to run the reports event-based or time based.
   - Delivering the reports to the online users through email, portal, and report server.
   - Providing metadata objects to be viewed during reporting.
   - Provide for saving the report /queries for repetitive execution as and when required by the users.
   - Analysis of historical & consolidated data across systems
2.7. Network Management

The Bidder shall provide a Network Management System with the following functions:

i. The network monitoring system shall help the computer system operators to easily identify the problem areas and hence to take necessary corrective action remotely or manually.

ii. The meter and the DCU and communication equipment in the network need to be monitored and tracked continuously in addition to the other IT networks.

iii. The Network Management System shall have visibility of accessibility to each of the end equipment, communication devices, and other intermediaries to give the operator real-time status and alarms in case of any of the nodes and channels being un-reachable.

iv. The equipment to be monitored shall include data concentrators, backbone connectivity, last mile connectivity, end points, etc.

v. The monitoring data shall be stored for 1 month and shall include lost data packet.

2.8. Network and Data Security

The following items need to be considered for adequate security at different levels i.e. systems, data, network and security and SI needs to provide:

i. Systematic description of how data security is maintained from the meters to the head end system. All elements of the proposed system shall support protection of data, confidentiality, data integrity and operational security. Physical security to prevent on-site tampering to be ensured.

ii. System should enable creation and maintenance of accounts, passwords and functionality access levels, along with log details.

iii. Description of the in-built anti-virus capabilities provided in connection with all proposed software platforms and solutions.

iv. Description of methods to detect and prevent attacks including but not limited to denial of Service and Intrusion.

2.8.1. Access Control:

i. There shall be an identity and access management system which shall control and log the access control of all users to the smart grid systems.

ii. The identity and access management system shall be able to define the access control levels of each user based on roles, responsibilities or hierarchy.

iii. The identity and access management system shall be able to define which user can access which function of the individual systems. For example, the identity and access management system shall define which user can initiate a load disconnect function for a particular consumer, and therefore rest of the unauthorized users will not be able to perform load disconnect function.

iv. The identity and access management system shall be integrated with rest of the Centralized Computer Systems.

2.8.2. Network Security:

i. Since Centralized Computer System has to access external environment through GPRS and so it is important to have adequate network security systems.

ii. There shall be intrusion detection and prevention systems deployed at the central layer.

iii. There shall also be firewalls which will be a separate system from the intrusion Prevention
iv. The firewall shall control the demilitarized zones in the data centre and control room, and also the systems and ports which will be open to public network/VPN.

v. If fixed IP and operator VPN is not available and Dynamic IP is being used, then the devices shall support SSL/IP-Sec. or allied VPN and the data shall be encrypted before send/received on GPRS/CDMA last mile network, for devices consisting of Smart Meter Network.

2.8.3. Systems and Data Security:

i. The systems deployed shall have the application scanning, hardware scanning tools in order to identify any vulnerability so as to mitigate any potential security threats.

ii. The application databases shall have exclusive security tools in order to prevent any potential internal attacks like SQL injection etc.

iii. The data shall be encrypted wherever supported by existing systems/devices/technology.

2.9. Customer Outreach and Education

The customer data acquired will be the basis of the design of suitable outreach programs to be executed by APDCL with the help of the SI, if necessary to address the issues captured in the survey exercise. These programs will be focused to the class(es) of consumer(s) and aim at creating awareness of the pilot and its benefit, dispel misgivings and carry all customers along with the SI/APDCL during the implementation of the pilot. The programs shall cover road shows to attract customer voluntary participation, booklets for general distribution, compilation of consumer survey data, workshops etc. In all these the SI is only expected to design and assist in preparation of the documents and APDCL will actually execute the programs. The expertise of the SI should be made available during these interactions. This method shall aid in the process of successful implementation of Demand Side Management for reduction of peak load.

2.10. Consumer Portal

SI needs to design Consumer portal on standard off the shelf product that can be easily managed by APDCL personnel after completion of Pilot project. Consumer Portal is one of the most important components of Smart Grid. The objective of Consumer portal is to provide high quality experience for the customers and business associates that will provide them a user friendly portal and will make it easy for them to communicate with APDCL through the web instead of direct phone calls or visits. This portal will also act as a source of information for the customers regarding policies and procedures. This in turn will improve customer satisfaction and reduce work load on the employee.

The Consumer Portal will host the web application for:-

i. Display of Load profiles selected based on organizational hierarchy of APDCL.

ii. Display of Reliability Indices selected based on organizational hierarchy of APDCL.

iii. Bill payment services.

iv. Other Information Sharing requirements based on standard Information Architecture.

v. The system integrator is expected to investigate the option of using existing consumer portal which is a part of R-APDRP for seamless integration with smart grid system.

Some of the functions that should be available are as below:

- The customer can view their live energy and cost data on the portal.
- The customer can receive real-time messages on the portal / SMS/ Email in case of any alerts set by him.
- The customer is able to view the TOU Tariff and their consumption during that time via the Portal.
- The customer should be able to see his historical data from the Web Interface.
- APDCL is able to notify the consumers on planned outages in their area.
- The Web portal would have an access control, i.e. a username and password to access his energy profile.
- The customer should see his penalties as well, till the current hour and his billing cycle.
- The consumer portal should be accessible from any web based browser. The response time on the dashboard should be fast and all the information should be Auto-scalable to the size of the screen.

2.11. **In-home Display Devices (IHD)**

In-Home Display provides easy access to energy data in the home to inform and empower the consumer on their electricity usage via a high resolution graphical back-lit display. The display shall Indicate:

i. Consumption in terms of energy and money with day, week, month and yearly comparative graphical displays.
ii. Power/energy consumption with alert and status indicators.
iii. Multi-rate energy registration, time and calendar information; updated via the Zigbee/ RF communications.
iv. IHD shall be compatible with smart metering solutions with Zigbee/RF enable meters.
v. IHD shall support Zigbee/RF Smart energy Profile.
vi. Below are the basic features to be supported by IHD:
   - High resolution Colour graphical touch-screen display
   - Zigbee/RF low power mesh radio for wireless operation
   - Instantaneous energy: (Kwh: Import / Export, Net, money, etc)
   - Historical data report(Kwh):hourly, 24hrs, 7 days, monthly and 12 months periods
   - Period Comparison (Kwh)
   - Fully portable, wireless and battery powered
   - User selectable consumption thresholds
   - Password protection for accessing setup parameters

3. **Outage Management**

Objective: Improve availability and reliability, customer satisfaction, proactive maintenance to avoid failures.

Outage management is extremely important for the Utilities and the customers they serve. The Utilities will leverage existing OMS (if exists) and utilize the capabilities of AMI and grid automation to improve grid reliability by self-healing and more quickly and accurately identifying the location and magnitude of an outage, resulting in faster restoration. The self-healing is that part of automation which provides for auto routing of power flow, in the event of a fault, to the load. This feature is also termed as 'Fault Location Isolation and Service Restoration – FLISR’. The automation
components provide the network status thereby aiding the OMS in resolving the faulty network section. Subsequently through the process of, isolation of faulty section and identifying the alternate network path, the appropriate line components are activated to restore power. This process is completed in the least possible time.

The system will include implementation/integration as applicable:

i. Condition-based monitoring

ii. Fault Management and system Restoration (FM & SR).

iii. Communication to data centre/Master Station.

iv. Analytics, with asset mapping.

v. Cyber Security tools and application.

vi. Tools for software application and Network Management.

3.1 Key Smart Features of OMS

Most important and notable Smart features of the Outage Management System are:

- Outage Management Solution
- Prediction of location of off-supply area or breaker that opened upon failure.
- Prioritizing restoration efforts and managing resources based upon criteria such as locations of emergency facilities, size of outages, and duration of outages.
- Providing information on extent of outages and number of customers impacted to management, media and regulators.
- Calculation of estimation of restoration times.
- Management of crews assisting in restoration.
- Calculation of crews required for restoration.
- Reduce outage durations due to faster restoration based upon outage location predictions.
- Reduce outage duration averages due to prioritizing.
- Improved customer satisfaction due to increase awareness of outage restoration progress and providing estimated restoration times.
- Improved media relations by providing accurate outage and restoration information.
- Fewer complaints to regulators due to ability to prioritize restoration of emergency facilities and other critical customers.
- Reduced outage frequency due to use of outage statistics for making targeted reliability improvements.

3.2 Fault Management and system Restoration (FM &SR):

i. The Bidder has to provide a solution such that a comprehensive view of the situation of the network shall be presented to the operator, allowing to quickly assess the nature and importance
of the reported disturbances/trippings.

ii. The corresponding work permits will be generated by the system for disturbances/trippings and shall be assigned to maintenance crews. The progress of the maintenance work is to be properly managed, including the monitoring of partial restorations.

iii. The Fault Management & System Restoration function designed by SI provides assistance to the OMS dispatcher for detection, localization, isolation and restoration of the distribution system. In case of permanent fault in the Distribution network, the function proposes switching plans to restore the supply in the healthy parts of the faulty feeder.

iv. The function shall be designed so as to be usable to compute switching plans to assist in the cases of reconfiguration of the network required by maintenance operations or partial load transfer of an overloaded feeder to the neighboring feeder(s).

4. Peak Load Management

Objective: Optimal utilization of energy resources by uniform distribution of load across the day, to save additional investment in capacity addition, improved access of power to rural areas, reduction in technical losses, and enhanced customer satisfaction by load curtailment in place of load shedding.

Peak load management is defined as an "economic reduction of electric energy demand during a utility's peak generation period." India being a country of close to 13.5% peak deficit, managing peak demand is of the utmost importance for the country. Flattening the peak means effective and optimized load management. The pilot project will enable Peak load management of Commercial, Industrial and residential customers.

This pilot will provide the information necessary to properly plan, forecast, and understand system loads and formulate decisions for more effective results. Properly sized transformers and distribution equipment will reduce electricity costs and improve system reliability.

The peak management refers to controlling the demand and matching it to the available supply at the instant of peak. The peak management function shall take inputs from SCADA for power availability and volume of shortage. Based on the shortage, the peak management function shall run algorithms considering various constraints and priorities predefined on the basis of customer profile by SI in association with APDCL personnel, and suggest the options to APDCL officials. The approach shall be to avoid tripping of feeders for load shedding and manage peak load either by load curtailment through AMI or by price incentives/disincentives.

SI needs to design and implement/ integrate the following as applicable:

i. Distribution Management System-DMS.

ii. Remote Terminal Units to monitor distribution grid, substations and distribution transformers as required.

iii. Communication with data center/Master Station.

iv. Analytics, for load forecast with reference to time of day for different seasons.

v. Access to SCADA database for information about generation and load.

vi. Customer profiles.

vii. TOU/CPP notification on the basis of day ahead load forecast and power supply availability.

ix. Meters with two-way communications (power cut if customer does not curtail).

The description of applications that need to be designed by SI are as follows:

a) **Load Shed Application (LSA)**

The load-shed application is to be designed by SI so that it automates and optimizes the process of selecting the best combination of switches to open in order to shed the desired amount of load. Given a total amount of load to shed, the load shed application will recommend different possible combinations of switches to open, in order to meet the requirement.

The operator will be presented with various combinations of switching operations based on an evaluation of load priorities and current load levels, which will result in a total amount of load shed, closely resembling the specified total. The operator can then chose any of the recommended actions, and execute them through a single action at the console.

b) **Power Flow Application**

A power distribution network normally consists of a large number of devices; correspondingly a large number of measurements are thus needed to describe its state. In most cases, however, relatively small portions of the electrical quantities are actually measured. The load flow application to be designed by SI needs to provide values for those electrical quantities at network locations where measurements are not available. These values are useful both in terms of providing a more complete view of the network to the operator in real-time, and as the basis for the remaining DMS software for which the load flow results serve as inputs.

c) **Network Connectivity Analysis (NCA)**

The network connectivity analysis function to be designed by SI will form the basis of the analysis/decision/action tools available to operators. Aside from providing live/dead status information to the operator in real-time, the results of the NCA function will serve as inputs, virtually to every other application in the DMS software package. The NCA function will be designed to determine the topology of the distribution network based on the physical connectivity of devices in the network and the status of connecting devices such as switches. In addition, the NCA function also needs to determine the electrical status of each device in the network, which can then be presented dynamically to the operator on one-line displays. The dynamic display rendering of electrical status will provide an indication of energized/de-energized state, and whether the device forms part of a loop or a parallel path.

d) **Load Monitoring:**

The Requirement for the same is detailed as below:

i. The system should be able to show a consolidated view of the load on all the feeders and the generation of renewable sources.

ii. Any deviation from the base line should generate alerts and these alerts should be sent to the respective owner of the system.

iii. This system should be a near real time system and a dash board for the same should be available at the control Centre.
iv. APDCL should be able to get an overview of the entire system and as needed should be able
to go to the details by zooming in the system.

v. The Bidder should provide the architecture of the system and the detailed working of the
system.

vi. The system should have user access control for authorized access to the system.

e) Load Balancing

SI needs to design load balancing study function to identify opportunities to transfer load
between feeders in an effort to increase network reserve loading capacity. If one considers the
capacity reserve of a network to be limited by the smallest capacity reserve of its component
devices, then the load balancing via feeder reconfiguration application can be said to identify
opportunities for shifting reserve capacity between individual devices in order to maximize the
reserve capacity of the network. To this end, the function needs to recommend a series of
switching operations, each consisting of opening one switch and closing another switch, in order
to transfer load from one feeder to another.

f) Load Forecast (LF)

SI needs to design this function for predicting the load which shall help to tie up bulk power
purchase optimally and track the load history of the system. The LF shall be based on historical
load profile database. In this function, a number of different profiles based on time interval of
15/30 minutes load basis are stored in the database and depending upon the day of week and
having seasonal consideration, the load for future days can be forecasted.

A proper and accurate load forecast can be achieved by real time monitoring of 11 KV feeders.
Depending upon the live data, rescheduling can be done during intraday operation, which can
result in reduction of power purchase cost. This will be carried out by first accumulating the data
over a period and then generate a Statistical model to create a forecasting module which will help
in predicting the load and hence the state resulting in optimization the UI charge benefit.

APDCL is looking for an IT solution which can address the following Business Requirements for
Load Forecasting:

i. Day-Ahead (up to 1 day) and short term (up to 1 month) demand /consumption forecasting-
   a) Enabling effective and optimized power procurement
   b) Reduction in UI charges through better and effective drawl schedules generation
   c) Effective utilization of the state pool and existing contracts for buying and selling
   d) Finalization of exchange contracts

ii. Medium Term and Long term demand/consumption forecasting (1 year and 1-20 years
respectively)-
   a) Decision making capability in terms of signing long term power contracts, thereby
      ensuring optimized portfolio management.
   b) Providing inputs for Network and Capacity planning.: Insight into growing business
      needs and changing patterns, so as to plan for any unforeseen challenges
      accordingly.

iii. This will improve Transactional efficiency through:
   a) Better Interaction with various Business partners involved such as SLDC, ALDC
      Generating Companies, Power trading Organizations.
   b) Improved reconciliation and settlement processes with counter parties.
Utility has following functional requirements for the demand forecasting solution:

i. **Day Ahead Forecast:**
   To accept inputs of different granularities and produce the desired set of demand forecasts at 15 minutes/any customized time interval load granularity for next day. The forecasting model should be flexible enough to generate week ahead forecasts if need be.

ii. **Short Term Forecast:**
   - Daily Granularity Consumption Forecast for up to 1 Month.
   - Daily Consumption Forecast should be decomposable into peak demand and base demand with appropriate tolerances.

iii. **Medium Term Forecast:**
   - Monthly Consumption Forecast for next 1 year.
   - Monthly Consumption Forecasts should be decomposable to higher granularities to indicate peak / base demand with appropriate tolerances.

iv. **Long Term Forecast:**
   - Annual Forecast of consumption, for next 1-20 Years for the utility.
   - Annual Forecasts should be decomposable into monthly peak and base demands.

v. **Forecast Decomposition:**
   - **Zone Level Forecasts:**
     A large geographical area encounters varied climatic conditions in different zones, affecting the electricity demand. Hence, separate forecasts should be generated for each of the zones using the respective weather profiles. Finally, Zone level Forecasts can be summated to arrive at the system level forecasts.
   - **Consumer Category wise Forecasts:**
     Entire consumer base has to be broken down to different categories (domestic and commercial) and forecasts to be done for each category. This will ensure that following are taken into consideration:
     a. Changes in consumer load profile with income levels, technological changes, lifestyle changes.
     b. Economic parameters such as growth rate, real state growth, industrial growth

vi. **End User Interface - Forecast Dashboard:**
   The Proposed Solution should have an UI which will help Users to generate Forecasts, Review the Forecasts outputs, Export the Forecast Outputs to Excel files, etc. The Dashboard should also display the Forecast results graphically and help in Generating Forecast Accuracy for different type of Forecasts.

vii. **Graphical representation of Forecasts:**
   Graphical representations of the following:
   - Input Data (Feeder Data, climate and Econometric Data, System level Data)
   - Output Data (Forecasts for various date ranges, Forecasts vs. Actuals, Forecasts vs. Forecasts of other regions)

viii. **Demand Forecasting Reports:**
    Few reports to be incorporated in standard system:
    - Forecasts for selected time period
    - Forecasts vs. Actual for selected time period
    - Accuracy Statistics of Forecasts for selected time period
    - System / feeder level data for specific time period at different granularities.
g) **Real Time Calculation**

This sub-system is to be designed by SI to allow operators to define calculations on analog and status data acquired from field. Once these calculations are defined in the database, they are executed in real-time and results are presented on suitable displays.

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5. **Demand Side Management/Demand Response/Load Management**

In all instances Demand Side Management (DSM) shall be achieved through the introduction of Time of Use (TOU) Tariff and Demand Response (DR) through initiatives such as Critical Peak Pricing (CPP) for residential consumers and C&I consumers.

5.1 **Residential, commercial & Industrial Peak Load Management**

i. Whilst it would be compulsory for consumers to participate in a TOU scheme, they would have the option to participate in a DR programme.

ii. Consumers participating in the DR programme would receive a financial incentive related to normal tariff.

iii. Notification of DR events would be on a 24hrs basis and APDCL would be able to communicate introduction / Removal of DR programs through the web interface via the DSM/DR portal, Email and SMS.

iv. HAN will be set up for all consumers.

v. All customers participating in the pilot would be provided with In Home Devices (IHD) which would enable them to view their consumption on a real-time basis. The consumers would also be provided with control devices (sensors/CMR) which would enable APDCL to control the appliances during the DR program.

vi. The customer however will have the capability to define the priority of the load to be controlled.

vii. The customer should be able to change the priority from the DSM/DR portal.

viii. The Device would also transmit the data to the Smart Grid Control Centre (SGCC).

ix. Consumers would also be provided with a log-in ID and password to DSM/DR Portal, which will be accessible via a web interface (Google Chrome, Internet Explorer & Firefox).

x. The Web interfaced energy management portal will enable consumers to view historical data, DSM performance and savings/penalties related to DR events when they have occurred.

xi. The pulse rate for data between the Smart Grid Control Centre and the in-home device is expected to be within 1 Minute.

5.2 **DSM/DR Functionalities**

i. APDCL should be able to define DR programs and publish the same to all the consumers.

ii. The consumers should be able to get notifications of new programs and choose to participate or reject the same.

iii. In case the consumer chooses to participate in the program, he should be able to classify his loads as essential / non-essential loads.

iv. During a Demand Response Event APDCL should be able to take control of the non-essential loads with prior information to the consumers.

v. The System should have the capability of aggregating potential DR capacity as well as keep a real
The DSM/DR system should be able to rate the performance of all the consumers and carry out the settlement for the consumers.

During the time when the event is not on, the DSM/DR Portal should be able to act as a demand Side management portal for the consumers.

The DSM / DR system can be based in APDCL’s data center or can have an option of being hosted in the cloud, if required.

This system should be a high availability system to perform real time complex calculations.

The System should be robust enough so that it does not allow any malpractices by the consumers.

5.3 Billing & Customer Management

Some of the functionalities under the load management are as below:

- Utility disconnects (or limit load to 50W) customer for credit or collection cause (payment default).
- System should provide details of the defaulters who made payment against disconnection due to credit or collection cause (can be integrated with existing system if already exists).
- Utility reconnects (or resumes load to normal contracted level) customer following credit and collection disconnect (reconnection after making payment).
- Field Representative (Line man) performs disconnection/reconnection manually as an exception, and these details to be captured in the system
- Utility limits customer’s load due to other reasons like exceeding contract load ( and then load regularization/enhancement not done)
- Utility gets notification of consumers violating the contract load, and utility to take necessary action.
- Schedule the disconnection or load-limiting work order on the desired date and time.
- Customer requests routine reconnection.
- Utility shall have a consolidated view of the grid frequency, demand schedule and actual drawl and also estimate the quantum of shortage. Utility should be able to further drill down to see the list of consumers violating sanctioned load (at that point in time, historically etc.)
- The billing system shall be notified of the load violation, and the corresponding charges shall be applied to customer (based on tariff rules).
- The AMI Meters/Devices shall send acknowledgement of successfully completed or failed disconnects or load-limiting and reconnects to the head-end and head-end to MDM, and MDM in turn will send these to Billing System.
- Based on the event type configuration in the MDM, this event will be sent to Billing System either in synchronous or batch mode.
6. Power Quality

Objective: Improved Customer satisfaction, reduction in losses, and increase in APDCL revenue by charging a premium price for power quality.

Power quality needs to be measured at feeder and HT commercial and industrial consumer level.

1. APDCL should be able to monitor power quality parameters like-
   a) Power factor
   b) Total harmonic distortion
   c) Power on/off
   d) Over Load and under Load
   e) Voltage & Current over and Under loading
2. System shall provide alerts to APDCL as well as customer (if applicable) on threshold violation of parameters like THD as and when occurred/recorded.
3. The system should be able to provide outage information report for the Feeders, DT, and HT commercial and industrial customers.

6.1. The pilot will include design and implementation/integration of the following, as applicable:

i. Remote Terminal Units to monitor distribution grid, substations.

ii. Communication to data centre/Master Station.

iii. Analytics, with asset mapping.

iv. Access to SCADA.

v. Field devices for Quality control.

vi. SI to give details for the solution proposed for Management of harmonics.
   - Management of reactive power.
   - Load balancing.

vii. Cyber Security tools and applications.

viii. Tools for software application and Network Management.

ix. Design of Applications for:

   a) Voltage / VAR Control (VVC)
   The VVC function will be designed by SI to monitor the set of telemetered voltage measurements associated with each VVC-controllable device. If the VVC function detects a limit violation, it advises the corrective control actions to operator. VVC-controllable devices are the set of transformers and capacitor banks selected by the operator for VVC control. Corrective controls include incrementing/decrementing the transformer tap position, and switching in/out a capacitor in a capacitor bank.

   b) Load Balancing
   SI needs to design load balancing study function to identify opportunities to transfer load between feeders in an effort to increase network reserve loading capacity. If one considers the capacity reserve of a network to be limited by the smallest capacity reserve of its component devices, then the load balancing via feeder reconfiguration application can be
said to identify opportunities for shifting reserve capacity between individual devices in order to maximize the reserve capacity of the network. To this end, the function needs to recommend a series of switching operations, each consisting of opening one switch and closing another switch, in order to transfer load from one feeder to another.

c) Management of Harmonics
SI is to design this solution such that it will send control signals to power quality devices based on inputs received from AMI system on quality parameters.

7. Distributed Generation
Objective: Sustainable growth, Improve power access in rural area.

Development and implementation of new and innovative technologies for distributed generation. Includes technology, products, and vendors and solutions evaluation and design of suitable solution for managing renewable integration. Examples are technologies and solutions related to EV/PHEV (Plug-in Hybrid and/or Electric Vehicles), wind, photovoltaic and other distributed generation technologies, systems and solutions supporting flexibility of interaction with customers, energy usage/exchange, demand and losses management, management of transactions, pricing and billing, etc. Proposal may include evaluation of state of technology and industry lessons-learned, implementation of technologies and subsequent maintenance and operation, and other services. The pilot will include:

i. Two way AMI metering with feed-in tariffs
ii. Cyber Security tools and applications
iii. Tools for software application and Network Management

7.1 Renewable Energy Monitoring
i. The system should be able to monitor generation from renewable energy sources typically solar.
ii. The System should be able to monitor the generation from the distributed sources on a 15 minutes/any customized time interval load basis.
iii. As this a distributed system, the data from the generating sources should be sent to the server using GPRS.
iv. The installed capacity and the type of renewable sources should be an input to the system.

The system should also be able to generate alerts on the efficiency of the renewable sources

7.2 Technical Issues of Integration
Integration of Renewable sources improves reliability of smart grid but poses a variety of issues like dynamic response and advanced protection to take into account the bidirectional flow of power. When Renewable energy sources are connected to the distribution system, the power flow gets altered and this would necessitate a change in the protection system settings. Also, sudden connection or disconnection of renewable energy sources due to faults etc. may result in unacceptable transients in voltages in the distribution system which needs to be addressed. These and other issues if any shall become part of the solution designed for managing renewable Integration.

8. Analytics and Reports
Business Intelligence tools shall be supplied to generate analytics and reports. Project implementing consortium is to suggest and design the reports in line with redesigned business processes and the
details of such reports are to be included in the technical proposal.

The Project implementing consortium needs to suggest and design reports for:
- Analytics for Load Forecasting.
- Analytics for Peak Load Management with Customer Segmentation.
- Analytics for Demand Response & Time of Use.
- Analytics for Outage including Transformer failure and diagnostics.
- Analytics for Energy Accounting and Leakage for unusual consumption and outliers with alerts.
- Analytics for visualization / dashboard/ Ad hoc reports.
- Time frames like weekly / daily / monthly / yearly.
- Objects, objects executed (actual) or combination of both in MS Excel or Web (Internet Explorer).
- Exporting to Excel, ASCII files, PDF and HTML or third party reporting tools (Crystal Reports)
- User based templates be created & used for reports:
  i. For calculations, filters and exceptions during reporting to be scheduled to run in batch.
  ii. Scheduling to run the reports event-based or time based.
  iii. Delivering the reports to the online users through email, portal, and report server.
  iv. Providing metadata objects to be viewed during reporting.
  v. Provide for saving the report /queries for repetitive execution as and when required by the users.
  vi. Analysis of historical & consolidated data across systems.
  vii. Monitoring the performance of data warehousing system.

The details of the functional specifications required for Smart Grid Analytics implementation may be seen at page no. from 300 to 308. These are:
- Analytics for Load Forecasting and Load Research,
- Analytics for Peak Load Estimation and Customer Segmentation,
- Analytics for Demand Response & Time of Use,
- Analytics for Outage & Asset Management,
- Analytics for Energy Accounting and Leakage,
- Visual in-memory Analytics.
IV. Section D: Minimum Technical Specifications

The Minimum technical specification (MTS) has been structured as per the table given below:

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1. INTRODUCTION & GENERAL INFORMATION

1.1 Introduction

Smart Grid is the modernization of electricity delivery systems so that it monitors, protects and automatically optimizes the operation of its interconnected elements-across the electricity value chain-from central and distributed generators through the HV transmission network and distribution Systems, to HT and LT consumers. Smart Grid is the system that is self-healing, adaptive, interactive, and secure from attacks, accommodates all the generation and storage options, support bi-directional energy flow, and distributed across geographies and organizational boundaries. In terms of commercial and behavioral issues, the Smart Grid can help identify theft and losses, provide choice to consumers, allow for new pricing mechanism such as Time-of-Use (ToU) or real-time, enable much improved transparency and conservation, and provide the structure for sophisticated billing, collection and information management.

In order to realize the objectives of meeting the ever increasing peak demand of a fast growing economy, reducing AT&C losses and ensuring reliable & quality supply and more sustainable Grid, the utilities in India need to modernize the electric grid using full digital technology-the confluence of Information and communication technology (ICT) and Automation and control. Such fully digitalized power Grid framework leads to the future Smart Grid in India.

However, following core issues need to be addressed for Smart Grid Implementation in India:

- **a)** Aging and improperly maintained infrastructures
- **b)** Unreliable and overloaded system components
- **c)** Commercial inefficiency - Power theft, poor billing, inadequate billing collection facilities, faulty metering, etc.
- **d)** Low demand side management (DSM) initiatives
- **e)** Lack of skilled resources and training.

1.2 Generic requirements

The Successful Bidder shall undertake detailed site survey immediately after award of the contract of all the sites to access the various requirements such as space, identification of input terminals, spare...
contacts etc. for completion of engineering, site installation, testing and commissioning of the project. The individual functions to be performed by the hardware and software and system sizing criteria are described in the relevant sections. The specification defines requirements on functional basis and does not intend to dictate a specific design. On the other hand certain minimum requirements must be met in accordance with the particular details provided elsewhere in the specification.

The items, which are not specifically identified but are required for completion of the project within the intent of the specification, shall also be supplied & installed without any additional cost implication to APDCL.

1.3 Facilities to be provided by APDCL

a) Arranging necessary shutdowns and work permits at various sites.

b) Providing all the necessary data regarding the Distribution system network.

c) Providing storage space at site free of cost wherever available. Special storage needs such as watch and ward services and air conditioning shall be provided by the successful Bidder.

d) The existing earthing system at the substations/Data Centre may be utilized for earthing of the offered equipment. However, the successful Bidder shall assess its suitability for the offered equipment. And carry out the modifications if required.

e) Suitable space/Infrastructure for Data Centre will be provided by APDCL.

f) Providing details of Existing Legacy systems, proposed SCADA/DMS, IT system under R-APDRP, Proposed ERP for integration.

1.4 General Requirements

a) The Bidder’s proposal shall address all functional, availability 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 enquiries.

b) An analysis of the functional, availability and performance requirements of this specification and/or site surveys, design, and engineering may lead the Contractor to conclude that additional items and services are required that are not specifically mentioned in this specification.

c) The Bidder shall be responsible for providing at no added cost to the employer all such additional items and services such that a viable and fully functional system is implemented that meets or exceeds the capacity, and performance requirements specified. Such materials and services shall be considered to be within the scope of the contract. To the extent possible, the Bidders shall identify and include all such additional items and services in their proposal. All equipment provided shall be designed to interface with existing equipment and shall be capable of supporting all present requirements and spare capacity requirements identified in this specification. The offered items shall be designed to operate in varying environments. Adequate measures shall be taken to provide protection against rodents, contaminant, pollutants, water & moisture, lightning & short circuit, vibration and electro-magnetic interference etc.

d) The Bidder shall demonstrate a specified level of performance of the offered items during well-structured factory and field tests. Further, since at the substations limited space is available the contractor shall make all the efforts to economize the space requirement. 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.

e) The successful bidder is required to visit all sites. The site visits after contract award shall
include all necessary surveys to allow the successful bidder to perform the design and implementation functions. After the site/route survey the successful bidder shall submit a survey report for all the sites.

f) This report shall include at least the following items; however, the exact format of the report shall be finalized by the contractor with the approval of Employer:
   - Proposed layout of Equipment in the existing rooms and buildings.
   - Proposed routing of power, earthing, signal cables and patch cords etc.
   - Confirmation of adequacy of Space and AC Power supply requirements.
   - Proposals for new rooms/buildings, if required.
   - Identification of facility modifications, if required.
   - Identify all additional items required for interconnection with the existing equipment.
   - Requirement of Modification to existing earthing arrangement, if any.

1.5 General Bidding Requirements
The offered equipment/system must be in successful operation for at least one year as on the date bid opening. To be considered responsive, the Bidder’s proposal shall include the following:

a) A detailed project implementation plan and schedule that is consistent with the scope of the project. The plan shall include all the activities required, show all key milestones, and clearly identify the nature of all information and project support to be provided for completion of the project. Manpower resources, proposed to be deployed during the execution phase, shall be clearly indicated.

b) Documentary evidence in support of the qualifying requirements specified in the bidding document i.e. RFP shall be submitted along with the bid.

c) Performance certificate for the offered equipment/systems from the user’s in line to the requirements mentioned in the bidding documents.

d) The type test certificates for the offered equipments. In case it is not type tested. The commitment for same to be conducted during implementation.

e) Completed equipment Data Requirement sheets/Questionnaire.

f) Technical details of the offered equipment/systems.

1.6 Items of Special Interest
To assist in understanding the overall requirements of the project, the following items of special interest are listed. The Bidder shall pay particular attention to these items in preparing the proposal.

a) The successful bidder shall be responsible for overall project management, system integration and testing to complete all the facilities under the project.

b) The project shall be implemented in the time schedule described in the clause 3 of section-G (Scope of Work), Volume I.

c) The database, displays and reports for Smart grid control centre are to be developed by the successful bidder; however, the contractor shall associate the APDCL’s engineers also during the data base development. The required hardware & software for completion of this activity may be used out of the hardware & software to be supplied under this contract.

d) The Protocols specified/needed are to be supplied. However the supply of source code is not mandatory.

e) Smart grid control centre, shall exchange data with IT system.
1.7 Site Conditions

The sites are located in Assam covering Paltanbazar, Ulubari and Narengi subdivision. The minimum to maximum temperature & relative humidity generally falls between 5° to 47°C. & 50% to 80% respectively. The state is well connected with road, rail and air transport. However, the system/equipment shall be designed as per the environmental conditions mentioned in the relevant section of this specification.

1.8 Applicable Standards

The applicable standards are mentioned in the respective technical section. The offered equipment shall conform to the standards mentioned in the specification except to the extent modified by this specification.

In case of any discrepancy between the description given in the specification and the standards the provisions of the technical specification shall be followed.

Wherever, new standards and revisions are issued during the period of the contract, the successful bidder shall attempt to comply with such standards, provided there is no additional financial implication to APDCL.

In the event the Contractor offers to supply material and/or equipment in compliance to any standard other than those listed herein, the Bidder shall include with their proposal, full salient characteristics of the new standard for comparison.

1.9 Warranty

This would include five years warranty for the related hardware & software supplied under the Smart Grid project after the operational acceptance of the Smart Grid System. The five year warranty shall include comprehensive OEM on-site warranty for all components (H/W and Software including OS) supplied including reloading and reconfiguration of all Software and device drivers/patches etc. if required.

1.10 Terms for utility & SGIA

The term successful bidder shall be referred as Smart Grid implementation agency (SGIA) & owner, employer shall be referred as APDCL where ever mentioned in the RFP /Model Technical specification (MTS).

1.11 System Specifications

Bidder should give detailed specifications for the following equipment (as applicable). The proposed system specifications are to be included in the technical proposal for evaluation.

a) Meters
   - Manufacturer
   - Model
   - Module Description
   - Accuracy
   - Memory size
   - Parameters that can be captured
   - Interfaces and protocols
   - Standards that it complies
   - Power source/capacity
   - Others
b) **Other Hardware Components/Field Devices**
   - Manufacturer
   - Model
   - Power rating
   - Interfaces and protocols
   - Processor (if exists)
   - Memory size
   - Others

c) **Software**
   - Programming language/platform
   - Database description
   - Licenses
   - Scalability
   - Interfaces and protocols
   - Use Case
   - Response time
   - Tools for managing application
   - Minimum Hardware and Operating System requirements
   - Others

d) **Communications Networking**
   - Technology
   - Equipment Model
   - Manufacturer
   - Interfaces and Protocols
   - End to end Capacity
   - End to end Latency
   - Others

e) **Communications Network Equipment**
   - Manufacturer
   - Model
   - Interfaces and protocols
   - Capacity
   - Throughput
   - Power Rating
   - Others

f) **IT systems**
   - Describe as applicable

g) **Standards (IEC, BIS, IEEE etc.)**
   - Names of standards and areas of application

h) **Data Collection Equipment**
   - Model
   - Channels and Capacity
   - Data storage capacity
   - Power rating
   - Interfaces and protocols
   - Others
1.12 Suggested List of Standards to be followed by the Bidder:

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<td>CIM Standard</td>
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<td>Communication Network for Substation Automation</td>
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<td>Cyber Security Standard</td>
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<td>6.</td>
<td>Electricity Metering; data exchange for metering, tariff</td>
<td>IEC 62056</td>
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<tr>
<td></td>
<td>and load control</td>
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<tr>
<td>7.</td>
<td>Grid Connectivity</td>
<td>IEEE 1547</td>
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<td></td>
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</table>
2. TECHNICAL SPECIFICATION FOR SINGLE PHASE LT STATIC WHOLE CURRENT SMART METER (5-30) AMP. OF ACCURACY CLASS 1.0 WITH DLMS.

2.1 SCOPE

- This specification covers design, engineering, manufacture, testing, inspection and supply of ISI marked A.C. single phase two wire solid state (static) / fully electronic energy meters of accuracy class 1.0 and current rating 5-30 Amps for single phase with back lit LCD display as per requirement given in this specification. This specification also covers load control with connection and disconnection through relay & prepaid metering facility.

- The single phase meter should be single phase two wire, two element type capable to record and display energy in KWh and demand in KW for single phase two wire A.C. loads respectively for power factor range of Zero Lag-Unity-Zero Lead, as per requirement given in this specification. Meters should record total energy (fundamental energy + harmonic energy) and have facility/capability for recording tamper information in LT 1-phase Consumers. The meter should be able to store at least 100 tamper events in its memory.

- It is not the intent to specify completely herein all the details of the design and construction of material. However the material shall conform in all respects in high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the right to reject any work or material which in his judgment is not in accordance therewith.

- The offered materials shall be complete with all components, accessories necessary for their effective and trouble free operation of the System for energy measurement. Such components shall be deemed to be within the scope of Bidder’s supply irrespective of whether those are specifically brought out in this specification and/or the commercial order or not.

- In case of Foreign Manufacturer, the authorized Agents /Traders/Distributors may also bid provided that they should be registered vendor and shall have all the testing facilities in India. It is thus mandatory that in case of Indian manufacturer, the offered meter shall be ISI marked and bidder shall have to furnish valid BIS certification along with the offer and in case of foreign bidder the meter shall comply either BS standard or standard of International Electro technical Commission, i.e, relevant IEC, shall be marked with the same and bidder must furnish valid BS or IEC certification along with the offer, however the meter must comply this specification.

2.2 STANDARD APPLICABLE

While drawing these specifications, reference has been made to following Indian and International Standard specification. In case certain details are not covered in these specifications, the relevant Indian and International Standard shall be applicable.

- IS 13779 (1999): A.C. Static Watt hour meter class 1.0.

- IS 9000: Environment testing


• IS 15884: Alternating Current Direct Connected Static Prepayment Meters for Active Energy (Class 1).

• IS 15959/IEC 62056: Data Exchange for Electric Meter.

• IEC 62052-11 (2003): Electricity Requirements (AC) General Requirements, Tests and Test conditions for A.C.Static Watt hour meter for active energy Class 1.0 and 2.0.

• IEC 62053-21 (2003) : A.C.Static Watt hour meter for active energy Class 1.0 and 2.0

• CEA Regulation on installation and operation of meters Dtd: 17/03/2006.

• ETD13 (6211)

NOTE: Unless otherwise specified elsewhere in this specification the meters shall conform to the latest version available of the standard as specified above. If above IS/IEC reports are amended, reference has to be made to Amended IS/IEC/Report up to the date of tenderization.

2.3 SYSTEM VARIATION

• Voltage range: -40% to 20% of ref. voltage
• Frequency: 50 Hz +5.0% to –5.0 %.
• Temperature & Temp. Coefficient: -10 deg. C. to 70 deg, C. with temp. Coefficient as 0.05. (As per IS 13779 )
• Humidity: 95% (sometimes approaches to saturation) : As per IS 13779

*In case of any discrepancy refer to IS 13779.

2.4 ELECTRICAL REQUIREMENT:

• Standard reference voltage: 240V (phase to neutral)
• Standard Basic Current: 5 Amps.
• Rated Max. Current: 30 Amps.
• Standard frequency: 50 Hz.
• Resistance to Surge voltage of 1.2/50 micro sec: 10 KV Peak
• Power consumption of voltage circuit: The active and apparent power consumption in each voltage circuit including the power supply of meter of reference voltage, reference temperature and reference frequency shall not exceed 1.5 watts and 8 VA.
• Power Consumption of current circuit: The apparent power taken by Current circuit at basic current reference and reference temperature shall not exceed 1 VA.

* Power Consumption of meter with relay and communication module shall comply with IS 13779 table 9 note 2 wherein higher Power Consumption can be declared by vendor.

2.5 GENERAL AND CONSTRUCTIONAL REQUIREMENT:

• The meter shall comply all general and constructional requirements as per IS 13779 (1999) and latest amendment. Meter shall be designed and constructed in such a way to ensure especially personal safety against electric shock, effect of excessive temperature, safety against spread of fire and protection against solid objects, dust and water etc. All parts, which are subject to corrosion under normal condition, shall be effectively protected. Any protective coating shall not be liable to damage by ordinary handling nor damage due to exposure under normal working condition.
The meter shall be projection type and dust and moisture proof. The meter base & cover shall be made out of unbreakable, high grade, fire resistant, reinforced Polycarbonate material so as to give it tough and non breakable qualities. The meter body shall be type tested for IP51 degree of protection as per IS 12063 against ingress of dust, moisture & vermin.

Standard terminal block as per IS: 13779/1999 (amended up to date) shall be provided. Moulded terminal block for current and voltage connections conforming to relevant standard to meet the requirement of terminal connection arrangement shall be provided. The termination arrangement shall be provided with a transparent terminal cover and shall be sealable independently to prevent unauthorized tampering.

All insulating materials used in the construction of the meter shall be substantially non-hygroscopic, non ageing and of tested quality.

All parts that are likely to develop corrosion under normal working condition shall be effectively protected against corrosion by suitable method to achieve durable results.

The thickness of material for meter body should be 2mm minimum for polycarbonate material.

The meter should have internal Real Time Clock with the backup of a Lithium Maintenance free battery of minimum life of Ten (10) years for operation of the time clock. The Real Time Clock shall be based on Quartz crystal timer so as to make it independent of line frequency variations. The clock shall be factory calibrated. The clock accuracy shall not vary more than ±3 min per year and it will be temperature Compensated from 0° C to 50° C.

The provision shall be made on the Meter for at least two seals to be put by utility user. However the supplier shall have to supply meters dully sealed with two nos. of Polycarbonate seals having supplier’s logo and serial numbers.

The meter shall be provided with flashing LED to represent the pulse output for testing the meter by suitable testing equipment. The operation indicator must be visible from the front.

It shall be possible to check the accuracy of active energy measurement of the meter in the field by means of LED output. Resolution of the test shall be sufficient to enable the starting current test in less than 10 minutes and accuracy test at the lowest load shall be completed with desired accuracy within 5 minutes. The meter shall be provided with additional LED for indicating earth leakage current, if any.

2.6 CURRENT AND VOLTAGE ELEMENTS:

The meter should have either one CTs & one shunt OR one shunt & one sensor OR two shunts or two CTS, having CTs with adequate magnetic shielding.

For Shunt type meters, the single phase meter shall be based on a E-beam shunt in the phase element and a Current Transformer/Shunt/Hall effect sensor in the neutral element. Alternatively, measurements in both the phase and neutral elements may be done using shunts with proper isolation. However, in case of using one CT the same shall be used in neutral element. The short time current rating shall be as per IS: 13779: 1999. The shunt(s) should preferably be directly soldered to the meter PCB, i.e. no wires should be soldered from the shunt to the PCB.

PT less design is highly preferred i.e. for power supply to PCB, in place of conventional electromagnetic VTS, use of potential divider is preferred.
• The meter shall also be capable to withstand phase to phase voltage (415V) if applied between phases to neutral for minimum 15 min.

• In meter, power supply unit should be micro control type instead of control transformer type to avoid magnetic influence.

• The RTC battery & the battery for display in case of power failure should be separate.

• The meter should have facility for data retrieval through port using Hand Held Unit (HHU) and RS 232 for Laptop/PC. Sealing arrangement for Optical port shall be provided.

• The meter shall record and display total energy including Harmonic energy.

• The meter shall keep log in its memory for unsatisfactory / non-functioning of the following:
  
a) Real time clock (RTC) Battery: Unsatisfactory functioning of Real Time Clock battery shall be recorded and indicated in reading file at base computer software end.

b) All display segments: “LCD Test” display shall be provided for this purpose.

• Vendor shall have to submit predefined copies of all the software’s i.e. meter reading software for CMRI, Base computer software for meter data analysis and technical details etc.

• The meter shall be software calibrated at factory end and shall be supplied with Certificate along with dispatch. However modification of calibration should not be possible at site. The meter should not have any form of mechanical adjustments such as trip pots potentiometer etc. for calibration.

• The meter shall be tested, calibrated and sealed at manufacturer’s works before dispatch. Further, no modification of calibration shall be possible at site by any means what so ever.

• Meter shall be capable of withstanding switching and transient surges of highest level so as to protect the internal meter circuit.

2.7 METER WITH POLY CARBONATE BASE & COVER

2.7.1 Materials of base/cover/terminal cover:

• The construction of the meter shall be suitable for its purpose in all respects and shall be given reasonable assurance of continuous performance in all mechanical, electrical and magnetic adjustments. The construction shall be such that the meter is not prone to produce audible noise in use. The meter cover & terminal cover shall be of injection molded in transparent UV stabilized polycarbonate in a natural transparent colour. For outdoor use meter shall be installed in sealed enclosure conforming to IP 55.

• The meter base, cover and terminal block cover (ETBC) shall be injection moulded and made of unbreakable high grade flame retardant polycarbonate having good dielectric and mechanical strength to ensure high reliability and long life. The construction of the meter shall be suitable for its purpose in all respects. The meter shall be compact & reliable in design & shall be immune to vibration & shock involved in transportation/handling. The entire design and construction shall be capable of withstanding the severe stresses likely to occur in actual service.
• The meter base shall be manufactured from high quality industrial grade material viz. Polycarbonate with 10% glass filled which shall meet following properties to ensure higher reliability and long life of the meter case. Meter base, cover & terminal cover shall conform to the following:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Test</th>
<th>10% Glass filled for meter base &amp; Transparent for meter cover &amp; terminal cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UV ageing for 200 Hrs. as per ASTM : G53(CL No. 9.3)</td>
<td>4 Hours UV at 60°C, 4 Hours condensation at 50°C</td>
</tr>
<tr>
<td>2</td>
<td>Boiling water test (10MIN)</td>
<td>No softening &amp; whitening &amp; No change in color, shape, size &amp; dimensions</td>
</tr>
<tr>
<td>3</td>
<td>Drop Test from 2 MTRS height-only for casing i.e. base + cover + terminal block + terminal cover, (Without inside assembly)</td>
<td>Shall not crack or break</td>
</tr>
<tr>
<td>4</td>
<td>Glow wire test IS:11000 (part2/SEC-1)1984 OR IEC PUB,60695-2-12</td>
<td>960°C</td>
</tr>
<tr>
<td>5</td>
<td>Heat deflection Temp. (HDT) HDT/Ae, 1.8Mpaedgew(100mm) As per ISO 75/Ae</td>
<td>132°C</td>
</tr>
<tr>
<td>6</td>
<td>Ball pressure test as per IEC- 60695-10-2</td>
<td>125°C +/- 2°C</td>
</tr>
<tr>
<td>7</td>
<td>Flammability Test (a) As per UL 94 or (b) As per IS 11731(Part) 1986</td>
<td>VO FVO</td>
</tr>
<tr>
<td>8</td>
<td>Thickness</td>
<td>2.0 mm +/- 0.2 Mm</td>
</tr>
</tbody>
</table>

• The meter manufacturer has to submit test certificate for materials used from reputed Lab/original supplier’s lab. For every lot offered for inspection.

• The thickness of casing, base & terminal cover shall be 2.0 mm +/-0.2mm.

• Sufficient clearance shall be allowed between terminals. Further, the supporting webs between the two terminals of the terminal block should be sufficiently high to ensure that the two neighboring terminals do not get bridged by dust or it is not possible to have flash over between adjacent terminals of terminal block.
The terminals shall be of suitable rating to carry 150% of Imax and made of electro- plated (or tinned) brass. For verification the test will be conducted at Vref, 150% Imax, UPF for two hours. After the test no physical damage should occur & % error should not exceed accuracy class of the meter at Ib, UPF.

All connection screws and washers should be tinned/nickel plated brass. The terminal screws shall not have pointed end at the bottom. All terminals will have two screws. The terminals shall be properly bound in the insulation. Sufficient clearance can be provided between terminals to avoid possible flash over.

Aluminum crimping pins of suitable size shall be supplied by the manufacture’s along with the Meters for proper termination of the cable ends which are to be packed in a polythene cover and tagged to each meter (for termination incoming & outgoing Aluminum leads).

The shunt shall be directly terminated on terminal block without using lug. Alternatively, the termination of current wires, if used inside the meter (shunt) on the terminal block should be through lugs and washers of proper size. The loop length of the primary current circuit should be kept minimum.

The embossing shall be provided on meter base, meter cover, terminal cover and terminal block as under UV STABILISED’. ‘APDCL’ and manufacturer’s logo/ trade name.

a. METER COVER FIXING ARRANGEMENT:

At least two sealing screws of Nickel plated steel shall be provided for proper fixing of meter cover. Each sealing screw shall have two independent sealing holes. One hole should be provided in the head and one in the bottom portion, so that two separate seals can be provided. The diameter of the hole shall be 2.0 mm and 1.5 mm for the head and bottom portion respectively. The length of the sealing screw shall be long enough to flush with the ground.

b. METER BASE FIXING ARRANGEMENTS:

Meter shall have two fixing holes, one at top & other at bottom. The top screw hole shall be provided on back of the meter so that screw head are not accessible after the meter is fixed. Lower hole shall be provided inside the terminal compartment so as to make them in accessible to an unauthorized person after terminal cover is fixed.

c. SEALING ARRANGEMENT.

The sealing screw used for the meter cover shall be fixed upside down so that these are tightened from the rear. The sealing screw shall be Brass or Nickel plated steel. In addition to the sealing screws provided for the meter cover, there shall be one or two similar tinned brass or nickel plated steel sealing screw for the terminal cover.

In addition to 2 Nos. of polycarbonate seals, further 2 Nos. of tamper proof void seals are to be provided on the Meter body in such a way that both the side covers shall be sealed by the tamper proof void seals. The tamper proof void seals to be provided on Meters shall be as per the following specification:

i. Size of the seal -- 3 x 1 inches.
ii. The seal should be digitally printed on white VOID film having UV destructive inks printed with thermal resin ribbon technology.

iii. The seal should be water proof and should withstand all the weather conditions. The seal should have adhesive of sufficient strength to avoid peeling off under extreme temperature and environmental conditions.

iv. The seal should be sticker type seal and applied on both the side of the Meter which connects the body and the box.

v. If someone lifts the seal, “VOID” impression should be transferred on the meter and if this is applied back, “VOID” impression should be readable from the surface of the seal.

vi. Barcodes of serial numbers should be printed on the seals and the barcodes should be readable with a barcode scanner.

vii. The seals should have continuous variable serial numbers along with security codes of last three digits of serial numbers printed in black and the same serial numbers along with code of serial numbers shall also be printed in a vertical semi circular shape which should be visible only under Ultra-violet (UV) light.

viii. Two security cuts should be given on the seal on both the sides, and if someone tries to lift the seal it should tear off from the security cuts. The security cuts should be made with a computer controlled plotter which should put the security cuts on the same position on each seal.

ix. The name of the supplier and supplier logo along with the security warning or any other information in any language as given by the company should be printed on the seal.

x. There should be a provision of incorporating officers’ signature on the seal as given by the company.

xi. If someone tries to remove the seal by applying heat, the printing should get disturbed and the shape of the seal should change if more heat is applied. The seals to be used for sealing of Meters are to be fixed after inspection is over.

d. INSULATION MATERIALS

All insulation materials used in the construction of meter shall be substantially non hygroscopic.

e. PROTECTION OF PARTS :

All parts, which are subjected to corrosion under normal working condition, shall be effectively protected against corrosion due to atmospheric condition. The protection coating shall not be liable to damage by ordinary handling or injuriously affected by exposure to air under normal condition of service in actual practice in Assam state.

f. SCREW INSULATION

All electrically live screws shall be of heavily tinned brass or nickel plated steel. All other screws shall be electroplated.
g. TERMINAL BLOCK:

The terminal block shall be of POLYCARBONATE of FR & glass filled quality & shall fulfill following requirements:

i. It shall have the glow temperature of 960 deg. C when tested as per IS:11000 (part2/sec1)1984 or IEC PUB 60695212

ii. Ball pressure test of 125 deg. Centigrade. as per IEC –60695102

iii. Heat deflection test of 132 deg. C. as per ISO 75/AeHDT/Ae, 1.8 Mpa edge 100mm

iv. It shall confirm to flame retardant (FR) rating of VO as per UL 94 testing OR vertical specimen method as per IS –11731 (Part2) –1986 (FVO category)

- Type of terminal cover:
  a) The Terminal cover shall be transparent, extended open type & shall enclose terminal compartment except for the provision of conductor entry at the bottom for incoming & outgoing leads.

- Length and materials of terminal:
  a) The length of terminal in the terminal block shall be adequate to have a proper grip of the conductor with the help of the screw.
  b) The internal diameter of terminal holes should be 4 to 6 mm. The materials of the terminals shall be of appropriately plated brass.

- Type of terminals:
  a) The terminals shall be suitable to carry rated continuous maximum current and short time overload current & be made of brass. PC ends shall be provided with lugs.

- Terminal screws:
  a) The terminal screws shall not have a thread sizes less than M4 and less than 5 mm dia. The screws shall not have pointed end of threads.

- Terminal screw materials:
  a) The materials of terminal screws shall be of brass.

- Clearance between adjacent terminals:
  a) The minimum centre to centre clearance between the adjacent terminals shall be 13 mm.
  b) The top cover should be ultrasonically welded or break to open type arrangement.

2.7.2 Crimping pins:

Crimping pins (aluminum) generally conforming to IS8309 shall be provided on the incoming and outgoing terminals to facilitate proper cable termination at site.
2.7.3 Name plate:

The meter shall have name plate beneath the meter cover such that the name plate cannot be accessed without opening the meter cover and without breaking the seals of the meter cover and the name plate shall be marked indelibly. The name plate marking shall not fade with lapse of time.

The basic marking on the meter nameplate shall be as under:

- Manufacturer's name and trade mark
- Type designation
- Serial number (Given By APDCL)
- Month and Year of manufacture
- Reference voltage
- Rated & Maximum Current
- Principal units of measurements (KWH)
- Meter constant (Amp/ kWh)
- BIS’ Mark (Applicable for both Indian and international meter manufacturers)
- Accuracy Class of meter (class-1.0).
- Property of Assam Power Distribution Company Ltd. (APDCL)
- Purchase Order No. & date
- Guarantee period-5 ½ years.
- Bar Code identification of adequate size.

The above detail shall be clearly visible, effectively secured against removal and distinctly marked. The bar Code shall contain details of (i) The make, (ii) Sr no and (iii) Model/type

2.7.4 Printed circuit board

The fully tested double layered glass epoxy shall be used. The latest technology such as hybrid microcircuit or application specific integrating circuit (ASIC) shall be used to ensure reliable performance. The mounting of components on the PCB shall be SMT (Surface Mounted Technology) Type. The electronic components used in the meter shall be of high quality from world renowned manufacturers and there shall be no drift in accuracy of the meter for at least up to 5 ½ years.

The make/grade and the range of the components should be from the following list.

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Component function</th>
<th>Requirement</th>
<th>Makes and Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Current Transformers</td>
<td>If the Meter is with one current Transformer as measuring elements. The current transformer should withstand for the clauses under 5&amp;8 of IS-13779 /1999</td>
<td>ANY MAKE OR ORIGIN CONFORMING TO IS-2705 OR RELEVANT STANDARD.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Measurement</td>
<td>The measurement or computing chips used in the Meter should be with the Surface mount type along with the ASICs. USA: Analog Devices, Cyrus Logic, Atmel, Philips South Africa : SAMES Japan: NEC</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Shunt Bimetal</td>
<td>E-beam welded shunts shall be provided in the phase element and CT / Shunt / Hall effect sensor may be provided in the neutral. Alternatively, both the current elements (phase &amp; neutral) shall have E-beam welded shunts with proper isolation. Redbourn Engg / Isabelle</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Quartz Crystal</td>
<td>AVX, VANLONG, ADVANCED CRYSTAL Etc</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Memory chips</td>
<td>The memory chips should not be affected by external parameters like sparkling, high voltage spikes or electrostatic discharges. USA: Atmel, National Semiconductors, Texas Instruments, Philips, ST, Japan : Hitachi</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Display modules</td>
<td>a) The display modules should be well protected from the external UV radiations. Display TEK/KCE/RCL Display/Suzhouheng Xiamen instruments/ Veritronics/ Bona-fide/ Jebon &amp;Z.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) The display visibility should be sufficient to read the Meter mounted at height of 0.5 meter as well as at the height of 2 meters. Hongkong : Genda Singapore: Bonafied Technologies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) The construction of the modules should be such that the displayed quantity should not disturbed with the life of display (PIN Type). Korea: Advantek. China : Success</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>d) It should be trans- reflective HTN or STN type industrial grade with extended temperature range. Japan : Hitachi, Sony, TIANMA, Haijing, Holtek,</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Communication Modules</td>
<td>Communication modules should be compatible for the optical port and RS-232 port for communication with meter reading instruments. USA: National, Semiconductors HP, Optonica. Holland/ Korea: Phillips Japan : Hitachi Taiwan: Ligitek</td>
<td></td>
</tr>
</tbody>
</table>
|   | **8** Optical port and RS-232 port | Optical port along with RS-232 port should be used to transfer the meter data to meter reading instrument. The mechanical construction of the Port should be such to facilitate the data transfer easily. The Optical Port should not be adversely affected by influence of electromagnetic field, Static discharge. | USA: National Semiconductors HP Agilent  
Holland/ Korea: Phillips  
Japan : Hitachi  
Taiwan: Ligitech |
|   | **9** Power supply | The power supply should be with the Capabilities as per the relevant standards. It should not be affected in case the maximum voltage of the system appears to the terminals due to faults or due to wrong connections. | SMPS Type or better |
|   | **10** Electronic components | The active & passive components should be of the surface mount type & are to be handled & soldered by the state of art assembly processes. | USA: National Semiconductors, Atmel, Philips, Taxas Instruments, Siemens WELWYN, VISHAY DRALORIC, YAGEO, KOA, ROHM, PHYCOMP, FAIRC HILD, PHILIPS, VISHAY SEMICOND, TEXAS INSTRUMENT, EPCOS, OSRAM, INFINION, NATIONAL SEMICOND etc. |
|   | **11** Mechanical parts | a) The internal electrical components should be of electrolytic copper & should be protected from corrosion, rust etc.  
b) The other mechanical components should be protected from rust, Corrosion etc. by suitable plating/painting methods. | |
|   | **12** Battery | Chargeable maintenance free Guaranteed life of 10 years. | Varta, Tedirun, Sanyo or National, Panasonic, Renata |
|   | **13** RTC & Micro Controller. | The accuracy of RTC shall be as per relevant IEC/ IS standards. | USA: Philips, Dallas, ST, Xicor Atmel, Motorola, Microchip Japan: NEC or Oki. |
|   | **14** PCB | Glass Epoxy, fire resistance grade FR4, with minimum thickness 1.6 mm. | A class vendor |
2.7.5 Display of measured value:

- The 7 Digit LCD displays of minimum 10 mm height shall be provided. The Push Button for manual scrolling in addition to Auto scrolling with a persistence time of 10 seconds for each parameter shall be provided.

- The display shall be permanently backlit LCD. The decimal units shall not be displayed for Cumulative kWh in auto scroll mode. However it shall be displayed in push button mode for high resolution display for testing. The meters shall have bright LCD Electronic display with back lit. The back lit should not glow during power off condition. The LCD shall be of STN (super tested pneumatics type) constructing suitably for temperature withstand of 80° C (storage) & 65° C (operation) i.e. When the meter is placed over at a constant temperature of 65 C for a period of 30 minutes, the character of LCD should not deform.

- After keeping the meter at a constant temperature of 80 C for a period of 30 minutes and when restored at normal temperature, LCD display should work satisfactorily. The LCD display should have a wide viewing angle of 120° C and up to one meter distance, for clear visibility of the display of the meter reading at distance. Large viewing area with large display icons is preferred. The registered parameters shall not be affected by loss of power. The display shall not be affected by electrical and magnetic disturbances. The meter shall make use of nonvolatile memory capable of storing and retaining all the data required to be stored, without the help of any power source or battery backup and shall have a minimum retention time of 10 years under unpowered condition. Dot Matrix type LCD display is not acceptable.

- The single phase meters shall be capable to measure and display continuously “Total Active Energy KWh” at all loads and power factors i.e. zero lag unity zero lead. The meter should also have provision for automatic recording of cumulative KWh at 24.00 Hrs on the last day of the month for each calendar month and the same should go to memory.

- On auto scrolling mode following parameters should be scrolled:
  
  a) Instantaneous voltage  
  b) Instantaneous phase current  
  c) Instantaneous neutral current  
  d) Instantaneous active load in Kw  
  e) Cumulative Active Energy KWh.

- Push button:(Manual) Scrolling:

  Following parameters one after another through push button should be provided on the meter display.

  a) LCD segment check  
  b) Date and time  
  c) Serial no. of meter (Given by APDCL)
d) Instantaneous voltage

e) Instantaneous phase current

f) Instantaneous neutral current.

g) Instantaneous active load in Kw

h) Cumulative total active energy (KWh)

i) High resolution display for total active energy (KWh) (for dial test)

j) Present Maximum Demand KW (since last reset)

k) Past Maximum Demand KW (recorded during last two reset)

l) Total Cumulative Active Energy for each calendar month for previous six months.

m) Temper wise nos. of count with easily interpretable notations.

- The facility for reading the meter in absence of power supply shall be provided. This facility shall be powering from a separate internal battery. The internal battery provided shall be of long life of not less than Ten years and shall be kept trickled charged from the mains supply source under normal conditions, alternatively suitable Lithium battery of more than 1 Ah capacity and having minimum life of 10 years shall be provided to ensure longer life even during prolonged power OFF condition. The battery shall not damage the meter even during prolonged idle storage of the meter. The battery shall preferably be located in a separate internal chamber, i.e. separate battery for standby power supply in addition to battery provided for RTC.

- The meter should record Total cumulative KWh reading and KW – MD at pre-programmed date and time of the month for minimum last 12 calendar months and stored in NVM with TOU (6 Tariff register and 6 time zones)

- The energy meter shall continuously monitor and calculate the average maximum demand for each demand for time interval of 15 minutes and maximum of these in a calendar month shall be stored. There shall be NO Resetting button for MD. 30 years calendar shall be programmed by manufacturer. Resets should be auto-monthly or through communication command integration period should be programmable.

- The meter shall be capable to measure and display:

  a) Cumulative Total (Fundamental+ Harmonics energy) KWh for tariff billing purpose,

  b) Instantaneous KW,

  c) Instantaneous Voltage,

  d) Instantaneous line current,

  e) Power Factor,

  f) MDKW,
g) Time and date.

- The meter shall also be capable of measuring, monitoring and storing in the memory six (6) register with 6 zones of time of day electrical quantities for pre-specified periods of the day.

**Zones for TOD -**

i. Peak hours -17.00 to 22.00 hrs

ii. Night hours - 22.00 to 06.00 hrs.

iii. Balance Hours –06.00Hrs to 17.00 hrs.

- The maximum demand shall automatically be reset at 24.00 hours of the last day of each calendar month. No reset push button shall be provided.

2.7.6 Output device :

- The meter shall have suitable blinking LED test output accessible from the front. The meter shall have LED / LCD Indicator for pulse/kWh, Tamper, Disconnection, Earth leakage.

- The test output should be suitable for use with sensing probe used with test bench or Electronic Reference Standard Meter.

- The test output should also work as operating indicator for meter.

- Output device shall be suitable for optical scanning for test purpose.

2.7.7 Communication Capability / Communication Port :

- Optical port along with RS-232 will be provided for local communication. The port for local communication and baud rate shall be as per IS 15959/ IEC 62056. 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 (Neighborhood Area Network) i.e. from Meter to Data Concentrator or directly for WAN (Wide Area Network). This Communication Module could operate on Low Power Radio / RF with Mesh/GPRS (directly up to HES). Different communication technologies shall follow relevant National or International Standard as applicable.

- It should not be possible to reset the energy reading in the meter or make any change in the data stored in the meters either current or historical, with the MRI.

- The compatibility of transferring data from the meter to MRI and then to the base computer system (BCS) should be easily established; any change in language or any other reasons, the supplier shall modify it at his own cost within the guarantee period.

- All meters shall support the open protocol (DLMS Indian Companion Specification-IS 15959/ International Electro technical Specification -IEC 62056) for relevant Single Phase meter data login.

a) Meter Reading Instrument (MRI)

i. The CMRI shall be supplied in the ratio of one for each 1000 nos. of meters free of cost along with battery charger.
ii. The MRI shall have facility to store minimum 200nos. of meter’s data. The supplier shall indicate nos of meters’ data which CMRI could retrieve.

iii. Further, there should be a facility in CMRI to provide the transfer of meter data to computer through USB port.

iv. The MRI shall be capable for down loading readings of other makes of meters. The bidder shall give an undertaking to this effect.

v. The MRI shall have a feature to read multiple meters within the range without pre-programming the meter serial numbers in advance.

vi. It shall be responsibility of the meter manufacturer to provide the required software and all the facilities required by the purchaser, to use the MRI for reading and retrieving the data from the meter and to download the data to BCS free of cost till the expiry of guarantee period. The downloaded data shall be converted to the ASCII or database file format for easy integration with the existing billing software of APDCL.

b) Readings to be downloaded with MRI:

i. The meter shall possess a suitable fast reliable communication port for manual / automatic transfer of data from Meter to CMRI. Arrangement in the meter should be such that, in case of failure of power supply, it should be possible to download the data.

ii. The MRI shall possess easily replaceable battery and shall be capable of storing data for minimum 200 nos. Meters at one time.

iii. The CMRI shall posses a specific serial number which cannot be changed. The downloaded data along with date and time stamp of such reading shall remain on CMRI with suitable encryption and it should not be possible to pre-program or manipulate the recorded data on the MRI before downloading the same with the serial number of MRI on computer. The MRI shall also download the serial number, make of meter, year and month of manufacture of meter. The Supplier shall supply Software (compatible with Windows xp and Windows 7 system and/ or higher) and training, free of cost for the use of software at multiple data collection and billing premises of the utility.

iv. After successful downloading of meter data to MRI, an indication on MRI and meter for confirmation of successful data transfer shall be provided. During this period the energy recording should not be affected.

v. Necessary upgrades shall be possible in MRI software and shall be supplied free of cost for downloading simultaneously the existing parameters and any parameters added in future specifications of meters. A copy of operation manual shall be supplied along with each MRI. The Supplier shall provide meter reading protocols free of cost which shall not be complicated and easily understandable by APDCL officials to introduce compatibility between meters and MRIs of different makes.
c) It should be possible to download the following data from the meter memory:

i. Serial Number of meter

ii. Cumulative total active energy (KWh)

iii. Cumulative total Active energy (KWh) for the last 12 calendar months

iv. Maximum Demand KW for last 6 calendar months with 15 minutes integration period

v. Maximum Demand KW since last reset

vi. Instantaneous voltage

vii. Instantaneous phase current

viii. Instantaneous neutral current

ix. Instantaneous load in Watt

x. The Tamper events like Magnet, Earth load, one line drawl (neutral missing), neutral Disturbance & reverse current should be logged with date and time (Occurrence & Restoration). The meter should be able to store at least 100 tamper events. The tamper of Cover Open Event, Magnetic Interference shall be communicated back to HES as and when they occur. These tamper events shall be sent as an alarm to the HES which shall store the same in its database.

xi. 36 (Power ON) days data to be recorded with 15 minutes integration period with date & time stamping for Active Energy Reading, Average Voltage, Average Current., average PF, Average KW.

d) Alarm: Alarm for power on/off, Under Voltage, Over Voltage, Over Current, Mal functioning of relay, malfunctioning of diagnostic events shall be generated and communicated to the HES immediately. It should be definable at HES.

e) Load Control:

i. Relay for connection/disconnection: Relay for connect / disconnect shall comply all relevant requirements of IS 15884 or any other equivalent International Standard.

ii. Phase and Neutral Disconnection on the following conditions:
   - Over current
   - Load Control Limit
   - Pre-programmed Tamper conditions
   - Disconnect signal from Utility Control Centre such as balance unavailable in case pre-paid facility is availed by consumer.

f) Load Control limits shall be programmable.

g) The disconnection mechanism is as follows:
i. The switch re-connection shall be decided by meter locally. It will try to re-connect the load up to 3 times, with 5 minutes interval.

ii. If the consumption is still more than the programmed limits, it will lock out and wait for 30 minutes (lock out period).

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

h) Reconnection mechanism:
Reconnection shall normally be done from HES. In case of failure of communication/HES, reconnection shall be possible through HHU locally and the same shall be password protected. Relay for connect/disconnect shall comply all relevant requirements of IS 15884.

i) Connect/Disconnect Indication:
Connect/Disconnect facility to be provided on both the wires i.e. phase and neutral simultaneously.

i. Status of Relay – i.e. Connected / Disconnected should be available on display as well as through communication.

ii. Connection and Disconnection should also be logged as events. Such twenty events should be recorded.

j) Programmability: It should be possible to program the parameters limits / values from remote through sufficiently adequate security mechanism. Once programmed it will be possible for the programmed parameters to come into effect from a certain date & time. Meteorology under such condition must remain intact and shall not be upgradable from remote.

k) Communication Protocol: IS 15959 / IEC 62056 is to be referred for the same.

l) RTC & time synchronization: Meter shall have RTC with 30 years calendar programmed in the memory and provision for time synchronization.

2.7.8 LED / LCD indicators: Meter should indicate following indicators of size 5 mm.

- LED indicator for Meter calibration (RED)
- LCD indicator for Current Reverse Indication.
- LCD indicator for Earth Tamper Indication.
- LCD indicator for One line drawl (neutral missing) Tamper Indication.
- LCD indicator magnetic influence Tamper Indication. The LCD notation must be easily interpretable

2.7.9 Softwares:

- Licensed copies of the following software shall be made available and shall be installed on each HHT or common meter reading instrument (CMRI) and Base computer software (BCS) by the supplier:
a) HHT or Common Meter Reading Instrument (CMRI) Software for reading, downloading meter data. The software shall be user friendly.

b) Windows based user interactive Base Computer Software (BCS) for receiving data from HHT or CMRI and downloading instructions from base computer software to CMRI.

c) Necessary software for loading application program into meter via CMRI.

- The supplier should ensure that software supplied with this package works properly with HHT or CMRIs of other manufacturers.

2.7.10 Self-diagnostic feature

The meter shall be capable of performing complete self diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location at all time. The meter shall have indication for unsatisfactory/nonfunctioning/malfunctioning of the following:

- Time and date on meter display
- All display segments on meter display
- Real Time Clock (RTC) status in meter reading prints out at BCS end
- Nonvolatile Memory (NVM) status in meter reading prints out at BCS end.

2.7.11 Last Gasp Outage Alert

The end point (smart meter) shall have functionality that when power goes out for more than 60 second the end point shall send a power outage message to HES which shall be populated on outage map of HES. This functionality shall help utility to identify the power outages on real time basis.

2.8 ELECTROMAGNETIC COMPATIBILITY AND INTERFERENCE REQUIREMENT

The meter shall meet EMI/EMC requirements as specified in the relevant standards and shall also be protected against radiated interference from either magnetic or radio frequency sources. The meter shall be designed in such a way that the conducted or radiated electromagnetic disturbance as well as electrostatic discharge do not damage or substantially influence the meter.

The disturbance(s) to be considered are:

i. Harmonics

ii. Voltage dips and short interruptions

iii. Fast transient burst test

iv. External D.C. and A.C. magnetic fields

v. Electromagnetic H.F. fields

vi. Electrostatic discharges & HVHF Field

vii. Radio frequency interference suppression

viii. Radio frequency interference suppression.
2.9 INSULATION REQUIREMENTS:

2.9.1 Insulation Resistance.

The Insulation resistance between both current circuits and voltage circuit connected together and earth (Frame) shall be more than 5 Mega Ohms.

2.9.2 Impulse voltage:

The meter shall withstand 1.2/50 microsecond impulse voltage of peak value 10 KV Peak without any damage in line with Clause 12.7.6.2 of IS 13779:1999. Error at Ib, Up.f before & after will be measured & after the test, variation in % error of the meter shall not exceed 50 % of class of index.

2.9.3 A.C. voltage:

The meter shall withstand 4 KV A.C.Voltage for one minute. This is applicable during lot inspection also.

2.10 ACCURACY REQUIREMENT

2.10.1 Limits of Error:

The meter shall comply all the requirement of limits of error as per IS 13779/99 on all the points mentioned in table no.15 of IS including special test at 0.25 lag & 0.5 lead of APDCL requirement. % error at 0.25 lag and 0.5 lead is ± 3.5% and ± 2.5% respectively for range from 0.1lb to Imax Same tests are to be carried out on neutral circuit also with the procedure and limits as per phase circuits.

2.10.2 Meter Constant:

Meter constant shall comply relation between test output and indication in the display with marking on the Name Plate. The manufacturer / bidder shall state necessary number of pulse/ count to ensure measuring accuracy of at least 1/10 of the accuracy class at different test points.

2.10.3 Starting:

The meter shall start and continue to register at 0.2% of basic current at reference voltage and unity power factor.

2.10.4 Running with no load:

This test shall be carried out as per provision of IS 13779/99.

2.10.5 Repeatability of error test: (For Acceptance)

Repeatability test at 5% Ib, 10% Ib& Ib at unity power factor as per IS 13779/99 shall be carried out during inspection of lot. And the difference of maximum and minimum value should not be more than half of the limit of class of index.

2.11 ELECTRICAL REQUIREMENT:

2.11.1 Power Consumption:

- Power Consumption of voltage circuit: The active and apparent power consumption in each voltage circuit including the power supply of meter of reference voltage, reference temperature and reference frequency shall not exceed 1.5 watts and 8 VA.
• Power Consumption of current circuit: The apparent power taken by Current circuit at basic
current reference and reference temperature shall not exceed 1 VA.

* Power Consumption of meter with relay and communication module shall comply with IS
13779 table 9 note 2 wherein higher Power Consumption can be declared by vendor.

• Short Time over current: The meter shall be able to carry short time over current of 30 I
max for half cycle at rated frequency.
• Initial start of the meter: The meter shall be fully functional within five second after the
rated voltage is applied to the meter terminals.

2.11.2 Influence quantities:

• The meter shall work satisfactorily with guaranteed accuracy as per limit of IS: 13779  under
presence of the following quantities:-
  i. External magnetic field.
  ii. Electromagnetic field: The persistence and restoration time is 1 minute.
  iii. Radio frequency interference.
  iv. Vibration.
  v. Harmonics.
  vi. Voltage fluctuation.
  vii. Electro static discharge & Electromagnetic high frequency field.

Note: The measurement by meter shall not get influenced by injection of AC
Voltages/chopped signal/DC signal / DC pulse of low frequency and harmonics.

2.11.3 TEMPERATURE RISE :

• Under normal conditions of use, measuring element and insulation shall not reach a
temperature, which might adversely affect the operation of the meters.

• With each current circuit of meter carrying rated maximum current and with each
voltage circuit (and those auxiliary voltage circuits which are energized for periods of longer
duration than their normal time constant) carrying 1.25 times the reference voltage, the
temperature rise of the respective parts shall not exceed the value given below over and
above an ambient temperature of 50°C.
  i. Measuring element: 50°C
  ii. External surface of the case: 15°C

2.12 TAMPER PROOFING FEATURE:

2.12.1 Meter shall record correct energy under reverse current condition. The indication of such reverse
current shall be provided by way of LCD on Display. Also Meter shall record correct energy during
interchanging of main and load terminal wires.

2.12.2 Meter shall record correct energy when load is connected to earth instead of neutral. The
indication of such event shall be provided by way of LCD on Display.
2.12.3. Flashing LED pulse output (with meter constant) for testing shall be provided by way of LED on front panel.

2.12.4. The External Magnetic Influence:

The meter shall be totally immune to tamper using external magnets as per relevant IS/IEC. In case the meter is not immune to tampering by permanent magnet, the meter shall be provided with built in logic / indication and sensor to detect tamper using stronger magnet (i.e. more than 0.2T in case of AC magnetic field and 0.5 T in case of DC magnetic field), record in accordance with CBIP Report – 304 (latest amendment) and display such occurrence with date and time of last 20 such occurrences. Such events shall be recorded in the memory of the meter and can be downloaded though MRI / BCS.

2.12.5. The meter shall also be capable of withstanding the effects of Harmonics i.e. the test under the influence of quantities as per clause no 11.2 of Table no 17(iii) of IS 13779/99.

2.12.6. The performance of meter shall not be affected under the influence of external DC/AC and permanent magnetic field of high intensity as mentioned in latest version of CBIP technical report no 304. This test shall be carried out in the Factory premises to check the effect of influence of external DC/AC magnetic field of high intensity as mentioned in the latest version of CBIP technical report no 304 on each lot offered for inspection. This test shall be carried out as per cl no 5.6.2.3 for DC magnetic field & 5.6.2.5 for AC magnetic field of CBIP technical report (latest version). For DC abnormal magnetic field test the same shall be carried out at 0.5 tesla as per the procedure specified in CBIP304. The bidders are requested to enclose certificate of proof in this regard. Without the certificate from the reputed Govt. approved lab.: NABL for Indian bidder and for foreign bidder the certificate should be from recognized Govt. approved lab. Of that respective country, the offer shall not be considered. Moreover meter working shall not be affected by permanent magnet of 0.5 T of minimum size 70 x70 x50 mm.

Note: The error limit for “DC abnormal magnetic field and Permanent magnetic field test at 0.5 tesla” shall be as per CBIP 304 cl no.5.6.2.3.

2.12.7. The meter shall not be susceptible to spurious signal / voltage (up to 100%) injected on neutral wire of the meter.

2.12.8. The meter shall also be capable of withstanding DC injection and also meter shall not generate conduct or radiated noise, which would interface with the other requirements. The above shall confirm to requirements as per IS 13779/99.

2.12.9. DC Immunity : The meter should not saturate on passage of direct current which can cause the meter either to stop recording or record inaccurately as per IS:13779 (latest version). The DC injection will be tested on both the phase and neutral circuit. The procedure and limit as per phase circuit.

2.12.10. Measurement of total energy: The meter shall record total energy i.e. fundamental + harmonics to be used for tariff billing purpose. The test for total energy shall be carried out as per Clause No. 8.2.1 of IEC 6205321 of 2003 along with CBIP 304 version. The bidders are requested to enclose certificate of proof in this regard. Without the certificate from the reputed Govt. approved lab.: NABL for Indian bidder and for foreign bidder the certificate should be from recognized Govt. approved lab. Of that respective country, the offer shall not be considered.

2.12.11. Test for total energy i.e. fundamental + harmonics as per Cl. No. 8.2.1 of IEC 62053/ CBIP 304 and
other display parameters. In case of non availability of separate display the test for fundamental & harmonics, the test should be done by using pulse method.

2.12.12. **Dry heat test:** The test will be conducted as per the clause no.12.6.1 of IS 13779/99. However, instead of meter in non operating condition the test will be conducted keeping the meter in operating condition at basic current at 0.866 lag at 115% of rated voltage. The other conditions of the test will remain same.

2.12.13. **Meter shall record the energy at Imax when magnetic field of beyond limit is applied or immune.**

2.12.14. **Meter shall record correct energy on reference voltage & actual current in absence of neutral, LCD indication of such tamper shall be provided on display & it should be started to record energy at min.1Amp.**

2.13 **GUARANTEE:**

- The meters of Indian Manufacturers shall be guaranteed against any manufacturing defect or bad workmanship for a period of at least 5 years from the date of commissioning or 5 & 1/2 years from date of supply, whichever is earlier.
- The meters of foreign manufacturers shall be guaranteed for a period of 10 years from date of supply.
- The meter found defective within the above guarantee period shall be replaced/repaired by the supplier free of cost within one month of the receipt of intimation.

2.14 **OTHER CONDITIONS:**

- Ordered quantity of meter are to be supplied in stipulated time.
- The Inspection call shall be given after conducting all acceptance tests and the copy of routine test certificates shall have to be submitted along with each meter to be supplied in lot. Each lot shall be inspected at firm’s works prior to dispatch of materials or as the case may be. The materials shall not be dispatched without inspection.

2.15 **DEMONSTRATION:**

The purchaser reserves the right to ask for the demonstration of the equipment offered at the purchaser’s place prior to qualifying the offer or placement of order.

2.16 **SUBMISSION OF TEST CERTIFICATE:**

2.16.1. **Submission of Test Certificate:** The supplier shall have to submit test certificate of meter along with bid documents. Please note that the Test Certificate submitted shall be as per APDCL’s specification and the same shall be verified at Meter Testing Laboratory, APDCL, Ulubari, Guwahati, Assam, India. Certificate of the following tests are to be provided:

- Insulation resistance test as per IS.
- Impulse voltage test at 10 KV as per specification.
- AC high voltage test method as per IS but shall be taken at 4 KV for one minute.
Test for limit of error as per specification.

Interpretation of test results, if required.

Test for meter constant.

Test of starting condition at 0.2 % of basic current as per specification.

Test of no load condition as per IS.

Test of repeatability of error as per specification.

Test of power consumption as per IS.

Test for total energy i.e. fundamental + harmonics as per Cl. No.12 of specification.

Test for influence of quantities i.e. Voltage and frequency variation test and 10% of 3rd harmonics as per IS (Strictly as per the clause 12.11 & notes 1 to 9)

Test for influence of AC / DC magnetic field as per cl no. 12 of specification.

Dry heat tests as per cl no.12 of specification.

Test for DC injection in both phase and neutral cl no. 12.

Test of Short time over current test as per IS.

Test of terminals for withstanding 150 % I max as per Specification

Test for withstanding phase to phase voltage (440V) between phase to neutral for minimum 5 min as per a clause of section 5.

Verification of Display parameters and Functional requirement

2.17 TYPE TEST CERTIFICATE:

The meter offered should have successfully passed all type tests described in the IS 13779/IS 14697/IS 15959 or BIS approved documents. The supplier shall have to submit all type test certificates from the Govt. approved laboratory viz: NABL, for Indian bidder and for foreign bidder the certificate should be from recognized Govt. approved lab. of that respective country, as per IS mentioned above or IEC 6205321 as the case may be along with bid. After opening of Technical Bid, no type test certificates shall be accepted. Type test should not be older than 3 years also the type test certificate of AC/DC magnetic influence test and total energy test shall also be furnished on the same rating of meter. Without above type test certificate the offer shall not be considered. APDCL reserves right to select randomly one meter from the offered lots for inspection for its type test and if meter during type test found failed then either order placed shall be cancelled and supplier has to collect all the meters at its cost for the supplied meters or shall have to replace all supplied meters at their cost after manufactured and successful type test within time frame given by the APDCL.
2.18 INSPECTION:

2.18.1. For Proto type samples

Following tests are to be carried out at supplier’s works during inspection of Proto type samples. The firm has to assure for testing facility for following tests at the time of offering the inspection call.

- Insulation resistance test as per IS.
- AC high voltage test method as per IS but shall be taken at 4 KV for one minute.
- Test for limit of error as per specification.
- Interpretation of test results, if required.
- Test for meter constant.
- Test of starting condition at 0.2 % of basic current as per specification.
- Test of no load condition as per IS.
- Test of repeatability of error as per specification.
- Test of power consumption as per IS.
- Test for total energy i.e. Fundamental + harmonics as per specification.
- Test for influence of quantities i.e. Voltage and frequency variation test and 10% of 3rd harmonics as per IS
- Test for influence of AC / DC magnetic field as per specification.
- Test for DC injection in both phase and neutral.
- Test of terminals for withstanding 150 % I max as per Specification
- Test for withstanding phase to phase voltage (440V) between phase to neutral for minimum 5 min.
- Verification of Display parameters and Functional requirement
- Testing for communication in all respect.

2.18.2. Acceptance tests :

All acceptance tests as stipulated as per IS 14697-1999 (reaffirmed 2004)/IS 13779 / IS 15884 / with latest amendments, shall be carried out by the supplier in the presence of the purchaser's representative. The following tests are to be carried out during regular inspection of each lot offered for inspection.

- Insulation resistance test as per IS.
- AC high voltage test method as per IS but shall be taken at 4 KV for one minute.
• Test for limit of error as per specification.
• Interpretation of test results, if required.
• Test for meter constant.
• Test of starting condition at 0.2 % of basic current as per specification.
• Test of no load condition as per IS.
• Test of repeatability of error as per specification.
• Test of power consumption as per IS.
• Test for total energy i.e. fundamental + harmonics as per specification.
• Test for influence of quantities i.e. Voltage and frequency variation test and 10% of 3rd harmonics as per IS
• Tamper condition tests.
• Test for DC injection in both phases.
• Test of terminals for withstanding 150 % I max as per Specification
• Test for withstanding phase to phase voltage (440V) between phase to neutral for minimum 5 min
• Verification of Display parameters and Functional requirement
• Testing for communication in all respect.

Note:
The measurement by meter shall not get influenced by injection of AC Voltages/chopped signal/DC signal / DC pulse of low frequency and harmonics. The facility for suitable testing of the same shall be made available for inspecting officer at the time of lot inspection and acceptance testing.

During inspection of each lot offered, the meter shall be tested for acceptance test as per IS 13779 (1999) and as per APDCL specification. However, this does not relieve the supplier of his responsibility to replace the meter, which is found defective during individual meter testing or found defective in field services.

The tests shall be carried out at suppliers works (in case of non-availability of facilities for the test specified as above), the test shall be carried out at Govt. Approved Lab. at suppliers cost viz, NABL or mutually agreed upon, during inspection of each lot. Minimum lot to be offered should be 10000 nos. or the ordered total quantity whichever is less. During the lot offered the meter shall be selected at random as per IS 4905 and as per IS 13779/99 (Annexure H). Failure of meter and failure of any meter in the test specified herein above, the lot shall be rejected. The certificates submitted will be considered for further evaluation.

2.18.3. Routine Tests: Each and every meter of the offered lot shall undergo the routine tests as well as functional tests as per IS 14697-1999 (reaffirmed 2004)/IS 13779 / IS 15884 / with latest
amendments. The firm shall produce Test reports for the following tests for each & every meter in the form of CD with each offered lot.

- AC High Voltage test
- Starting and No load tests.
- Insulation Resistance Test.
- Limits of error test.

2.19 TESTING AND MANUFACTURING FACILITIES:

2.19.1. Testing facilities:

The Bidder shall have at least the following testing facilities for carrying the various tests Specified (as above) for Proto type samples as well as LOT inspections to ensure accurate calibration as per IS: 13779(1999), Manufacturer should have fully automatic computerized meter test bench with printer & static source for carrying out lot testing during inspection. The firm shall have dust proof & air conditioned assembly & testing hall. Also all the equipment shall be calibrated from Govt. approved/NABL accredited laboratory.

- Manufacturing activities:

  i. The bidder shall have own facilities or have assured access through hire, lease or sub-contractor of SMT pick & place machine & reflow solder process. However the party should have their own proper quality control system for electronics components.

  ii. Quality shall be ensured at the following stages:

      a) At PCB manufacturing stage, each board shall be subjected to computerize testing bare board testing.

      b) At insertion stage, all components shall undergo computerized testing for conforming to design parameters and orientation.

      c) Complete assembled and soldered PCB shall undergo functional testing using Automatic Test Equipments (ATES).

      d) Supplier has to see that prior to final testing and calibration, all meters shall be subjected to ageing test (i.e. Meters will be kept in ovens for 72 hours at 55 deg C temperature and atmospheric humidity condition. After 72 hours meters shall work accurately) to eliminate infant mortality.

      e) Assembly & testing of meters shall be carried out in dust proof & air conditioned environment.

      f) The bidders shall submit the list of all imported and indigenous components separately used in meter along with the offer.

- Bought out items:

  A detailed list of bought out items, which are used in manufacturing of the meter shall be furnished indicating the name of firms from whom these items are procured. The bidder shall also give the details of quality assurance procedures followed by them in respect of the
bought out items. However, at the time of offering the lot, the list of bought out items should be submitted, components of the make mentioned in the list shall be preferable and due weightage shall be given.

APDCL reserves right to select any of the meters from any of the lot offered and give it to Govt. approved laboratory for conforming the same and if it is differing, the lot /order will be rejected /cancelled as decided by the APDCL.

2.20 AUDIT TESTING:

From any offered/dispatched lot, eight (8) nos. of meters shall be randomly selected & sent for audit testing. On receipt of test reports acceptability of the lot will be decided. Following tests are to be carried out during the audit testing:

i. Insulation resistance test as per IS.

ii. AC high voltage test method as per IS but shall be taken at 4 KV for one minute.

iii. Test for limit of error as per specification.

iv. Interpretation of test results, if required.

v. Test for meter constant.

vi. Test of starting condition at 0.2 % of basic current as per specification.

vii. Test of no load condition as per IS.

viii. Test of repeatability of error as per specification.

ix. Test of power consumption as per IS.

tax. Test for total energy i.e. fundamental + harmonics as per specification.

xi. Test for influence of quantities i.e. Voltage and frequency variation test and 10% of 3rd harmonics as per IS.

xii. Test for influence of AC / DC magnetic field as per IS. 304

2.21 PRE QUALIFICATION CONDITIONS:

Bidder shall have pre-qualification conditions specified as per Annexure I. The bidder shall not be considered if any of the pre-qualification conditions are not met. The bidder shall have to submit this Annexure duly filled and supported by relevant documentary proof for the details furnished.

2.22 QUALITY ASSURANCE:

- The manufacturer shall have a comprehensive quality assurance program at all storages of manufacture for ensuring products giving reliable, trouble free performance. The bidder shall furnish with their offer a comprehensive Quality Plan covering all aspects of the design, procurement, assembly, testing etc for purchaser evaluation along with a detailed manufacturing flow diagram. The QP shall also give details of the quality control procedures, documentation, certification available / being practiced by the manufacturer and their major suppliers/ sub-suppliers.

- The design life of the meter shall be minimum 20 years and to prove the design life the firm shall have at least the following quality Assurance Plan:
i. The factory shall be completely dust proof.

ii. The testing rooms shall be temperature and humidity controlled as per relevant standards.

iii. The testing and calibrating equipments should be automatic and all test equipment shall have their valid calibration certificates.

iv. Power supplies used in testing equipment shall be distortion free with sinusoidal, waveforms and maintaining constant voltage, current and frequency as per the relevant standards.

v. During the manufacturing of the meters the following checks shall be carried out:

   a) Meter frame dimensions tolerances shall be minimum.

   b) The assembly of parts shall be done with the help of jigs and fixtures so that human errors are eliminated.

   c) The meters shall be batch tested on automatic, computerized test bench and the results shall be printed directly without any human errors.

• The Bidder shall invariably furnish the following information along with the bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of material offered:

i. Statement giving list of important raw materials, names of sub suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials.

ii. Information and copies of test certificates as in (i) above in respect of bought out accessories.

iii. List of manufacturing facilities available.

iv. Level of automation achieved and list of areas where manual processing exists.

v. List of areas in manufacturing process, where stage inspections are normally carried out of quality control and details of such tests and inspections.

vi. List of testing equipment available with the bidder for final testing of equipment specified and test plant limitations, if any, vis à vis type, special acceptance and routine tests specified in the relevant standards and this specification. These limitations shall be very clearly brought out in schedule of deviations.

vii. The manufacturer laboratory must be well equipped for testing of the meters. They must have computerized standard power source and standard equipment calibrated not later than a year (or as per standard practice). The details of testing facilities available for conducting (a) The routine tests and (b) Acceptance tests shall be furnished with the bid.

viii. Organization structure of the works with details of QA set up in overall work flow.

ix. Copy of system manual showing QAP as actually practiced at works.
x. List of raw materials and critical components (ASIC chip, crystal clock, memory register chip, LCD etc) with their suppliers.

xi. Stage inspection of product before final testing.

xii. Procedure adopted for in situ testing of PCBs, after placement of SMT component, for quantitative parametric variation of tolerance.

xiii. Testing and calibration facility with manpower data of bench operators.

xiv. Sample copies of test certificate of bought out components.

2.23 PACKING:

Each meter shall be packed in suitable mode to ensure safe and eco environmental friendly use. The meter shall have in plastic paper cover. 20 to 25 such single phase meter cases shall be again packed in box having holding hooks of Nylon or any other arrangement.

2.24 SCHEDULES:

The bidder shall submit the following Schedules (as per standard format) which are part and parcel of the specification:


Schedule – B: Source of material and place of manufacture, testing and inspection.

2.25 SCHEDULE –A GUARANTEED TECHNICAL PARTICULAR OF AC SINGLE PHASE STATIC KWH METER

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<td>The terminal cover should be fixed with case through upper hinge</td>
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<td>Voltage and Current Circuits should be solidly connected inside the meter without any links</td>
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<td>Meter case shall be transparent/translucent</td>
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<tr>
<td>36.</td>
<td>The meter should be equipped with the facility to read the parameters during power cut. Same push button shall be used for display access and reading.</td>
<td></td>
</tr>
<tr>
<td>37.</td>
<td>Indications should be provided to facilitate test output pulse</td>
<td></td>
</tr>
<tr>
<td>38.</td>
<td>Guaranteed Accuracy within different ranges of voltage and P.F.</td>
<td></td>
</tr>
<tr>
<td>39.</td>
<td>Meter should run with no load on 70% to 120% of the rated voltage</td>
<td></td>
</tr>
<tr>
<td>40.</td>
<td>The meter should be immune to DC magnetic fields as per the CBIP 304</td>
<td></td>
</tr>
<tr>
<td>41.</td>
<td>The meters should record energy as per rated parameters even when neutral from the incoming and outgoing is removed</td>
<td></td>
</tr>
<tr>
<td>42.</td>
<td>The meter accuracy should not be affected by any influence of externally applied abnormal high frequency which may be up to some Giga Hertz</td>
<td></td>
</tr>
<tr>
<td>43.</td>
<td>The meter should be designed with application specific integrated circuit and should be manufactured using Surface Mount Technology (SMT) components</td>
<td></td>
</tr>
<tr>
<td>44.</td>
<td>The meter should be capable to detect the opening of the case in power off conditions also</td>
<td></td>
</tr>
<tr>
<td>45.</td>
<td>For local meter reading the meter should be capable enough to provide entire meter data and the download time should be within 120 seconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The meter should have SMPS based power supply for operation over a wide range of voltages</td>
<td></td>
</tr>
</tbody>
</table>

Certified that all the information / parameters indicated above exist in the meter offered by us and have successfully undergone all the tests specified above within the variation of current / voltage frequency and climatic conditions specified therein.

SIGNATURE OF BIDDER
NAME
DESIGNATION
2.26 SCHEDULE – B SOURCE OF MATERIAL AND PLACES OF MANUFACTURER, TESTING AND INSPECTION

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Item part</th>
<th>Name of manufacturer</th>
<th>Place of manufacturer</th>
<th>Place of testing and inspection</th>
<th>Source of procurement of material not manufactured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

PLACE:

SEAL & SIGNATURE OF TENDERER
NAME:
DESIGNATION:
2.27 ANNEXURE-I PREQUALIFICATION CONDITIONS FOR SINGLE PHASE STATIC METERS

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Particulars</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bidders must have produced/ executed order of tendered item to any SEBS/power utility company in last 3 years. The bidder should submit the order copies along with their Bid as a evidence.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>2</td>
<td>Bidders must have valid ISI license</td>
<td>Yes/No</td>
</tr>
<tr>
<td>3</td>
<td>Bidder preferably possesses ISO 9001 certification.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>4</td>
<td>Bidder shall be manufacturer of static meters. Offer from traders / agents are not acceptable</td>
<td>Yes /No</td>
</tr>
<tr>
<td>5</td>
<td>Bidder shall have ISI license for similar design product and/or type test certificate for all the type tests as per type tests as per the IS 13779/IS 14697/IS 15959 or BIS approved documents or IEC-62053 from International or from Indian Govt. Approved lab. as well as DC magnetic influence test for 0.5 tesla and total energy test. The tender without valid type test report should be out rightly rejected.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>6</td>
<td>Bidder shall have to submit type test report for AC/DC magnetic field as per CBIP 304 &amp; its latest amendments from independent Govt. Approved lab. as well as DC magnetic influence test for 0.5 tesla and total energy test. The tender without valid type test report should be out rightly rejected.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>7</td>
<td>Bidders shall have dust free &amp; air conditioned environment for assembly as well as testing.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>8</td>
<td>Bidders shall have automatic computerized test bench for lot testing of meters and oven for ageing test. The document evidence is to be attached along with the bid.</td>
<td>Yes/No</td>
</tr>
<tr>
<td></td>
<td><strong>Bidder shall have to submit type test report for AC/DC magnetic field as per CBIP 304 &amp; its latest amendments from independent Govt. Approved lab. as well as DC magnetic influence test for 0.5 tesla and total energy test. The tender without valid type test report should be out rightly rejected.</strong></td>
<td>Yes/No</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>7</td>
<td><strong>Bidders shall have dust free &amp; air conditioned environment for assembly as well as testing.</strong></td>
<td>Yes/No</td>
</tr>
<tr>
<td>8</td>
<td><strong>Bidders shall have automatic computerized test bench for lot testing of meters and oven for ageing test. The document evidence is to be attached along with the bid.</strong></td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

**PLACE:**

**SEAL & SIGNATURE OF TENDERER**

**NAME:**

**DESIGNATION:**

**Bidders are requested to read the following as the part of tender technical specifications document.**

- At the end of the tender technical specification, following paragraph should be added and read as under:

  The material supplied shall be conforming to Indian Standard Specification (except DLMS compliance, if any) and also with ISI marking and even after inspection of the lot, if the material received at site is found without ISI marking, the lot shall be rejected and no further correspondence shall be entertained in this regard.
3. Technical Specification for Three phase LT Static Whole Current Smart Meter (10-60) Amp. of Accuracy Class 1.0 with DLMS.

3.1. SCOPE

- This specification covers the design, manufacture, assembly, inspection, testing at manufacturers works before dispatch, supply and delivery at site/FOR destination anywhere in “Assam State” static whole current electronic meter of Class 1.0 accuracy of current range 10-60 Amps for tariff purpose along with other associated component as per requirement given in this specification which is based on CEA Regulations on Installation and Operation of meters and its amendments and IS 13779 / IS 15884/ IS15959 with latest amendments for respective requirements except for those parameters which have been specifically mentioned to be otherwise in this specification. This specification also covers load control with connection and disconnection through relay & prepaid metering facility.

- The meter shall be 3 phase 4 wire type suitable for connection to LT 3X240V, 3 phase 4 wire systems. The meter shall be suitable for balanced as well as unbalanced load at all power factors i.e. Zero lag–Unity –Zero lead. The meter shall be capable to record and display kWh, KVARH, KVAH and maximum demand in kW for 3 phase 4 wire AC balanced/unbalanced loads for a power factor range of zero (lagging), unity and zero (leading) as per requirement given in this specification.

- It is not the intent to specify completely herein all the details of the design and construction of meter. The meter shall, however, conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing for continuous commercial operation in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject the meter which is not in accordance therewith. The offered meter shall be complete with all accessories, hardware, software and components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder’s supply irrespective of whether those are specifically brought out in this specification and/or the commercial order or not.

3.2. STANDARDS APPLICABLE

Unless otherwise specified elsewhere in this specification, the performance and testing of the meters shall conform to the following Indian/International Standards and all related Indian/International standards to be read with up To-date and latest amendments/revisions thereof:
When the equipment offered by the bidder conforms to standards other than those specified above, salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule.

### 3.3. CLIMATIC CONDITIONS

The meters to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions. Meters shall be capable of maintaining required accuracy under hot, tropical and dusty climate.

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Standard No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IS 13779/ 1999</td>
<td>Specification of AC Static Watt hour meters, class 1.0 &amp; 2.0</td>
</tr>
<tr>
<td>5.</td>
<td>IS : 9000</td>
<td>Basic Environmental Testing Procedures For Electronic &amp; Electrical items.</td>
</tr>
<tr>
<td>6.</td>
<td>IEC 1036</td>
<td>Static Energy Meters</td>
</tr>
<tr>
<td>7.</td>
<td>IEC 62052-11</td>
<td>Electrically Metering equipment (AC) General Requirement, Test &amp; Test condition</td>
</tr>
<tr>
<td>8.</td>
<td>IEC 62053-21</td>
<td>Static Energy Meters for Active Energy</td>
</tr>
<tr>
<td>9.</td>
<td>IS 12346</td>
<td>Specification for testing equipments for AC energy Meters</td>
</tr>
<tr>
<td>10.</td>
<td>IS 15884</td>
<td>Alternating Current Direct Connected Static Prepayment Meters for Active Energy (Class 1 and 2)</td>
</tr>
<tr>
<td>11.</td>
<td>IS 15959</td>
<td>Data Exchange for Electricity Meter - Reading Tariff and Load Control -Companion Specification</td>
</tr>
</tbody>
</table>

- **a)** Maximum ambient air temperature in shade: 50 Deg Cent
- **b)** Minimum ambient temperature: (-) 5 Deg. C.
- **c)** Maximum relative humidity: 95%
- **d)** Minimum relative humidity: 10%
The temperature range and relative humidity for performance of meters shall be as per relevant standards.

3.4. GENERAL AND CONSTRUCTIONAL REQUIREMENTS

- Meter shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following shall be ensured.
  
  i. Personal safety against electric shock
  
  ii. Personal safety against effects of excessive temperature
  
  iii. Protection against spread of fire
  
  iv. Protection against penetration of solid objects, dust and water
  
- All the material and electronic power components used in the manufacture of the meter shall be of highest quality and reputed make to ensure higher reliability, longer life and sustained accuracy.

- The meter shall be designed and manufactured using SMT (Surface Mount Technology)Components.

- All insulating material used in the construction of meter shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.

- The meter shall have an operation indication device such as a blinking LED. The operation indicator shall be visible from the front window and capable of being monitored conveniently with suitable testing equipment.

- The meter shall conform to the degree of protection IP 51 of IS:12063/IEC:529 for protection against ingress of dust, moisture and vermin’s.

- The meter shall be supplied with a transparent extended terminal block cover (ETBC).

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

Meter base & cover and 2) terminal cover shall conform to the following:-

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>e) Max Height above mean sea level</td>
<td>Up to 1000 meters.</td>
</tr>
<tr>
<td>f) Dust storms likely to occur</td>
<td>Between March to July in a year</td>
</tr>
<tr>
<td>g) Average number of thunder storm days per annum</td>
<td>40</td>
</tr>
<tr>
<td>h) Average number of tropical monsoon months per year</td>
<td>4 months</td>
</tr>
<tr>
<td>i) Annual rain fall</td>
<td>10 cms to 150 cms.</td>
</tr>
<tr>
<td>j) Seismic level(Horizontal accn)</td>
<td>0.30g</td>
</tr>
<tr>
<td>k) Iso-ceramic level (days per year)</td>
<td>50</td>
</tr>
<tr>
<td>l) Maximum wind pressure</td>
<td>150 kg sq mt</td>
</tr>
<tr>
<td>Sr. No</td>
<td>Test</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>UV ageing for 200 Hrs. as per ASTM : G53(CL No. 9.3)</td>
</tr>
<tr>
<td>2</td>
<td>Boiling water test(10 MIN)</td>
</tr>
<tr>
<td>3</td>
<td>Ball pressure test as per IEC--60695-10-2</td>
</tr>
<tr>
<td>4</td>
<td>Flammability Test</td>
</tr>
<tr>
<td></td>
<td>(a) As per UL 94 or</td>
</tr>
<tr>
<td></td>
<td>(b) As per IS 11731(Part-2) 1986</td>
</tr>
<tr>
<td>5</td>
<td>Glow wire test</td>
</tr>
<tr>
<td></td>
<td>IS:11000(part 2/SEC-1) 1984 OR IEC PUB,60695-2-12</td>
</tr>
<tr>
<td>6</td>
<td>Heat deflection Temp.(HDT)</td>
</tr>
<tr>
<td></td>
<td>HDT/Ae, 1.8MPa edge(100mm)</td>
</tr>
</tbody>
</table>

- The terminal block shall be of high grade non-hygrosopic, fire retardant, low tracking fire resistant, reinforced poly-carbonate or equivalent high grade engineering plastic which shall form an extension of the meter case and shall have terminal holes and shall be of sufficient size to accommodate the insulated conductors & meeting the requirement of IS 13779 :1993/CBIP technical report- 304.

- The meter cover shall be fully transparent. However, in case of non transparent cover the window shall be of fully transparent Polycarbonate material for easy reading of all the displayed values/ parameters, name plate details and observation of operation indicator. The fixing of the window with the cover in the later case shall be temper proof, dust proof & moisture proof.

- The meter cover and base shall be suitably shielded with metallic material so as to protect the meter from adverse effect of AC/DC Abnormal external magnetic field. The meter shall meet the requirements of CBIP-304 with its latest amendment for immunity against continuous magnetic induction.

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

- The terminals shall have suitable construction with barriers and cover to provide firm and
safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles). The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The internal diameter of the terminal holes shall be 8.5 mm minimum. The clearance and creep-age distance shall conform to relevant clause of IS 13779:1993/CBIP technical report no.-304. (Latest version)

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

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

3.5. SAMPLING RATE AND DERIVATION OF BASIC MEASURABLE QUANTITIES

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

The meter shall have internal Real Time Clock with the backup of a Lithium maintenance free battery of minimum shelf life of Ten (10) years for operation of the time clock. The Real Time Clock shall be based on Quartz crystal timer so as to make it independent of line frequency variations.

3.6. QUANTITIES TO BE MEASURED, MONITORED AND MEMORIZED

- The meter shall be capable of measuring and storing in the memory and displaying the electrical quantities within specified limits of error for poly phase supplies (i.e. 3- phase, 4 wire system with star point (neutral) solidly grounded or floated) of 3 phase Delta or Star connected load having a floating or a grounded Star point with balanced or unbalanced loads at all power factors. Apparent demand and energy shall be derived from active energy (cosine part recording arrangement) and reactive energy (sine part lagging and leading power factor recording arrangement) through vector summation of Active energy and only lagging Reactive electrical energies traversed for 15 minutes integration period.

- The meter shall also be capable of measuring, monitoring and storing in the memory 8 tariff registers with 8 zones of time of day electrical quantities for pre-specified Periods of the day.
• Zones for TOD -
   i. Peak hours - 17.00 to 22.00 hrs
   ii. Night hours - 22.00 to 06.00 hrs.
   iii. Balance Hours – 06.00 Hrs to 17.00 hrs.

• Active energy: Absolute Cumulative kWh energy.

• Reactive energy: Cumulative KVARH lagging with respect to Active energy.

• Apparent energy: Cumulative Absolute KVAH derived vectorally from lagging Reactive and Active energy.

• Maximum Demand: Highest Active MD KW demand established after last Reset.

• High resolution mode for KWH, KVAH, KVARH (LAG), KVARH

• Recording of active energy (KWh) for billing purpose: The Meter should record and display max. Demand in KW (i.e. Fundamental plus Harmonics power) and Total KWH (i.e. Fundamental plus Harmonics energy).

• The Meter should record Average Max. KVA MD derived from Vectorial summation of Total KW (i.e. Fundamental plus Harmonics power) and Lag KVAR. Similarly it should measure and record cumulative KVAh energy also derived from vectorial summation of Total cumulative KWH (fundamental + harmonic energy) and cumulative KVARH energy (lag only).

• The high resolution display having of seven digit (two digits before decimal points & five digits after decimal points e.g. 21.64286) for KWH, KVAH & KVARH (lag), KVArh (Lead) shall be provided under mode – 3 for the accuracy checking of meter in the field.

• The meter shall have 3 modes for display:
   i. Mode-1 – (Main Mode) This mode shall display billing and tamper parameters.
   ii. Mode-2–This mode shall display observation parameters like TOD zone wise energies, MD, etc.
   iii. Mode-3–This mode shall display high precision readings of energy for accuracy testing at site. Mode wise parameters to be displayed on the meter are as per annexure -A.

• Recording of active energy (KWH) for billing purpose shall indicate on the display for measurement of total energy (fundamental + harmonics) i.e. it will display total energy i.e. (fundamental + harmonics) KWH

• The meter shall keep following quantities recorded and memorized in its Non Volatile memory chip (non battery backed up) with 10 years data retention, so that in event of failure/damage of the meter the last reading of billing quantities would not be lost.

• Cumulative energies from the date of installation -
   i. Cumulative KWH energy to the consumer.
ii. Cumulative KVARH lag (With respect to export KWH) and Cumulative KVARH lead (With respect to KWH) both separately with identification.

iii. Cumulative KVAH energy derived from Victoria summation of Active and Reactive (lag only) energy.

iv. MD for last power on.

3.7. SEALING OF THE METER

Reliable sealing arrangement shall be provided to make the meter tamper proof and to avoid fiddling or tampering by unauthorized persons. In case of any discrepancy, refer to CEA specification. For this, at least two (2) Nos. seals on meter body, two (2) No. seal on meter terminal cover, one (1) No. seal on communication port and one (1) No. seal on MD reset button (if such button is provided) shall be provided. All the seals shall be provided on front side only. **Rear side sealing arrangement shall not be accepted.** The bidder in their offer shall explain the sealing arrangement.

The supplier shall have to provide to two polycarbonate Plastic seals on the meter body of each meter before dispatch of the meter. The plastic seal shall have embossing of the supplier’s logo on one side of seal & APDCL & SR.No. Of seal on other side of seal. 6 Digits SR. No of seal is to be provided on both male & female part of the seal.

3.8. BOUGHT OUT ITEMS

A detailed list of bought out items, which are used in the manufacture of the meter, shall be furnished indicating the name of firms from whom these items are procured. The bidder shall also give the details of quality assurance procedures followed by him in respect of the bought out items.

3.9. OUTPUT DEVICE

The meter shall have a test output accessible from the front and be capable of being monitored with suitable testing equipment. The operation indicator must be visible from the front. Test output device shall be provided in the form of LED output device for kWh and KVarh measurement. The relation between test outputs shall comply with the marking on the name plate or with the indication on display if so provided in addition to details on name plate i.e. pulse per KWh / KVarh.

3.10. COMMUNICATION

Optical port along with RS-232 port will be provided for local 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 (Neighborhood Area Network) i.e. from Meter to Data Concentrator or directly for WAN (Wide Area Network). This Communication Module could operate on Low Power Radio / RF with Mesh/ PLC/GPRS (directly up to HES (High End Server). The communication module option can be decided at the time of actual implementation by the utilities. Different communication technologies shall follow relevant National or International Standard as applicable.

The meter shall be capable of executing instructions from base computer service center and MRI only after due authentication through protected two level pass word, for the following:

i) Change in integration period
ii) Change in automatic re-setting for billing data date & time.

iii) Meter should have provision for eight time zones as per ICS, however presently it should be configured in three zones, i.e. peak, night and others as specified. So that in future it shall be modified as per the requirement up to eight zones and same should be recorded/displayed.

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

3.11. **MARKING OF METER**

The meter terminal marking and mounting arrangement shall be as per Indian Standard. The marking on every meter shall be in accordance with IS 13779/1999.

The meter shall have name plate beneath the meter cover such that the name plate cannot be accessed without opening the meter cover and without breaking the seals of the meter cover and the name plate shall be marked indelibly. The name plate marking shall not fade with lapse of time. The basic marking on the meter nameplate shall be as under:

- Manufacturer's name and trade mark
- Type designation
- Number of phases and wires
- Serial number
- Month and Year of manufacture
- Reference voltage
- Basic Current
- Principal unit(s) of measurement
- Meter constant (imp/kWh)
- ‘BIS’ Mark (Applicable for Indian meter manufacturers only)
- Accuracy Class of meter (class-1)
- "Property of APDCL." Purchase Order No. & date
- Guarantee period-5 ½ years.
- Category: C

Only one meter Sr. no which is provided by the APDCL must be on name plate. Unique procedure of Meter Sr. no. having Alfa-numeric character will be decided by APDCL and will be given at the time of placing Order so that 7 digit numeric part will appear on meter display and Alfa-numeric part will appear in BCS (MRI data) as well as on name plate.

3.12. **ALARM:**

Alarm shall be present for Power ON/OFF, under & over Voltage, Over Current, and...
Malfunctioning of relay. Malfunctioning of diagnostic events shall be generated and communicated to the HES.

3.13. **CONNECTION DIAGRAM, PHASE SEQUENCE & TERMINAL MARKINGS:**
Clear indication of phase sequence shall be marked and connection diagram relevant to meter must be permanently pasted (manufactured from good quality plastic sticker material) on the inside of the extended transparent terminal cover.

3.14. **ELECTRICAL REQUIREMENTS:**

- Supply system:

<table>
<thead>
<tr>
<th>Rated voltage (Vref)</th>
<th>3 x 240 V - Phase to Neutral (3 phase 4 wire system)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current (Ib) (connected through CT)</td>
<td>Basic current 10A (Ib), Maximum current-60 Amps (Imax.)</td>
</tr>
</tbody>
</table>

- Power factor range:

  The meter shall be suitable for full power factor range from zero (lagging) through unity to zero (leading).

- Power supply variation:

  The meter should be suitable for working with following supply system variations:-

<table>
<thead>
<tr>
<th>Specified operating range</th>
<th>0.8 to 1.1 V ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit range of operation</td>
<td>0.7 to 1.2 V ref.</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz +/-5% (As per standard)</td>
</tr>
</tbody>
</table>

In case of any discrepancy, refer CEA specification. For influence quantities like voltage variation, frequency variation, voltage unbalance etc. the limits of variation in percentage error shall be as per IS: 13779.

- Accuracy: Class of accuracy of the meter shall be 1.0.

- Power consumption:

  i. Voltage Circuit: The active and apparent power consumption in each voltage circuit including the power supply of meter at reference voltage, reference temperature and reference frequency shall be as per the provision of IS-13779 (latest amendment).

  ii. Current Circuit: The apparent power taken by each current circuit at basic current, reference frequency and reference temperature shall be as per the provision of IS-13779:99 with latest amendments.

- Starting current: The meter shall start registering the energy at 0.2% of Ib and unity power factor.
• Maximum current: The rated maximum current for the meter shall be 60 Amps (600 % Ib) at which the meter purports to meet the accuracy requirement.

• Impulse voltage:

The meter shall be with stand impulse voltage at 10 KV. This is a special requirement of APDCL. To verify this requirement, APDCL reserves the right to select the sample meter from any offered lot and to get the same tested at any National Accredited laboratory prescribed by APDCL. The test is to be carried out in the presence of APDCL representative and also the test report shall be approved from the CE (P &P), APDCL. The test charges for this shall be borne by the party.

In case, failure of sample meter in this test not only the entire offered lot, but the lot previously supplied shall also be rejected and supplier has to replace the same at his cost. In case of the meter already utilized by APDCL prior to the test and failure of sample therein, the APDCL reserve the rate to deduct suitable penalty in lieu of the replacement of meter.

• Repeatability Test:

The difference between maximum and minimum error shall not be more than 0.5. The test shall be conducted on the three sample selected from the eight meters selected for accuracy test as per clause no. 12.7 of IS 13779.

3.15. SOFTWARE:

Adequate number of licensed copies of the following software shall be made available and shall be installed on CMRI and BCS by the supplier. The exact quantity of each type of software to be so supplied shall be intimated to the supplier prior to/at the time of ordering. Further, the software shall be supplied free of cost by the meter manufacturer.

The above software shall be suitable for the operating system of the associated APDCL’s Computers:

• Software for reading the meter contents in the MRI
• Base computer software for accepting data from MRI and down loading instructions from Base Computer to MRI. Windows based Base Computer Software (BCS) for receiving data from CMRI and downloading instructions from base computer software to CMRI. This BCS shall have, amongst other requirements and features and facilities described later in this specification, the facility to convert meter reading data into user definable ASCII file format so that it may be possible for the user to integrate the same with the user’s billing program and process the selected data in desired manner.
• The meter should be capable to communicate directly to Lap Top computer. Any other special applications software and additional software not mentioned above but necessary for functioning of the system.

3.16. SALIENT FEATURES:

The meters shall have the following additional salient features:-

• The meter shall have provision to read in the absence of power through an internal rechargeable battery.
• The meter shall work accurately irrespective of phase sequence of the mains supply.

• The meter shall remain powered up and functional in presence of any two wires.

• The meter shall continue to record accurately as per prevailing electrical conditions even if the neutral of supply gets disconnected.

• The meter shall record correct energy in case of current reversal of one or more phase.

• Drawing of current through local earth. The meter shall register accurate energy even if load is drawn down partially or fully through local earth.

• The potential link shall not be provided outside on meter terminal block. Instead internal link of sliding/spring type arrangement having adequate capacity shall be provided.

• The meter should be programmed for both KVA MD and KW MD. However other programmable parameters should be made available as per ICS.

3.17. **DISPLAY OF MEASURED VALUES:**

• The measured value(s) shall be displayed on seven segment, seven digit Liquid crystal Display LED / (LCD) display with backlit unit, having minimum character height of 10 mm. Good quality display shall be used to enable correct reading even from distance.

• The data shall be stored in non-volatile memory. The non-volatile memory shall retain data for a period of not less than 10 years under un-powered condition.

• It shall be possible to easily identify the displayed parameters through symbols/legend on the meter display itself.

• In case of multiple values presented by a single display, it shall be possible to identify each displayed value/parameter through separate symbol/legend to be made available on the display itself.

3.18. **METER SERIAL NUMBER:**

In addition to providing serial number of the meter preferably on the display or on the meter name plate, the meter serial number shall also be programmed into meter memory for identification through CMRI/meter reading print out.

3.19. **MAXIMUM DEMAND (MD) REGISTRATION:**

The meter shall monitor and calculate the average demand in KW/KVA established during pre-specified integration period set and record/display the maximum registered value and the same shall be stored along with date and time when it occurred in the meter memory. The integration period shall of be 30 minutes and it should be programmable with due authentication. MD should available also for TOD.

3.20. **MAXIMUM DEMAND RESET:**

The meter shall have the following maximum demand resetting arrangements:

• Automatic resetting at the end of pre-specified date of every calendar month (e.g. 00.00 hours on First day of every month).
3.21. **LOAD SURVEY CAPABILITY & BILLING POINT REQUIREMENTS:**
- Meter shall record load survey of 36 days for average voltage, average current, avg pf, for all three phase and KWH reading and KVARH lag reading, KVAH reading, average demand in KW with integration period of 15 minutes. It shall be possible to select either demand or energy view at the BCS end.
- The load survey data shall be available in the form of bar charts as well as in spreadsheets. The BCS shall have the facility to give complete load survey data both in numeric and graphic form.
- The load survey data must be available in FIFO manner (First in First Out). The load survey data is only for power on days.
- For billing point of view last twelve reset back up is required for various energy & demand parameters with TOU and average power factor.
- It shall be possible to retrieve these data via communication media on computer and get complete details of the load/demand pattern in terms of KW/KWh both in numeric data form and in graphic form for all the 24 hours a day divided as per the pre-set integration period of 15 minutes in each individual case. Necessary software for this purpose must be provided by the supplier. The total time in minutes to be taken by meter for retrieval of all above data shall have to be clearly indicated in offer.

3.22. **SELF DIAGNOSTIC FEATURE:**
The meter shall be capable of performing complete self-diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location all the time. The meter shall provide information for unsatisfactory/nonfunctioning/malfunctioning of the following:-
- Time and date
- All display segments as per the requirement
- Real Time Clock (RTC)
- Non Volatile Memory (NVM)
If possible, the details of malfunctioning shall be recorded in the meter memory and alarm for this to be sent to HES.

3.23. **TAMPER AND FRAUD PROTECTION:**
- The meter shall have features to detect the occurrence and restoration of, at least, the following common ways of tamper and fraud: The Voltage and current related tampers shall
be as per ICS. **(Tamper wise logic and threshold values are as per Annexure–B)**. The threshold values for voltage, current and P.F. etc. for the purpose of logging occurrence and restoration of various types of tamper will be mutually decided by the purchaser and supplier. The supplier shall, however, propose these values in their offer.

The bidder shall furnish with detailed explanation as to how their meter is able to detect /protect recording the above tamper & fraud features with sketches & phasor diagrams. Additional features any in their meter may also be highlighted.

- Minimum of total one hundred (100) events (occurrence and restoration) of all types of tamper with date and time shall be available in the meter memory on first in, first out basis. For tamper events refer IS 15959. Compartments, if any may be clearly indicated in the bid. Snap shots should be available (numerical values) of voltage, current, power factor and energy (kWh) readings as well as the date and time of logging of the occurrence and restoration of tamper events.

- All this information shall be available in simple and easily understandable format. These 100 events will be shown during the testing of meter offered for proto inspection.

The tamper logic shall be capable of discriminating the system abnormalities from source side and load side and it shall not log/record tamper due to source side abnormalities. Meter shall not record wrong kWh if only unbalanced capacitive load is connected at the consumer end. The tamper events shall be recorded in sequence manner in FIFO/Roll Over basis.

The total Nos of Tamper counts to be displayed and memorized shall increase as per occurrence (not restoration) of tamper events. The total number of tamper counts shall also be provided on the meter display as well as at the BCS end. Cover Open Event, Magnetic Interference shall be communicated back to Base Computer Center as and when they occur. These tamper events shall be sent as an alarm to the base computer center which shall store the same in its database.

**3.24. TAMPER PERSISTENCE TIME:**
The tamper persistence time for logging/registration of an occurrence and restoration of tamper shall be as per Annexure – B

**3.25. ACCURACY REQUIREMENT:**
The accuracy of parameters measured by meters shall be tested in accordance with the relevant standards described in clause 2.0 of this specification.
The test shall be carried out for balanced load and unbalanced current load i.e. individual phase.

**3.26. ELECTRICAL REQUIREMENT:**
The electrical requirement of meters shall be as specified in the relevant standards described in clause 2.0 of this specification.

**3.27. ELECTROMAGNETIC COMPATIBILITY AND INTERFERENCE REQUIREMENT:**
The meter shall meet EMI/EMC requirements as specified in the relevant standards described in Clause 2.0 of this specification.
3.28. **MECHANICAL REQUIREMENT:**
The meter shall meet the mechanical requirements as specified in the relevant standards described in clause 2.0 of this specification.

3.29. **CLIMATIC INFLUENCE REQUIREMENT:**
The meter shall meet Dry Heat/Cold/Damp heat cycle test requirement as per the relevant standards described in clause 2.0 of this specification.

3.30. **MINIMUM TESTING FACILITIES:**
The Bidder shall have the necessary minimum testing facilities for carrying out the following tests:

- AC voltage test
- Insulation resistance test
- Test of limits of errors
- Test of meter constant
- Test of starting condition
- Test of no load condition
- Repeatability of error test
- Test of power consumption
- Tamper conditions - as per this specification

The manufacturer shall have duly calibrated ERS meter of Class 0.5 accuracy or better. Manufacturer also shall possess automatic computerized meter test bench system for carrying out the relevant routine/acceptance tests as well as facility to generate test reports for each and every meter tested.

3.31. **METER READING INSTRUMENT (MRI):**

- The CMRI shall be supplied in the ratio of one for each 1000 nos. of meters free of cost along with battery charger.

- The MRI shall have facility to store minimum 200 nos. of meter’s data. The supplier shall indicate nos of meters’ data which CMRI could retrieve.

- Further, there should be a facility in CMRI to provide the transfer of meter data to computer through USB port.

- The MRI shall be capable for down loading readings of other makes of meters. The bidder shall give an undertaking to this effect.

- The MRI shall have a feature to read multiple meters within the range without pre-programming the meter serial numbers in advance.
• It shall be responsibility of the meter manufacturer to provide the required software and all the facilities required by the purchaser, to use the MRI for reading and retrieving the data from the meter and to download the data to BCS free of cost till the expiry of guarantee period. The downloaded data shall be converted to the ASCII or database file format for easy integration with the existing billing software of APDCL.

Readings to be downloaded with MRI:

• The meter shall possess a suitable fast reliable communication port for manual / automatic transfer of data from Meter to CMRI. Arrangement in the meter should be such that, in case of failure of power supply, it should be possible to download the data.

• The MRI shall possess easily replaceable battery and shall be capable of storing data for minimum 200 nos. Meters at one time.

• The CMRI shall posses a specific serial number which cannot be changed. The downloaded data along with date and time stamp of such reading shall remain on CMRI with suitable encryption and it should not be possible to pre-program or manipulate the recorded data on the MRI before downloading the same with the serial number of MRI on computer. The MRI shall also download the serial number, make of meter, year and month of manufacture of meter. The Supplier shall supply Software (compatible with Windows xp and Windows 7 system and/ or higher) and training, free of cost for the use of software at multiple data collection and billing premises of the utility.

• After successful downloading of meter data to MRI, an indication on MRI and meter for confirmation of successful data transfer shall be provided. During this period the energy recording should not be affected.

• Necessary upgrades shall be possible in MRI software and shall be supplied free of cost for downloading simultaneously the existing parameters and any parameters added in future specifications of meters. A copy of operation manual shall be supplied along with each MRI. The Supplier shall provide meter reading protocols free of cost which shall not be complicated and easily understandable by APDCL officials to introduce compatibility between meters and MRIs of different makes.

It should be possible to download the following data from the meter memory:

• Serial Number of meter

• Cumulative total active energy (KWh)

• Cumulative total Active energy (KWh) for the last 12 calendar months

• Maximum Demand KW for last 6 calendar months with 15 minutes integration period

• Maximum Demand KW since last reset

• Instantaneous voltage
• Instantaneous phase current
• Instantaneous neutral current
• Instantaneous load in Watt

• The Tamper events like Magnet, Earth load, one line drawl (neutral missing), neutral Disturbance & reverse current should be logged with date and time (Occurrence & Restoration). 100 nos of each event should be recorded. The tamper of Cover Open Event, Magnetic Interference shall be communicated back to HES as and when they occur. These tamper events shall be sent as an alarm to the HES which shall store the same in its database.

• 36 (Power ON) days data to be recorded with 15 minutes integration period with date & time stamping for Active Energy Reading, Average Voltage, Average Current, average PF, Average KW.

3.32. **ALARM**

Alarm for power on/off, Under Voltage, Over Voltage, Over Current, Mal functioning of relay, malfunctioning of diagnostic events shall be generated and communicated to the HES immediately. It should be definable at HES.

3.33. **LOAD CONTROL:**

**Relay for connection/disconnection:** Relay for connect / disconnect shall comply all relevant requirements of IS 15884 or any other equivalent International Standard.

Phase and Neutral Disconnection on the following conditions:

• Over current

• Load Control Limit

• Pre-programmed Tamper conditions

Load Control limits shall be programmable.

The disconnection mechanism is as follows:

i. The switch re-connection shall be decided by meter locally. It will try to re-connect the load up to 3 times, with 5 minutes interval.

ii. If the consumption is still more than the programmed limits, it will lock out and wait for 30 minutes (lock out period).

iii. If the consumption is still above the limit, the procedure as defined above in i) and ii) shall be repeated.

The number of re-connection attempts, time interval between re-connection and lock-out period shall be programmable by the utility.
Reconnection mechanism:

Reconnection shall normally be done from base computer. In case of failure of communication/base computer, reconnection shall be possible through HHU locally and the same shall be password protected.

Relay for connect/disconnect shall comply all relevant requirements of IS 15884.

Connect/Disconnect Indication:

Connect/Disconnect facility to be provided on both the wires i.e. Phase and neutral simultaneously.

Status of Relay – i.e. Connected / Disconnected should be available on display as well as through communication. Connection and Disconnection should also be logged as events.

3.34. PROGRAMMABILITY:

It should be possible to program the parameters limits / values from remote through sufficiently adequate security mechanism. Once programmed it will be possible for the programmed parameters to come into effect from a certain date & time. Meteorology under such condition must remain intact and shall not be upgradable from remote. It shall be possible to upgrade firmware if required with adequate password and security. This programmability shall be as per IS 15959.

3.35. READING FREQUENCY:

The reading frequency proposed is once in 24 hours automatically. However it should be programmable up to 15 min. Alarms are to be communicated on their occurrences. On demand meter reading facility shall also be available.

3.36. RTC & TIME SYNCHRONIZATION:

Meter shall have RTC with 30 years calendar programmed in the memory and provision for time synchronization.

*In case of any discrepancy, please refer to IS13779 and CEA specifications.

3.37. LAST GASP OUTAGE ALERT:

The end point (smart meter) shall have functionality that when power goes out for more than 60 second the end point shall send a power outage message to HES which shall be populated on outage map of HES. This functionality shall help utility to identify the power outages on real time basis.

3.38. TESTS:

- Prototype sample:

The supplier shall also have to manufacture 3 nos. of sample meters complying to all above technical specification, type rating functional requirements, tamper features, display design etc. and shall have to offer for inspection within one month from the date of placement of LOI.
And before commencement of bulk supply. The bulk manufacturing must be commenced only after confirmation from APDCL authority. The three no. of samples prepared as above shall have to be preserved till the completion of the supply of last lot.

The supplier shall also have to offer one no. of MRI for functional testing verifications / testing of related software.

During the proto type sample testing all the display parameter and other parameters shall be checked and same shall be tested /observed for acceptance test & other tests as per cl.no 32.3 of the specification.

- **Routine Tests:**

  All routine tests as stipulated as per IS 14697-1999 (reaffirmed 2004)/IS 13779 / IS 15884 / with latest amendments, shall be carried out and routine test certificates/reports shall be submitted along with inspection call letter in the form of composite disk (CD) and on the CD, A/T No. serial no. of meters to be offered etc. shall be provided with sticker pasted on the CD, to the purchaser for approval and also placed inside individual meter packing.

- **Acceptance Test:**

  All acceptance tests as stipulated as per IS 14697-1999 (reaffirmed 2004)/IS 13779 / IS 15884 / with latest amendments, shall be carried out by the supplier in the presence of the purchaser's representative. Also the following additional tests are carried out on mutually agreed quantity of meters from each lot offered for inspection.

  i. Magnetic induction of external origin (AC & DC)
  
  ii. Tamper & fraud protection
  

  The meter should pass acceptance tests as per IS-13779/99, CBIP 304 latest version and IEC61036/2000 during inspection. Please note that the total energy i.e. fundamental + harmonics shall be measured as per cl.no. 5.6.2.1 of IEC 61036/2000 along with other tests. If the facility for any of the tests is not available at supplier's works, the testing shall be arranged at any of the NABL/ any other Govt. approved lab only and for such tests all the expenditures i.e. test charges etc. shall have to be borne by the supplier.

  In case order is placed on part or full quantity, APDCL reserves right to select sample as per relevant IS/IEC from the first lot (minimum 20% of the ordered quantity) offered by party and the samples will be tested at any Govt. approved laboratory which is approved by APDCL for type tests and on successful passing the test the lot will be accepted or otherwise the whole lot will be rejected and in that case testing charges shall have to be borne by the party concerned.

- **Type Tests:**

  The meter offered should have successfully passed all type tests described in the IS 13779/IS
14697/IS 15959 or BIS approved documents. The bidder should submit Type Test Reports for all tests having been conducted on the sample meter, not prior to 3 (Three) years before the issue of tender, from reputed third party Govt. approved laboratory. All the type tests must have been conducted within One year’s tenure and on the sample as specified under Cl. No: 12.2.2.1 of IS-13779-1999. Offers without the Type Test reports shall be rejected. The type test report submitted shall be of the same type and design of the meter offered. Please note that the bidder in case of supplier having own NABL accredited lab., the type test certificate furnished with tender from such lab shall not be accepted.

3.39. **INSPECTION:**

The purchaser may carry out the inspection at any stage of manufacture. The manufacturer shall grant access to the purchase’s representative at a reasonable time when he work is in progress. Inspection and acceptance of any equipment under this Specification by the purchaser shall not relieve the supplier of his obligation of furnishing the meters in accordance with the specification and shall not prevent subsequent rejection if the meters are found to be defective.

All acceptance tests and inspection shall be made at the place of manufacturer works unless otherwise especially agreed upon by the bidder and purchaser at the time of purchase. The bidder shall offer the inspector representing the purchaser all responsible facilities without charge, to satisfy him that the equipment is being furnished in accordance with this specification.

The supplier shall keep the purchaser informed in advance, about the manufacturing program so that arrangement can be made for inspection.

In case of non availability of meter during the visit of inspection of the lot offered, the visit shall be considered as unfruitful visit and all charges of this visit shall be deducted from the bill of the supplier.

The purchaser reserves the right to carry out type tests of any meter selected from the lot/meter received at store of APDCL.

3.40. **QUALITY ASSURANCE PLAN:**

The bidder shall invariably furnish the following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of material offered.

- The structure of organization.
- The duties and responsibilities assigned to staff ensuring quality of work.
- The system of purchasing, taking delivery and verification of materials. The system of ensuring quality of workmanship.
- The quality assurance arrangement shall confirm to relevant requirements of ISO9001 or 9002 as applicable.
- Statement giving list of important raw materials names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested.
• List of test normally carried out on raw materials in presence of Bidders representative, copies of test certificates. Information and copies of test certificates as in (i) above in receipt of bought out accessories.

• List of manufacturing facilities available.

• Level of automation achieved and lists of area where manual processing exists.

• List of area in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

• List of testing equipment available with the bidder for final testing equipments specified and test plant limitation. If any vis-a-vis the type, special acceptance and routine tests specified in the relevant standards.

These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

• The offer will be accepted only from the original manufacturers / supplier/ authorized representative. The manufacturer must be having at least five years experience of manufacturing and operation of similar type of Trivector meters.

• BIS MARK- The meter manufacturer having valid BIS license for 10/60A meters shall only be considered. Meters offered must have ISI marking.

3.41. GUARANTEE:

The meter shall be guaranteed for the period of five years from the date of commissioning or five and half year from the date of delivery whichever is earlier. The meters found defective within above guarantee period shall be replaced / repaired by the supplier free of cost.

If defective meters are not replaced/ repaired within one month from the date of the receipt of the intimation, APDCL shall recover an equivalent amount plus 15% supervision charges from any of the bills.

3.42. PACKING:

The meters shall be suitably packed in order to avoid damage or disturbance during transit or handling. Each meter may be suitably packed in the first instance to prevent ingress of moisture and dust and then placed in a cushioned carton of a suitable material to prevent damage due to shocks during transit.

3.43. SERVICES:

The bidder shall provide following services:

• Services free of cost during guarantee period.

• To train APDCL staff for installation and handling of these meters.

• To assist APDCL lab staff to install calibration, checking etc.

• To assist the APDCL staff for taking MRI reading, theft wrapped meter analysis etc. at free of cost during guarantee period.
• The Tender Item i.e. 3 phase meter 10-60A whole current meter for DLMS Protocol, meter should comply as per BIS ICS.doc ETD 13(6211) April, 2010 for category ‘C’. The bidder will have to submit the certificate of CPRI conforming above BIS along with the bid. If the certificate/ relevant documents are not submitted, the bid will not be considered for further evaluation.

• To assist the APDCL staff for installing, using and operation of software
### APPENDIX-A

**GUARANTEED TECHNICAL PARTICULAR-(GTP) FOR 3-PHASE WHOLE CURRENT METER WITH DLMS**

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Particulars</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bidders must have produced/ executed order of tendered item to any SEBS/power utility company in last 3 years. The bidder should submit the order copies along with their Bid as a evidence.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>2</td>
<td>Bidders must have valid ISI license</td>
<td>Yes/No</td>
</tr>
<tr>
<td>3</td>
<td>Bidder preferably possesses ISO 9001 certification.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>4</td>
<td>Bidder shall have manufacturer of static meters. Offer from traders / agents are not acceptable</td>
<td>Yes /No</td>
</tr>
<tr>
<td>5</td>
<td>Bidder shall have ISI license for similar design product and/or type test certificate for all the type tests as per IS 13779 or IEC-62053 from International or from Indian Govt. approved lab</td>
<td>Yes/No</td>
</tr>
<tr>
<td>6</td>
<td>Bidder shall have to submit type test report for AC/DC magnetic field as per CBIP 304 &amp; its latest amendments from independent Govt. Approved lab. as well as DC magnetic influence test for 0.5 tesla and total energy test. The tender without valid type test report should be out rightly rejected.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>7</td>
<td>Bidders shall have dust free &amp; air conditioned environment for assembly as well as testing.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>8</td>
<td>Bidders shall have automatic computerized test bench for lot testing of meters and oven for ageing test. The document evidence is to be attached along with the bid.</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

**PLACE :**

**SEAL & SIGNATURE OF TENDERER**

**NAME:**

**DESIGNATION:**

_Bidders are requested to read the following as the part of tender technical specifications document._

- At the end of the tender technical specification, following paragraph should be added and read as under:

  The material supplied shall be conforming to Indian Standard Specification (except DLMS compliance, if any) and also with ISI marking and even after inspection of the lot, if the material received at site is found without ISI marking , the lot shall be rejected and no further correspondence shall be entertained in this regard.
4. Technical specification for Three phase LT CT operated static meter 100/5 amp. And 200/5 amp. With DLMS

4.1. **SCOPE:**

This specification covers the design, manufacture, assembly, inspection, testing at manufacturers works before dispatch, supply and delivery at site/FOR destination anywhere in "Assam State" static whole current electronic meter of Class 0.5s accuracy of LTCT operated static meter 100/5A and 200/5A for tariff purpose along with other associated component as per requirement given in this specification which is based on CEA Regulations on Installation and Operation of meters and its amendments, CEA(Installation and Operation of Meters for Renewable Energy Sources)Regulations, 2013* and IS 14697//IS15959 with latest amendments for respective requirements except for those parameters which have been specifically mentioned to be otherwise in this specification.

4.2. **STANDARD APPLICABLE:**

While drawing these specifications, reference has been made to following Indian and International Standard Specifications. In case certain details are not covered in these specifications the relevant Indian/ International standard shall be applicable.

<table>
<thead>
<tr>
<th>IS 14697 (1999) with latest amendment</th>
<th>AC static Watt-hour Meter Class 0.5s &amp; 0.2s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 62053-11</td>
<td>Electrically metering equipment (AC) – General Requirement, Test &amp; Test condition.</td>
</tr>
<tr>
<td>IEC 62053-21</td>
<td>Static Energy Meters for Active Energy.</td>
</tr>
<tr>
<td>PFC Spec.</td>
<td>For high precision 3 vector energy meter.</td>
</tr>
<tr>
<td>IS 9000</td>
<td>Environmental testing.</td>
</tr>
<tr>
<td>CBIP report No. 304</td>
<td>Specification for A.C. electrical energy meters.</td>
</tr>
<tr>
<td>IS 2705 (Part-I&amp;II)</td>
<td>Specification for current transformers</td>
</tr>
<tr>
<td>IS15959</td>
<td>Data Exchange for Electricity Meter - Reading Tariff and Load Control - Companion Specification.</td>
</tr>
</tbody>
</table>

The meters must be compliant to ICS DLMS ETD 13(6211) for category C.

4.3. **SUPPLY SYSTEM:**

<table>
<thead>
<tr>
<th></th>
<th>3 – Phase, 4 wire system</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td></td>
</tr>
<tr>
<td>Std. voltage</td>
<td>3x240V (Phase-Neutral)-415V (P-P)(CT operated Meters)</td>
</tr>
<tr>
<td>Std. basic current</td>
<td>5 Amp. (Through current transformer)</td>
</tr>
<tr>
<td>Max. rated current ( % age of IB )</td>
<td>120% of Ib.(CT operated meters 100/5,200/5)</td>
</tr>
<tr>
<td>Ref. frequency</td>
<td>50 Hz</td>
</tr>
</tbody>
</table>

4.4. **SYSTEM VARIATION:**

The meters should be suitable for working satisfactorily and accurately with following variations in the supply system parameters and ambient temperature and humidity.

<table>
<thead>
<tr>
<th>Electrical Quantities:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>20% to-40% of V ref. 415V(P-P)</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50Hz+5% to -5% of Freq.</td>
</tr>
<tr>
<td>Range of temp. Variation</td>
<td>0°C to 45°C Ambient.</td>
</tr>
<tr>
<td>Average working temp</td>
<td>27°C + 10°C - 10°C</td>
</tr>
<tr>
<td>Reference temp</td>
<td>27°C</td>
</tr>
</tbody>
</table>
4.5. PAST EXPERIENCE:

The manufacturer should have at least five years of experience of manufacturing and operation of the static type of meters offered. (With or without DLMS).

4.6. GENERAL AND CONSTRUCTIONAL REQUIREMENT AND MARKING OF METERS:

The meter shall comply all general and constructional requirement and marking of meters as per IS 14697 (1999) with latest revisions thereof and as per CBIP report No. 304. wherever applicable.

- Meter shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following shall be ensured.
  
  i. Personal safety against electric shock
  ii. Personal safety against effects of excessive temperature
  iii. Protection against spread of fire
  iv. Protection against penetration of solid objects, dust and water

- All the material and electronic power components used in the manufacture of the meter shall be of highest quality and reputed make to ensure higher reliability, longer life and sustained accuracy.

- The meter shall be designed and manufactured using SMT (Surface Mount Technology) components.

- All insulating material used in the construction of meter shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.

- The meter shall have an operation indication device such as a blinking LED. The operation indicator shall be visible from the front window and capable of being monitored conveniently with suitable testing equipment.

- The meter shall conform to the degree of protection IP 51 of IS: 12063/IEC: 529 for protection against ingress of dust, moisture and vermin’s.

- The meter shall be supplied with a transparent extended terminal block cover (ETBC).

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

Meter base & cover and terminal cover shall conform to the following:

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Test</th>
<th>10% Glass filled non transparent material for meter base &amp; terminal block</th>
<th>Transparent material for meter cover &amp; terminal cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UV ageing for 200 Hrs. as per ASTM : G53(CL No. 9.3)</td>
<td>4 Hours UV at 60° C, 4 Hours condensation at 50° C</td>
<td>4 Hours UV at 60° C, 4 Hours condensation at 50° C</td>
</tr>
<tr>
<td>2</td>
<td>Boiling water test(10 MIN)</td>
<td>No softening &amp; whitening &amp; No change in colour, shape, size &amp; dimensions</td>
<td>No softening &amp; whitening &amp; No change in colour, shape, size &amp; dimensions</td>
</tr>
</tbody>
</table>
3. Ball pressure test as per IEC-60695-10-2
   - Conditions: 125°C +/- 2°C
   - Joint Type: VO FVO

4. Flammability Test
   - (a) As per UL 94 or IS 11731 (Part-2)
   - Conditions: VO FVO

5. Glow wire test IS:11000 (part 2/SEC-1) 1984 OR IEC PUB,60695-2-12
   - Conditions: 960°C, 850°C

6. Heat deflection Temp. (HDT)
   - Conditions: 132°C, 125°C

- The terminal block shall be of high grade non-hygroscopic, fire retardant, low tracking, fire resistant, reinforced poly-carbonate or equivalent high grade engineering plastic which shall form an extension of the meter case and shall have terminal holes and shall be of sufficient size to accommodate the insulated conductors & meeting the requirement of IS 14697(1999)/CBIP technical report- 304.

- The meter cover shall be fully transparent. However, in case of non transparent cover the window shall be of fully transparent Polycarbonate material for easy reading of all the displayed values/parameters, name plate details and observation of operation indicator. The fixing of the window with the cover in the later case shall be temper proof, dust proof & moisture proof.

- The meter cover and base shall be suitably shielded with metallic material so as to protect the meter from adverse effect of AC/DC Abnormal external magnetic field. The meter shall meet the requirements of CBIP-304 with its latest amendment for immunity against continuous magnetic induction.

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

- The terminals shall have suitable construction with barriers and cover to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles). The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The internal diameter of the terminal holes shall be 5.5 mm minimum. The clearance and creep-age distance shall conform to relevant clause of IS 14697:1999/CBIP technical report no.-304. (Latest version).

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

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

Reliable sealing arrangement shall be provided to make the meter tamper proof and to avoid fiddling or tampering by unauthorized persons. For this, at least two (2) Nos. seals on meter body, two (2) No. seal on meter terminal cover, one (1) No. seal on communication port and one (1) No. seal on MD reset button (if such button is provided) shall be provided. All the seals shall be provided on front side only.

Rear side sealing arrangement shall not be accepted. The bidder in their offer shall explain the sealing arrangement.

The supplier shall have to provide two polycarbonate Plastic seals having the serial no. in sequence on the meter body of each meter before dispatch of the meter. The plastic seal shall have embossing of the supplier’s logo on one side of seal & APDCL & SR.NO. Of seal on other side of seal. 6 Digits Sr. No of seal is to be provided on both male & female part of the seal.

In addition to 2 Nos. of polycarbonate seals, further 2 Nos. of tamper proof void seals are to be provided on the Meter body in such a way that both the side covers shall be sealed by the tamper proof void seals. The Serial Nos. of seals should be in sequence. The tamper proof void seals to be provided on Meters shall be as per the following specification:

- **Size of the seal:** 3 x 1 inches.

- The seal should be digitally printed on white VOID film having UV destructive inks printed with thermal resin ribbon technology.

- The seal should be water proof and should withstand all the weather conditions. The seal should have adhesive of sufficient strength to avoid peeling off under extreme temperature and environmental conditions.

- The seal should be sticker type seal and applied on both the side of the Meter which connects the body and the box.

- If someone lifts the seal, “VOID” impression should be transferred on the meter and if this is applied back, “VOID” impression should be readable from the surface of the seal.

- Barcodes of serial numbers should be printed on the seals and the barcodes should be readable with a barcode scanner.

- The seals should have continuous variable serial numbers along with security codes of last three digits of serial numbers printed in black and the same serial numbers along with code of serial numbers shall also be printed in a vertical semi circular shape which should be visible only under Ultra-violet (UV) light.

- Two security cuts should be given on the seal on both the sides, and if someone tries to lift the seal it should tear off from the security cuts. The security cuts should be made with a computer controlled plotter which should put the security cuts on the same position on each seal.

- The name of the supplier and supplier logo along with the security warning or any other information in any language as given by the company should be printed on the seal.

- There should be a provision of incorporating officers’ signature on the seal as given by the company.

- If someone tries to remove the seal by applying heat, the printing should get disturbed and the shape of the seal should change if more heat is applied. The seals to be used for sealing of Meters
are to be fixed after inspection is over.

4.8. **TYPE OF INTERNAL CLOCK AND LIFE OF BATTERY FOR THE METER:**

The meter should have internal real time clock with the backup of A Lithium maintenance free battery of minimum life of Six years for operation of the time clock. Real time clock should be based on Quartz crystal timer so as to make it independent of line frequency variation.

4.9. **ELECTRICAL REQUIREMENT:**

- Power consumption in Voltage Circuit: The power consumption in each voltage circuit of meters at reference voltage, reference temperature and ref. frequency should be as per IS 14697.

- Power consumption in Current Circuit: Power consumption in each current circuit for CT operated meter at basic current, reference frequency and ref. Temperature should be as per IS 14697

- Short time over current: The meter should be able to carry a short time over current of 20 I max. For 0.5 second (One half cycles) for meters connected through current transformer.

- Initial start of meter: The meter should be fully functional within five second after rated voltage is applied to the meter terminal.

- Running with no load: When the voltage is applied with no current flowing in the current circuit, the test output of the meter shall not produce more than one output/ count.

- Starting: The meter shall start and continue to register at 0.1% of basic current at unity P.F.

- Meter constant: Relation between the test output and indication in the display shall comply with the marking on the name plate.

- Repeatability error: As per IS 14697

- AC voltage: The meter should pass AC voltage test of 2 KV and 4 KV for metal case and insulating material case respectively

- Limit of error and other accuracy: The meter should comply the requirement of limit of errors and other accuracy requirement as per IS 14697 (1999) and as per CBIP report No. 304.

- Impulse Voltage Test - The meter should withstand 10kv impulse voltage.

4.10. **LAST GASP OUTAGE ALERT**

The end point (smart meter) shall have functionality that when power goes out for more than 60 second the end point shall send a power outage message to HES which shall be populated on outage map of HES. This functionality shall help utility to identify the power outages on real time basis.

4.11. **OUT PUT DEVICE:**

The meter shall have a test output accessible from the front and be capable of being monitored with suitable testing equipment. The operation indicator must be visible from the front. Test output device shall be homogenous and be provided in the form of LED output device for kWh and kVARh measurement.

The relation between test outputs shall comply with the marking on the name plate or with the indication on display if so provided in addition to details on name plate i.e. pulse per kWh / KVARh.

4.12. **COMMUNICATION PORT:**
Optical port along with RS-232 port will be provided for local communication. The port for local communication and baud rate shall be as per IS 15959 (once the single phase specification is defined). 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 (Neighborhood Area Network) i.e. from Meter to Data Concentrator or directly for WAN (Wide Area Network). This Communication Module could operate on Low Power Radio / RF with Mesh/GPRS (directly up to HES). The communication module option can be decided at the time of actual implementation by the utilities. Different communication technologies shall follow relevant National or International Standard as applicable.

The meter shall have galvanically isolated communication port so that it can be easily connected to a hand-held meter reading instrument (MRI) for Lap Top PC for Data transfer or subsequently hooked to remote metering instrument such as modem etc. The meter shall be capable of executing instructions from base computer service center only after due authentication through protected two level password, for the following:

i. Change in integration period (As per ICS DLMS).
ii. Change in automatic re-setting for billing data date & time (As per ICS DLMS).
iii. TOD shall be programmed initially and time zones can be changed on later stage as per ICS DLMS.

The meter shall thereafter communicate above information while off-loading the data to computer through hand-held meter reading instrument (MRI) with either relevant billing quantities or relevant energy audit/load survey data.

4.13. SOFTWARES:

The following software shall be supplied by the meter manufacturer without extra cost. This software should be suitable for the operating system of the associated Board’s computers.

i. Software for reading and programming the meter contents in the MRI.

ii. Base computer software should be window based software for accepting data from MRI and down loading instructions from Base computer to MRI.

iii. Necessary window based software for loading application programs via communication port.

iv. The meters should be capable to communicate directly to Laptop computer.

v. The meter shall have a facility for providing external upgradable Remote metering system through available.

vi. Any other special application software of the manufacturer and additional software not mentioned as above necessary for functioning of the system.

vii. The meters should have software lock for programming/ change of all parameters & the same should be protected with two level passwords.

- **Programmability:** It should be possible to program the parameters limits / values from remote through sufficiently adequate security mechanism. Once programmed it will be possible for the programmed parameters to come into effect from a certain date & time. Meteorology under such condition must remain intact and shall not be upgradable from remote.

- **Communication Protocol:** The present IS 15959 is not applicable for single phase meters which would be developed by BIS committee. Meanwhile, Meter manufacturers will share their protocol and memory map with the Utility.
• **RTC & time synchronization:** Meter shall have RTC with 20 years calendar programmed in the memory and provision for time synchronization.

4.14. **DISPLAY :**

The measured value(s) shall be displayed on seven segment, seven digit Liquid crystal Display LED / (LCD) display with backlit unit, having minimum character height of 10 mm. Good quality display shall be used to enable correct reading even from distance. The information is to be shown on electronic display in a cyclic mode LED/LCD type.

In case of power supply failure, also display should be made available to facilitate meter reading by providing back up supply to the display circuit of the meter. For this internal battery or power pack (inverter) may be provided. However in case of power pack the party has to supply one power pack for every 100 Nos. of meters without any financial implications. Volatile data will be stored in the Non Volatile memory and shall have a minimum retention of 10 Years. The display should be backlit so as to read easily in low light/darkness.

Following quantities should be recorded and displayed in specified sequence:

• Instantaneous Phase voltage –R,Y & B
• Instantaneous Phase currents –R,Y & B
• Instantaneous Frequency
• Phase Sequence: Voltage & Current OR Voltage- Should be provided on display Only ( As per ICS)
• Instantaneous PF of individual Phases(Lag or Lead with +/- sign )
• RTC – date, day & time
• Rising demand in KW with elapsed time - Should be provided on display Only ( As per ICS)
• TOD-Zone wise Cumulative Active energy KWH (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours
• TOD-Zone wise Cumulative Reactive energy KVARH (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours
• TOD-Zone wise Cumulative Apparent energy KVAH (i.e. derived from total Active energy and only lagging Reactive energy) (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours.
• TOD-Zone wise MD in KW (integration period of 15 minutes) for (i) last billing period and (ii) current billing period. i.e. KW-MD for (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours
• TOD-Zone wise MD in KVA (derived from Active energy and only lagging Reactive energy) for (i) last billing period and (ii) current billing period. i.e. KVA-MD (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours
• No of MD reset counts-
• Cumulative KW Max. - Should be provided on display Only ( As per ICS)
• Total Cumulative KWH/ Total Cumulative KVARH – Lag/ Total Cumulative KVARH Lead, Cumulative KVAH.
- Tamper Features-as per ICS:
  i. voltage failure count-phase wise
  ii. current failure count-phase wise
  iii. voltage unbalance count
  iv. current unbalanced count
  v. Current reversal count phase wise
  vi. Over voltage count
  vii. Low voltage count
  viii. Over current count
  ix. Total no. of tamper counts.
- Meter CT ratio
- Meter Sr.No.
- HIGH Resolution for KWH, KVARH (lag), KVAH.
- The meter shall have 3 modes for display:
  i. Mode-1 – (Main Mode) This mode shall display billing and tamper parameters.
  ii. Mode-2-This mode shall display observation parameters like TOD zone wise energies, MD, etc.
  iii. Mode-3-This mode shall display high precision readings of energy for accuracy testing at site. Mode wise parameters to be displayed on the meter are as per annexure -A.
- Recording of active energy (KWH) for billing purpose shall indicate on the display measurement of total energy (fundamental + harmonics) i.e. it will display total energy i.e. (fundamental + harmonics) KWH.

4.15. **QUANTITIES TO BE MEASURED**

This meter should be capable of recording active energy (KWH), KVARH, KVAH, MD KW, MDKVA, P.F., Voltage & Currents. The maximum demand registered during the month should remain on display. The meter should Measure, Display and memorize the Total Energy (50 Hz pure sine wave + Harmonic energy). The actual supply wave of related voltage & currents should be sampled out at the rate of minimum 3000 samples per second and the meter shall provide integrated values of each actual voltage & current cycle while deriving actual basic active (cosine part measurable component) and reactive (sine part measurable component) energy (with respective to relevant voltage wave & current wave) to assess actual contents of energies persisting/traversing to have up-to-date information for total energy even when highest order harmonics is present in supply wave.

**Recording of active energy (Kwh) for billing purpose:**

The Meter should record and display max. Demand in KW (i.e. Fundamental plus Harmonics power) and Cumulative Total KWH (i.e. Fundamental plus Harmonics energy). The Meter should record Average Max. KVA MD derived from Vectorial summation of Total KW (i.e. Fundamental plus Harmonics power) and Lag KVAR. Similarly it should measure and record cumulative KVAh energy
also derived from vectorial summation of Total cumulative KWH (fundamental + harmonic energy) and cumulative KVARH energy (lag only).

The high resolution display having of eight digits (two digits before decimal points & six digits after decimal points e.g. 21.642867) for KWH, KVAH & KVARH (lag) shall be provided under mode –3 for the accuracy checking of meter in the field.

- **Max. Demand register:**
  
The meter should monitor demand during pre-specified integration period set & record / display the max. Registered value. The rising demand under the current integration period should be displayed along with elapsed time. The integration period shall be capable of making adjustments with duration of 30 minutes. However, it should have facility for programming for defined time as per DLMS ICS in future at APDCL field office with software/hardware lock. The above adjustment option shall be available & it should be possible to select the period of integration by use after duly authenticated through base computer service center only.

- **Monthly total energy:**
  
Total energy should be stored in the no-erasable memory along with name of the month. Such 12 monthly readings shall be stored in no-erasable memory & shall be accessible for reading through MRI/laptop.

- **Max. Demand reset:**
  
The Maximum demand registered during the month should remain in display and should have following MD resetting facility:

  i. Automatic resetting at the end of pre-specified date of every calendar month (e.g. 24.00 hours on last day of every month).

  ii. A provision for revising the resetting cycle for modifying the date and time of automatic resetting through base computer service center or via hand-held meter reading instrument only after using protected pass word through authenticated BCS should be available.

  iii. Provision for Manual Resetting of the monthly Max Demand with adequate sealing arrangement must also be made.

  iv. In all the above listed MD resets, No of counts shall increase on every reset.

- **Memory for billing, tamper & load survey:**

  i. Fix parameters - Name Plate details as per IS 14697 (1999) and ICS DLMS ETD 13 (6211) for category C.

  ii. Load survey - The meter should be capable of storing in its non volatile memory at specified 15 minutes time integration period: KW, KVA (derived from Active energy and only lagging Reactive energy), KVAR (Lag)

Meter should be able to memorize the above parameters for a period of minimum days. The load survey with 15 minutes time integration period with 5 parameters like: RTC, Forward kWh, Forward KVARh-Lag, Forward kVARh-lead and Forward KVAh should be provided. This data should be stored in the memory, in First in First out (FIFO) manner.
- **Billing Parameters**

  The meter should also memorize the following values on cumulative (since installation) basis for billing purpose for last and present billing period:
  
  i. TOD- Zone wise Cumulative Active energy KWH- for 24 Hours, for Night Hours, for Day Hours and for Peak Hours.
  
  ii. Cumulative Reactive energy KVARH (Lag)
  
  iii. TOD-Zone wise Cumulative Apparent energy KVAH (i.e. derived from Active energy and only lagging Reactive energy)- for 24 Hours, for Night Hours, for Day Hours.

- **Tamper & fraud records:-**

  Must be kept recorded permanently without facility of resetting. The meter should record following tamper conditions with date, time & duration in FIFO/Roll over type method.
  
  i. Missing Voltage- Phase wise
  
  ii. Missing current -Phase wise
  
  iii. Voltage unbalance-
  
  iv. Current unbalance
  
  v. Current reversal- Phase wise
  
  vi. Over voltage
  
  vii. Low voltage
  
  viii. Neutral Disturbance
  
  ix. Magnetic Influence

  **Note:-** The meter should record minimum 100 tampers as per ICS events (occurrence and restoration) the temper persistence time for occurrence shall be 15 minutes and restoration should be 1 to 2 minutes. Recording should be with occurrence date & time & restoration date & time & snap shot.

  The tamper of Magnetic Interference shall be communicated back to HES as and when they occur. These tamper events shall be sent as an alarm to the HES which shall store the same in its database.

- **Reset record:-**

  Meter should keep permanent record of date & time of last at least 12 MD Resets & total no. of resets.

- **Meter should have following facility:**

  i. Snap shot - Facility to record snap shot for voltage, current & p.f & KWH at the time of occurrence & restoration of event of each tamper.

  ii. The meter shall be capable to register demand & energy consumption for minimum 3 different zones in a 24 hours cycle to record time of day consumption. It should be possible to change the time of day for these registers through base computer service center directly or via hand held MRI only after authentication through protected password from base computer. The meter should be able to record active energy consumption’s for MINIMUM 3 specified time of day to help application of proper tariff. The meter should have facility to have at least 8 zones programmable in future, however at present following 3 zones are to be provided.
iii. Zones for TOD -
   - Peak hours -17.00 to 22.00 Hrs
   - Night hours - 22.00 to 06.00 Hrs.
   - Balance Hours –06.00 To 17.00 Hrs

4.16. **TAMPER FEATURES:**

The meter should have the following special features to prevent/detect different ways of tamper and fraud.

- Phase sequence reversal: The meter shall keep working accurately irrespective of reversal of any phase sequence of supply. The date, time of such occurrence should be recorded by the meter. The last restoration of normal supply also should be similarly recorded.
- Polarity reversal: The Meter should register correct energy even though polarities are reversed.
- CT polarity reversal: The meter should keep registering correct energy even though all the CT polarities are reversed. This data should also be recorded in different register & with date & time of reversal for all events in the billing period.
- Meter must work in absence of neutral.
- The meter should record in event of voltage unbalance between any of the three phases. The meter should be capable of giving phasor diagram of the installation at which the meter is connected on a Laptop PC.
- The meter should be able to store at least 100 tamper events in its memory.

The tamper logic and tamper condition are as per ANNEXURE-B.

4.17. **CONNECTION DIAGRAM & TERMINAL MARKING:**

The connection diagram of the meter shall be clearly shown in inside portion of the terminal cover & shall be of permanent nature. Meter terminals shall also be marked.

4.18. **METER READING INSTRUMENTS:**

Common MRI shall be supplied as per specification, i.e. Annexure-C attached herewith with minimum 4 MB static RAM. The qualified supplier shall have to supply one no. of MRI free along with each lot of 1000 nos. of meters.

4.19. **SAMPLE:**

The sample should be taken for testing as per recommended sampling plan as per Annexure-X of IS-14697 - 1999 and will be tested for the tests as per CBIP report 88 and IS-14697 - with latest revisions thereof.

- **Proto type – inspection & testing:**

The supplier shall also have to manufacture 3 Nos of sample meters complying to all above technical specifications, type, rating, functional requirements, tamper features, display and design etc and shall have to offer for the inspection within 30 days from the date of placement of LOI and before commencement of bulk supply. The bulk manufacturing must be commenced only after written confirmation from APDCL authority. The 3 Nos of
samples prepared as above shall have to be preserved till the completion of supply of last lot.

During the proto type sample testing all the display parameter and other parameters shall be checked and same shall be tested /observed for acceptance test & other tests as per the specification.

The supplier shall also have to offer one no. of MRI for functional testing and verification / testing and related software.

4.20. **TYPE TEST, ACCEPTANCE TEST and ROUTINE TESTS:**

- **Type test**-
  
  The bidder should submit Type Test Reports for all tests as per schedule of IS 13779/IS 14697/IS 15959 or BIS approved documents ,for the tests having been conducted on the sample meter, not prior to 3 (Three) years before the issue of tender, from reputed third party Govt. approved laboratory NABL only. All the type tests must have been conducted within One year’s tenure and on the sample as specified under Cl. No: 12.2.2.1 of IS-14697-1999. Offers without the Type Test reports shall be rejected. The type test report submitted shall be of the same type and design of the meter offered. Please note that the bidder in case of supplier having own NABL accredited lab, the type test certificate furnished with tender from such lab shall not be accepted. (i.e. Type test certificate from own NABL Lab.)

- **Routine test**-
  
  All routine tests as stipulated in the relevant standards shall be carried out and routine test- certificates/reports shall be submitted along with inspection call letter in the form of composite disk (CD) as per IS 14697-1999 (reaffirmed 2004)/IS 13779 / IS 15884 / with latest amendments and on the CD, A/T No. serial no. of meters to be offered etc. shall be provided with sticker pasted on the CD, to the purchaser for approval and also placed inside individual meter packing.

- **Acceptance test**-
  
  The meter should pass acceptance test as per IS 14697-1999 (reaffirmed 2004)/IS 13779 / IS 15884 / with latest amendments, CBIP 88 latest version and IEC-62053-21 & IEC 61036/2000 during inspection. Please note that the total energy i.e. fundamental + harmonics shall be measured as per cl.no. 5.6.2.1 of IEC 61036/2000 along with other tests. If the facility for any of the tests is not available at supplier’s works, the testing shall be arranged at any of the NABL/ Govt. approved lab and for such tests all the expenditures i.e. test charges etc. shall have to be borne by the supplier.

  In case order is placed on part or full quantity, Board reserves right to select sample as per relevant IS/IEC from the first lot (minimum 20% of the ordered quantity) offered by party and the samples will be tested at any Govt. approved laboratory which is approved be GEB for type tests and on successful passing the test the lot will be accepted or otherwise the whole lot will be rejected and in that case testing charges shall have to be borne by the party concerned.

4.21. **MINIMUM TESTING FACILITIES:**

Manufacturer should possess fully computerized meter test bench system for carrying out routine and acceptance tests as per IS 14697 or CBIP 304. In addition, this facility should produce test reports for each and every meter.
The bidder should have the necessary minimum testing facilities for carrying out the following tests:
- AC voltage test
- Insulation resistance test
- Test limits of errors
- Test on meter constants
- Test of starting condition
- Test of no-load condition
- Repeatability of error test
- Test of power consumption
- Vibration test
- Shock test
- The manufacturer should have duly calibrated ERS meter of class 0.1 accuracy.
- 10 KV Impulse voltage test facility.
- Test for Influences Quality.
- AC & DC Magnetic Influence test

4.22. **MANUFACTURING ACTIVITIES:**

- Meter should be manufactured using SMT (Surface Mount Technology) components and by deploying automatic SMT pick and place machine and Wave soldering process.
- Quality should be ensured at the following stages.
  i. At insertion stage, all components should undergo computerized testing for conforming to design parameters and orientation.
  ii. Complete assembled and soldered PCB should undergo functional testing using Automatic Test Equipment’s (ATES).
  iii. Prior to final testing and calibration, all meters shall be subjected to aging test (i.e. Meters will be kept in ovens for 72 hours at 55deg. C temperature and atmospheric humidity under real life condition at its full load currents. After 72 hours meters should work satisfactorily) to eliminate infant mortality.
  iv. The calibration of meters shall be done in-house with a automated computerized test set-up.
  v. All the components should be sourced directly from the reputed manufacturers or their authorized distributors.
  vi. A detailed list of bought out items which are used in the manufacture of the meter should be furnished indicating the name of firm from whom these items are procured. The bidder shall also give the details of quality assurance procedures followed by him in respect of the bought out items.

4.23. **DEVIATION STATEMENT:**

The supplier should submit details of deviation (If any) in proforma as shown below. If it is observed that there are deviations in the offered in Guaranteed Technical particulars other than those specified in the deviation schedule then such deviation shall be treated as deviation offers with deviation are liable for rejection. If no deviation is there, they should mentioned as NIL and submit the proforma as shown below:
4.24. **GUARANTEE:**
Bidder should agree for 5 years guarantee and free replacement of any component / meters for smooth functioning of the meters. The meters & MRI found defective within the guarantee period shall be replaced / repaired by the suppliers free of cost within one month of receipt of intimation failing which the Board shall recover an equivalent amount plus 15% supervision charges from any of the bills of the supplier.

4.25. **PACKING:**
The meters shall be suitably packed in order to avoid damage or disturbance during transit and handling each meter should be suitably packed in the first instance to prevent ingress of moisture and dust and placed in a cushioned cartoon of a suitable material to prevent damage due to shocks during transit. The lid of cartoon should be suitably sealed as suitable member of sealed cartoons may be packed in a case of adequate strength with extra cushioning. The cases may then be properly sealed against accidental opening in transit. The packing cases may be marked to indicate the fragile nature of the contents.

4.26. **SERVICES:**
The supplier shall provide following services –
- Services free of cost shall be provided during guarantee period.
- To train APDCL staff for installation and handling of these meters.
- To assist APDCL Lab. staff to install calibration, checking etc.
- Ordered quantity of meters are to be supplied in stipulated time.
- To provide necessary personnel for taking reading, documentation of report and submission of the same to APDCL authority as required
- Inspection and test certificates will have to be submitted prior to dispatch of ordered material and each lot shall be inspected at your works prior to dispatch of material. All material shall be subject to acceptance after final inspection/ checking and testing as per ISS.
- They should provide necessary assistant to APDCL staff for any meter related problems and wrapped meter checking at lab., for taking data through MRI up to guarantee period of 5 years without any extra cost.

**NOTE:** The meters must be compliant to ICS DLMS ETD 13( 6211) for category C.

The suppliers shall have to submit necessary documents and certification in this regard along with their technical offer. The offers, not complying to above, shall be rejected without any further correspondence. In case of foreign bidders, the type test certificates, in respect of the tests conducted as per relevant international standard, i.e. IEC-62053 shall be acceptable. The suppliers shall have to submit the valid License in accordance with IEC-62053 issued by the respective country.

BIS MARK- The meter manufacturer having valid BIS license for tendered items shall only be considered. Meters offered must have ISI marking. The sample passed in electrical testing should be considered for further evaluation.
### ANNEXURE - A Display Parameters for 3-Phase 4 wire LT Static CT Operated 100/5 Amp & 200/5 Amp Energy Meter (TO BE PROVIDED IN FOLLOWING SEQUENCE)

<table>
<thead>
<tr>
<th>Mode : 1</th>
<th>Parameters of this mode should display on auto scrolling as well as manually up &amp; down scrolling using push button</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sequence</strong></td>
<td><strong>Parameter</strong></td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>Display check</td>
</tr>
<tr>
<td>1-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>1-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>1-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>Sr. No. of Meters</td>
</tr>
<tr>
<td>2-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>2-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>2-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>CT Ratio</td>
</tr>
<tr>
<td>3-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>3-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>3-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>RTC date &amp; time</td>
</tr>
<tr>
<td>4-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>4-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>4-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td>R- Phase Voltage</td>
</tr>
<tr>
<td>5-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>5-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>5-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td>Y- Phase Voltage</td>
</tr>
<tr>
<td>6-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>6-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>6-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td><strong>7</strong></td>
<td>B- Phase Voltage</td>
</tr>
<tr>
<td>7-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>7-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>7-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>R- Phase Line Current</td>
</tr>
<tr>
<td>8-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>8-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>8-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>9</td>
<td>Y- Phase Line Current</td>
</tr>
<tr>
<td>9-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>9-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>9-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>10</td>
<td>B- Phase Line Current</td>
</tr>
<tr>
<td>10-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>10-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>10-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>11</td>
<td>Inst. P.F. (Avg. of 3Ph.)</td>
</tr>
<tr>
<td>11-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>11-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>11-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>12</td>
<td>Inst. Total active power</td>
</tr>
<tr>
<td>12-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>12-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>12-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>13</td>
<td>24hrs. apparent energy derived from Vectorial summation of total (fund+ Harm.) active energy and reactive (lag only)</td>
</tr>
<tr>
<td>13-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>13-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>13-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>14</td>
<td>Rising demand in KW with elapse time</td>
</tr>
<tr>
<td>14-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>14-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>14-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
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<tr>
<td>15</td>
<td>KW-MD of last billing period i.e. billing MD of 24 hours recorded between last two resets</td>
</tr>
<tr>
<td>15-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>15-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>15-C</td>
<td>MD of 24 hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>16</td>
<td>Cumm KWH for Peak hours (Zone-1)</td>
</tr>
<tr>
<td>16-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>16-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>16-C</td>
<td>MD of 24 hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>17</td>
<td>Cumm. KWH for Night hours (Zone-2)</td>
</tr>
<tr>
<td>17-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>17-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>17-C</td>
<td>MD of 24 hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>18</td>
<td>Cumm KWH for Balance hours (Zone-3)</td>
</tr>
<tr>
<td>18-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>18-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>18-C</td>
<td>MD of 24 hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>19</td>
<td>MD KW between last two resets – Peak Hours (Zone-1)</td>
</tr>
<tr>
<td>19-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>19-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>19-C</td>
<td>MD of 24 hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>20</td>
<td>MD KW between last two resets – Night Hours (Zone-2)</td>
</tr>
<tr>
<td>20-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>20-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>20-C</td>
<td>MD of 24 hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>21</td>
<td>MD KW between last two resets – Balance hours (Zone-3)</td>
</tr>
<tr>
<td>21-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>21-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>21-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>22</td>
<td>MD KW for Present Billing – Peak Hours ( Zone -1)</td>
</tr>
<tr>
<td>22-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>22-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>22-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>23</td>
<td>MD KW for Present Billing – Night Hours ( Zone -2)</td>
</tr>
<tr>
<td>23-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>23-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>23-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>24</td>
<td>MD KW for Present Billing – Balance hours ( Zone -3)</td>
</tr>
<tr>
<td>24-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>24-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>24-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>25</td>
<td>MD KW for Present Billing Period ( After last reset)</td>
</tr>
<tr>
<td>25-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>25-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>25-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>26</td>
<td>Voltage failure count phase wise</td>
</tr>
<tr>
<td>26-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>26-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>26-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>27</td>
<td>Current failure count phase wise</td>
</tr>
<tr>
<td>27-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>27-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>27-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>28</td>
<td>Voltage unbalance Count</td>
</tr>
<tr>
<td>28-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>Mode : 2</td>
<td>Parameters of this mode should display manually up &amp; down scrolling using push button</td>
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<tr>
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</tr>
<tr>
<td>Sequence</td>
<td>Parameter</td>
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<tr>
<td>1</td>
<td>Inst. P.F.Phase 1</td>
</tr>
<tr>
<td>2</td>
<td>Inst. P.F.Phase 2</td>
</tr>
<tr>
<td>3</td>
<td>Inst. P.F.Phase 3</td>
</tr>
<tr>
<td>4</td>
<td>Phase Sequence - Voltage</td>
</tr>
</tbody>
</table>

<p>| 28-B | 24hrs. total reactive energy | TC Kvarh lg |
| 28-C | MD of 24hours recorded (Cumulative MD) | CMD -----------Kw |
| 29   | Current unbalance Count | |
| 29-A | 24hrs. total active energy (fundamental+ harmonics) | TC Kwh |
| 29-B | 24hrs. total reactive energy | TC Kvarh lg |
| 29-C | MD of 24hours recorded (Cumulative MD) | CMD -----------Kw |
| 30   | Current reversal count- phase wise | |
| 30-A | 24hrs. total active energy (fundamental+ harmonics) | TC Kwh |
| 30-B | 24hrs. total reactive energy | TC Kvarh lg |
| 30-C | MD of 24hours recorded (Cumulative MD) | CMD -----------Kw |
| 31   | Low Power factor count | |
| 31-A | 24hrs. total active energy (fundamental+ harmonics) | TC Kwh |
| 31-B | 24hrs. total reactive energy | TC Kvarh lg |
| 31-C | MD of 24hours recorded (Cumulative MD) | CMD -----------Kw |
| 32   | Magnet tampers count. | |
| 32-A | 24hrs. total active energy (fundamental+ harmonics) | TC Kwh |
| 32-B | 24hrs. total reactive energy | TC Kvarh lg |
| 32-C | MD of 24hours recorded (Cumulative MD) | CMD -----------Kw |
| 33   | Total Tamper Count | |
| 33-A | 24hrs. total active energy (fundamental+ harmonics) | TC Kwh |
| 33-B | 24hrs. total reactive energy | TC Kvarh lg |
| 33-C | MD of 24hours recorded (Cumulative MD) | CMD -----------Kw |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>5</td>
<td>Phase Sequence - Current</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Frequency</td>
<td>Hz</td>
</tr>
<tr>
<td>7</td>
<td>Cumm. KVARH (Lead)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Cumm KVARH-lag for night hours (Zone2)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Cumm. KVARH-lag for peak hours (Zone1)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Cumm KVARH-lag for balance hours (Zone3)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Cumm KVARH for night hours (Zone2)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Cumm. KVAH for peak hours (Zone1)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Cumm KVAH for balance hours (Zone3)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Avg. PF for last billing – Peak Hours (Zone1)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Avg. PF for last billing – Night Hours (Zone2)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Avg. PF for last billing – Balance hours (Zone3)</td>
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</tr>
<tr>
<td>17</td>
<td>MD KVA after last billing – Peak Hours (Zone2)</td>
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</tr>
<tr>
<td>18</td>
<td>MD KVA after last billing – Night Hours (Zone1)</td>
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</tr>
<tr>
<td>19</td>
<td>MD KVA after last billing – Balance hours (Zone3)</td>
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</tr>
<tr>
<td>20</td>
<td>MD KVA between last two resets – Peak Hours (Zone2)</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>MD KVA between last two resets – Night Hours (Zone1)</td>
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<tr>
<td>22</td>
<td>MD KVA between last two resets – Balance hours (Zone3)</td>
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</table>

**Mode : 3**

Parameters of this mode should display manually up & down scrolling using push button

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<thead>
<tr>
<th>Sequence</th>
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<th>Notation</th>
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<tbody>
<tr>
<td>1</td>
<td>High Resolution display for KWH</td>
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<tr>
<td>2</td>
<td>High Resolution display for KVARH-Lag</td>
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</tr>
<tr>
<td>3</td>
<td>High Resolution display for KVAH</td>
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</table>
### 4.28. ANNEXURE-B

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Type of Tamper</th>
<th>Requirement</th>
<th>Tamper Logics / Conditions &amp; (Occurrence &amp; Restoration) Persistence Time</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Occurrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage</td>
</tr>
<tr>
<td>1</td>
<td>Voltage Failure</td>
<td>Phase wise</td>
<td>Vx&lt;40% of Vref irrespective to any other phase voltage</td>
</tr>
<tr>
<td>2</td>
<td>Current Failure</td>
<td>Phase wise</td>
<td>All voltages &gt;75 % of Vref.</td>
</tr>
<tr>
<td>3</td>
<td>Voltage Unbalance</td>
<td>-</td>
<td>(V_{max}-V_{min}) &gt;10%of max Voltage of 3 phase voltages and all voltages &gt;60% of Vref.</td>
</tr>
<tr>
<td></td>
<td>Current Unbalance</td>
<td>-</td>
<td>All voltages &gt;75 % of Vref.</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------</td>
<td>---</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Current reversal</td>
<td>Phase wise</td>
<td>All voltages &gt;75 % of Vref.</td>
</tr>
<tr>
<td>6</td>
<td>Magnetic Influence</td>
<td>-</td>
<td>All voltages &gt;75 % of Vref.</td>
</tr>
<tr>
<td>7</td>
<td>Neutral Disturbance</td>
<td>-</td>
<td>Phases to Neutral voltage for any two phases remaining phase is&lt;50V</td>
</tr>
<tr>
<td>8</td>
<td>Low Voltage</td>
<td>-</td>
<td>Vx &gt; 40% of Vref &amp; Vx&lt; 75 % of Vref</td>
</tr>
<tr>
<td>9</td>
<td>High Voltage</td>
<td>-</td>
<td>Vx&gt; 115% of Vref</td>
</tr>
</tbody>
</table>

Note: For tamper logics, following points shall be taken in consideration:

- During Neutral disturbance tamper, all voltage related tampers (i.e. Voltage Failure, Voltage Unbalance, and High Voltage & Low Voltage) shall not be logged.
- During High Voltage & Low Voltage tampers, Voltage unbalance tamper shall not be logged.
- During Voltage failure Tamper, Voltage Unbalance & Low Voltage tamper shall not be logged.
- During current failure Tamper, Current Unbalance tampers shall not be logged.
4.29. **ANNEXURE – C HHU SPECIFICATIONS FROM ICS**

- **Requirement and Specification of DLMS/COSEM complaint HHU/CMRI**

Communication standards in the Indian metering scenario require supporting considerations for the utilization of those standards in HHUs (Hand Held units) or in CMRI (Common Meter Reading Instrument). This annexure provides a suitable approach to the implementation of the IEC-62056 standards and this Indian Companion Specification in such devices.

The terms of this suggested implementation are as below.

i. HHUs may retrieve data from DLMS/COSEM Meters conforming to this standard using the same DLMS/COSEM communication port that is provided for remote meter reading.

ii. HHUs shall exclusively use the Meter Reading association (MR) and shall support all the features and specifications listed in this specification for the MR Association.

iii. HHUs shall have the same data access rights that are available to the MR Association, as that available for remote meter reading.

iv. HHUs shall implement the DLMS/COSEM communication standard conforming to this specification to provide a DLMS/COSEM client protocol driver to communicate with the meters to download billing data or perform other services available to the MR Association.

v. HHUs shall provide a DLMS/COSEM server interface to the BCS (Base Computer System – the Data collection software) over a suitable communication medium (Local serial port implementing the DLMS/COSEM CO 3-layer stack is suggested).

vi. HHUs shall internally map the individual meter data to logical devices (One logical device for each meter). Inside each logical device the structure and naming of the data shall be the same as that retrieved from the meter.

vii. The BCS shall maintain a mapping table that maps the individual meter identifications (the same IDs that are used to identify the meter during remote meter reading) to Logical device addresses. During upload of data from HHU to BCS, the BCS shall query each Logical device to download the data of each meter over the local serial port.

viii. The logical device addresses allocated to each meter shall be unique across all meters that are to be retrieved using one HHU. Other HHUs may re-use the same addressing from their own range of allocated meters. The BCS shall take care to ensure that the re-use of addresses does not create conflicts in meter.
### ANNEXURE-I PREQUALIFICATION CONDITIONS FOR THREE PHASE STATIC METERS

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Particulars</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bidders must have produced/ executed order of tendered item to any SEBS/power utility company in last 3 years. The bidder should submit the order copies along with their Bid as a evidence.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>2</td>
<td>Bidders must have valid ISI license</td>
<td>Yes/No</td>
</tr>
<tr>
<td>3</td>
<td>Bidder preferably possesses ISO 9001 certification.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>4</td>
<td>Bidder shall be manufacturer of static meters. Offer from traders / agents are not acceptable</td>
<td>Yes/No</td>
</tr>
<tr>
<td>5</td>
<td>Bidder shall have ISI license for similar design product and/or type test certificate for all the type tests as per IS 13779 or IEC-62053 from International or from Indian Govt. approved lab</td>
<td>Yes/No</td>
</tr>
<tr>
<td>6</td>
<td>Bidder shall have to submit type test report for AC/DC magnetic field as per CBIP 304 &amp; its latest amendments from independent Govt. Approved lab. as well as DC magnetic influence test for 0.5 tesla and total energy test. The tender without valid type test report should be out rightly rejected.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>7</td>
<td>Bidders shall have dust free &amp; air conditioned environment for assembly as well as testing.</td>
<td>Yes/No</td>
</tr>
<tr>
<td>8</td>
<td>Bidders shall have automatic computerized test bench for lot testing of meters and oven for ageing test. The document evidence is to be attached along with the bid.</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>
Bidders are requested to read the following as the part of tender technical specifications document.

- At the end of the tender technical specification, following paragraph should be added and read as under:

  The material supplied shall be conforming to Indian Standard Specification (except DLMS compliance, if any) and also with ISI marking and even after inspection of the lot, if the material received at site is found without ISI marking, the lot shall be rejected and no further correspondence shall be entertained in this regard.
5. **Technical Specification for Three Phase HT CT operated TOD meter with DLMS Protocol**

5.1. **SCOPE:**
This specification covers design, manufacturing, testing, supply and delivery of three Phase, four Wire, 63.5V(Phase-Neutral), 5 Amps, CT / PT operated class 0.2s fully Static TOD Tri-Vector Energy Meters as per Category C of ICS for measurement of different electrical parameters listed elsewhere in the document including Active Energy (kWh), Reactive Energy (kVARh), Apparent Energy (kVAh) etc. in three phase, four wire balanced / unbalanced loads of HT Consumers.

5.2. **STANDARD APPLICABLE:**
While drawing these specifications, reference has been made to following Indian and International Standard Specifications. In case certain details are not covered in these specifications the relevant Indian/International standard shall be applicable.

<table>
<thead>
<tr>
<th>IS 14697 (1999) with latest amendment</th>
<th>AC static Watt-hour Meter Class 0.5s &amp; 0.2s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 62053-11</td>
<td>Electrically metering equipment (AC) – General Requirement, Test &amp; Test condition.</td>
</tr>
<tr>
<td>IEC 62053-21</td>
<td>Static Energy Meters for Active Energy</td>
</tr>
<tr>
<td>PFC Spec.</td>
<td>For high precision 3 vector energy meter.</td>
</tr>
<tr>
<td>IS 9000</td>
<td>Environmental testing</td>
</tr>
<tr>
<td>CBIP report No. 304</td>
<td>Specification for A.C. electrical energy meters.</td>
</tr>
<tr>
<td>CBIP report No. 88 with latest amendment:</td>
<td>for AC Static Transformer operated Watt Hour &amp; VAR- Hour meters (class 0.5S)</td>
</tr>
<tr>
<td>IS 2705 (Part-I&amp;II)</td>
<td>Specification for current transformers</td>
</tr>
<tr>
<td>IS15959</td>
<td>Data Exchange for Electricity Meter - Reading Tariff and Load Control - Companion Specification</td>
</tr>
</tbody>
</table>

The meters must be compliant to IS 15959:2011 for category C.

5.3. **SUPPLY SYSTEM:**

<table>
<thead>
<tr>
<th>System</th>
<th>3 – Phase, 4 wire system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std. voltage</td>
<td>3x63.5 V(Phase-Neutral)-110V(P-P)(CT operated Meters)</td>
</tr>
<tr>
<td>Std. basic current</td>
<td>5 Amps. (Through current transformer)Max. rated current</td>
</tr>
<tr>
<td>Ref. frequency</td>
<td>50 Hz</td>
</tr>
</tbody>
</table>

The meters should be suitable for working satisfactorily and accurately with following variations in the supply system parameters and ambient temperature and humidity.

<table>
<thead>
<tr>
<th>Electrical Quantities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>+215 to-30% of V ref. 415V(P-P)</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50Hz+5% to -5% of Freq.</td>
</tr>
<tr>
<td>Range of temp. Variation</td>
<td>0°C to 55°C Ambient.</td>
</tr>
<tr>
<td>Average working temp</td>
<td>27°C + 10°C - 10°C</td>
</tr>
<tr>
<td>Reference temp</td>
<td>27°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>As per IS 14697 (1999)</td>
</tr>
</tbody>
</table>
5.4. PAST EXPERIENCE:

The manufacturer should have at least ten years of experience of manufacturing and operation of the static type of meters offered (with or without DLMS). The Meter Manufacturer is expected to have manufactured static/whole current and CT operated meters for utilities.

5.5. GENERAL AND CONSTRUCTIONAL REQUIREMENT AND MARKING OF METER:

The meter should comply all general and constructional requirement and marking of meters as per IS 14697 (1999) with latest revisions thereof and as per CBIP report No. 304. wherever applicable.

- Meter shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following shall be ensured.
  - i. Personal safety against electric shock
  - ii. Personal safety against effects of excessive temperature
  - iii. Protection against spread of fire
  - iv. Protection against penetration of solid objects, dust and water

- All the material and electronic power components used in the manufacture of the meter shall be of highest quality and reputed make to ensure higher reliability, longer life and sustained accuracy.

- The meter shall be designed and manufactured using SMT (Surface Mount Technology) components.

- All insulating material used in the construction of meter shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.

- The meter shall have an operation indication device such as a blinking LED. The operation indicator shall be visible from the front window and capable of being monitored conveniently with suitable testing equipment.

- The meter shall conform to the degree of protection IP 51 of IS: 12063/IEC: 529 for protection against ingress of dust, moisture and vermin’s.

- The meter shall be supplied with a transparent extended terminal block cover (ETBC).

- Push button shall be provided for scrolling the parameters in Alternate Display (On Demand) mode and manual MD RESET.

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

| Meter base & cover and terminal cover shall conform to the following: |
|---|---|---|
| Sr. No | Test | 10% Glass filled non transparent material for meter base & terminal block | Transparent material for meter cover & terminal cover |
| 1 | UV ageing for 200 Hrs. as per ASTM : G53(CL No. 9.3) | 4 Hours UV at 60° C, 4 Hours condensation at 50° C | 4 Hours UV at 60° C, 4 Hours condensation at 50° C |
The terminal block shall be of high grade non-hygroscopic, fire retardant, low tracking, fire resistant, reinforced poly-carbonate or equivalent high grade engineering plastic which shall form an extension of the meter case and shall have terminal holes and shall be of sufficient size to accommodate the insulated conductors & meeting the requirement of IS 14697(1999)/CBIP technical report- 304.

- The meter cover shall be fully transparent. However, in case of non transparent cover the window shall be of fully transparent Polycarbonate material for easy reading of all the displayed values/ parameters, name plate details and observation of operation indicator. The fixing of the window with the cover in the later case shall be temper proof, dust proof & moisture proof.

- The meter cover and base shall be suitably shielded with metallic material so as to protect the meter from adverse effect of AC/DC Abnormal external magnetic field. The meter shall meet the requirements of CBIP-304 with its latest amendment for immunity against continuous magnetic induction.

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

- The terminals shall have suitable construction with barriers and cover to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles). The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The internal diameter of the terminal holes shall be 5.5 mm minimum. The clearance and creep-age distance shall conform to relevant clause of IS 14697:1999/CBIP technical report no.-304. (Latest version).

- The meter shall be compact in design. The entire design and construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.
All parts that are likely to develop corrosion shall be effectively protected against corrosion. The construction of the meter shall be such as to be sealed independently and prevent unauthorized tampering.

5.6. SEALING:

Reliable sealing arrangement shall be provided make the meter tamper proof and to avoid fiddling or tampering by unauthorized persons. For this, at least two (2) Nos. seals on meter body, two (2) No. seal on meter terminal cover, one (1) No. seal on communication port and one (1) No. seal on MD reset button (if such button is provided) shall be provided. All the seals shall be provided on front side only. Rear side sealing arrangement shall not be accepted. The bidder in their offer shall explain the sealing arrangement.

The supplier shall have to provide two polycarbonate Plastic seals having the serial no. in sequence on the meter body of each meter before dispatch of the meter. The plastic seal shall have embossing of the supplier’s logo on one side of seal APDCL & SR.NO. of seal on other side of seal. 6 Digits Sr. No of seal is to be provided on both male & female part of the seal.

In addition to 2 Nos. of polycarbonate seals, further 2 Nos. of tamper proof void seals are to be provided on the Meter body in such a way that both the side covers shall be sealed by the tamper proof void seals. The Serial Nos. of seals should be in sequence. The tamper proof void seals to be provided on Meters shall be as per the following specification:

- Size of the seal: 3 x 1 inches.
- The seal should be digitally printed on white VOID film having UV destructive inks printed with thermal resin ribbon technology.
- The seal should be water proof and should withstand all the weather conditions. The seal should have adhesive of sufficient strength to avoid peeling off under extreme temperature and environmental conditions.
- The seal should be sticker type seal and applied on both the side of the Meter which connects the body and the box.
- If someone lifts the seal, “VOID” impression should be transferred on the meter and if this is applied back, “VOID” impression should be readable from the surface of the seal.
- Barcodes of serial numbers should be printed on the seals and the barcodes should be readable with a barcode scanner.
- The seals should have continuous variable serial numbers along with security codes of last three digits of serial numbers printed in black and the same serial numbers along with code of serial numbers shall also be printed in a vertical semi circular shape which should be visible only under Ultra-violet (UV) light.
- Two security cuts should be given on the seal on both the sides, and if someone tries to lift the seal it should tear off from the security cuts. The security cuts should be made with a computer controlled plotter which should put the security cuts on the same position on each seal.
- The name of the supplier and supplier logo along with the security warning or any other information in any language as given by the company should be printed on the seal.
- There should be a provision of incorporating officers’ signature on the seal as given by the company.
If someone tries to remove the seal by applying heat, the printing should get disturbed and the shape of the seal should change if more heat is applied. The seals to be used for sealing of Meters are to be fixed after inspection is over.

5.7. TYPE OF INTERNAL CLOCK AND LIFE OF BATTERY FOR THE METER:

The meter should have internal real time clock with the backup of a Lithium maintenance free battery of minimum life of Six years for operation of the time clock. Real time clock should be based on Quartz crystal timer so as to make it independent of line frequency variation. It shall be non rechargeable and shall be pre-programmed for 30 Years Day / date without any necessity for correction. 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 or Sub-station logger ‘PC.
- The RTC battery & the battery for display in case of power failure shall be separate.

5.8. ELECTRICAL REQUIREMENT:

- Power consumption in Voltage Circuit: The power consumption in each voltage circuit of meters at reference voltage, reference temperature and ref. frequency should be as per IS 14697.
- Power consumption in Current Circuit: Power consumption in each current circuit for CT operated meter at basic current, reference frequency and ref. Temperature should be as per IS 14697
- Short time over current: The meter should be able to carry a short time over current of 20 I max. For 0.5 second (One half cycles) for meters connected through current transformer.
- Initial start of meter: The meter should be fully functional within five second after rated voltage is applied to the meter terminal.
- Running with no load: When the voltage is applied with no current flowing in the current circuit, the test output of the meter shall not produce more than one output/ count.
- Starting: The meter shall start and continue to register at 0.1% of basic current at unity P.F.
- Meter constant: Relation between the test output and indication in the display shall comply with the marking on the name plate.
- Repeatability error: As per IS 14697
- AC voltage: The meter should pass AC voltage test of 2 KV and 4 KV for metal case and insulating material case respectively
- Limit of error and other accuracy: The meter should comply the requirement of limit of errors and other accuracy requirement as per IS 14697 (1999) and as per CBIP report No. 304.
- Impulse Voltage Test - The meter should withstand 10kv impulse voltage.
5.9. LAST GASP OUTAGE ALERT

The end point (smart meter) shall have a functionality that when power goes out for more than 60 second the end point shall send a power outage message to HES which shall be populated on outage map of HES. This functionality shall help utility to identify the power outages on real time basis.

5.10. OUTPUT DEVICE:

The meter shall have a test output accessible from the front and be capable of being monitored with suitable testing equipment. The operation indicator must be visible from the front. Test output device shall be homogenous and be provided in the form of LED output device for kWh and kVArh measurement.

The relation between test outputs shall comply with the marking on the name plate or with the indication on display if so provided in addition to details on name plate i.e. pulse per kWh / kVARh.

5.11. COMMUNICATION PORT:

Optical port along with RS-232 port will be provided for local 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 (Neighborhood Area Network) i.e. from Meter to Data Concentrator or directly for WAN (Wide Area Network). This Communication Module could operate on Low Power Radio / RF with Mesh/GPRS (directly up to HES). The communication module option can be decided at the time of actual implementation by the utilities. Different communication technologies shall follow relevant National or International Standard as applicable. Both ports shall support the default and minimum baud rate of 9600 bps.

It should be possible to connect the meter to a data concentrator unit (DCU) / Modem over DLMS, which can then transmit the data over GPRS / SMS to the head-end System with proper security.

The meter shall have galvanically isolated communication port so that it can be easily connected to a hand-held meter reading instrument (MRI) for Lap Top PC for Data transfer or subsequently hooked to remote metering instrument such as modem etc. The meter shall be capable of executing instructions from base computer service center only after due authentication through protected two level pass word, for the following:

i. Change in integration period (As per ICS DLMS).

ii. Change in automatic re-setting for billing data date & time (As per ICS DLMS).

iii. TOD shall be programmed initially and time zones can be changed on later stage as per ICS DLMS.

The meter shall thereafter communicate above information while off-loading the data to computer through hand-held meter reading instrument (MRI) with either relevant billing quantities or relevant energy audit/load survey data.

5.12. SOFTWARES:

The following software shall be supplied by the meter manufacturer without extra cost. This software should be suitable for the operating system of the associated Board’s computers.

i. Software for reading and programming the meter contents in the MRI.

ii. Base computer software should be window based software for accepting data from MRI and down loading instructions from Base computer to MRI.
iii. Necessary window based software for loading application programs via communication port.

iv. The meters should be capable to communicate directly to Laptop computer.

v. The meter shall have a facility for providing external upgradable Remote metering system through available.

vi. Any other special application software of the manufacturer and additional software not mentioned as above necessary for functioning of the system.

vii. The meters should have software lock for programming/ change of all parameters & the same should be protected with two level passwords.

- **Programmability:** It should be possible to program the parameters limits / values from remote through sufficiently adequate security mechanism. Once programmed it will be possible for the programmed parameters to come into effect from a certain date & time. Meteorology under such condition must remain intact and shall not be upgradable from remote.

- **Communication Protocol:** The present IS 15959 is not applicable for single phase meters which would be developed by BIS committee. Meanwhile, Meter manufacturers will share their protocol and memory map with the Utility.

- **RTC & time synchronization:** Meter shall have RTC with 20 years calendar programmed in the memory and provision for time synchronization.

5.13. **DISPLAY:**

The measured value(s) shall be displayed on seven segment, seven digit Liquid crystal Display LED / (LCD) display with backlit unit, having minimum character height of 10 mm. Good quality display shall be used to enable correct reading even from distance. The information is to be shown on electronic display in a cyclic mode LED/LCD type.

In case of power supply failure, also display should be made available to facilitate meter reading by providing back up supply to the display circuit of the meter. For this internal battery or power pack (inverter) may be provided. However in case of power pack the party has to supply one power pack for every 100 Nos. of meters without any financial implications. Volatile data will be stored in the Non Volatile memory and shall have a minimum retention of 10 Years. The display should be backlit so as to read easily in low light/darkness.

Following quantities should be recorded and displayed in specified sequence:

- Instantaneous Phase voltage –R,Y & B
- Instantaneous Phase currents –R,Y & B
- Instantaneous Frequency
- Phase Sequence: Voltage & Current OR Voltage- Should be provided on display Only ( As per ICS)
- Instantaneous PF of individual Phases(Lag or Lead with +/- sign )
- RTC – date, day & time
- Rising demand in KW with elapsed time - Should be provided on display Only ( As per ICS)
- TOD-Zone wise Cumulative Active energy KWH (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours
- TOD-Zone wise Cumulative Reactive energy KVARH (Lag) (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours
- TOD-Zone wise Cumulative Apparent energy KVAH (i.e. derived from total Active energy and only lagging Reactive energy) (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours.
- TOD-Zone wise MD in KW (integration period of 15 minutes) for (i) last billing period and (ii) current billing period. I.e. KW-MD for (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours
- TOD-Zone wise MD in KVA (derived from Active energy and only lagging Reactive energy) for (i) last billing period and (ii) current billing period. I.e. KVA-MD (i) for Night Hours, (ii) for Peak Hours and (iii) For Balance Hours
- No of MD reset counts.
- Cumulative KW Max. - Should be provided on display Only (As per ICS)
- Total Cumulative KWH/ Total Cumulative KVARH – Lag/Total Cumulative KVARH Lead, Cumulative KVAH.
- Tamper Features – as per ICS:
  i. voltage failure count-phase wise
  ii. current failure count-phase wise
  iii. voltage unbalance count
  iv. current unbalanced count
  v. Current reversal count phase wise
  vi. Over voltage count
  vii. Low voltage count
  viii. Over current count
  ix. Total no. of tamper counts.
- Meter CT ratio
- Meter Sr.No.
- High Resolution for KWH, KVARH (lag), KVAH.
- The meter shall have 3 modes for display:
  i. Mode-1 – (Main Mode) This mode shall display billing and tamper parameters.
  ii. Mode-2-This mode shall display observation parameters like TOD zone wise energies, MD, etc.
  iii. Mode-3-This mode shall display high precision readings of energy for accuracy testing at site. Mode wise parameters to be displayed on the meter are as per annexure -A.
- Recording of active energy (KWH) for billing purpose shall indicate on the display measurement of total energy (fundamental + harmonics) i.e. it will display total energy i.e. (fundamental + harmonics) KWH.

5.14. QUANTITIES TO BE MEASURED:

This meter should be capable of recording active energy (KWH), KVARH, KVAH, MD KW, MDKVA, P.F., and Voltage & Currents. The maximum demand registered during the month should remain on display. The meter should Measure, Display and memorize the Total Energy (50 Hz pure sine wave + Harmonic energy). The actual supply wave of related voltage & currents should be sampled out at the rate of minimum 3000 samples per second and the meter shall provide integrated values of each actual voltage & current cycle while deriving actual basic active (cosine part measurable component) and reactive (sine part measurable component) energy (with respective to relevant voltage wave & current wave) to assess actual contents of energies persisting/traversing to have up-to-date information for total energy even when highest order harmonics is present in supply wave. Recording of active energy (Kwh) for billing purpose.
The Meter should record and display max. Demand in KW (i.e. Fundamental plus Harmonics power) and Cumulative Total KWH (i.e. Fundamental plus Harmonics energy). The Meter should record Average Max. KVA MD derived from Vectorial summation of Total KW (i.e. Fundamental plus Harmonics power) and Lag KVAR. Similarly it should measure and record cumulative KVAr energy also derived from vectorial summation of Total cumulative KWH (fundamental + harmonic energy) and cumulative KVArH energy (lag only).

The high resolution display having of eight digits (two digits before decimal points & six digits after decimal points e.g. 21.642867) for KWH, KVAH & KVArH (lag) shall be provided under mode –3 for the accuracy checking of meter in the field.

- **Max. Demand register:**
  The meter should monitor demand during pre-specified integration period set & record / display the max. Registered value. The rising demand under the current integration period should be displayed along with elapsed time. The integration period shall be capable of making adjustments with duration of 15 minutes. However, it should have facility for programming for defined time as per DLMS ICS in future at APDCL field office with soft ware/ hardware lock. The above adjustment option shall be available & it should be possible to select the period of integration by use after duly authenticated through base computer service center only.

- **Monthly total energy:**
  Total energy should be stored in the no- erasable memory along with name of the month. Such 12 monthly readings shall be stored in no- erasable memory & shall be accessible for reading through MRI/laptop.

- **Max. Demand reset:**
  The Maximum demand registered during the month should remain in display and should have following MD resetting facility:
  i. Automatic resetting at the end of pre-specified date of every calendar month (e.g. 24.00 hours on last day of every month).
  ii. A provision for revising the resetting cycle for modifying the date and time of automatic resetting through base computer service center or via hand-held meter reading instrument only after using protected pass word through authenticated BCS should be available.
  iii. Provision for Manual Resetting of the monthly Max Demand with adequate sealing arrangement must also be made.
  iv. In all the above listed MD resets, No of counts shall increase on every reset.

- **Memory for billing, tamper & load survey:**
  v. Fix parameters- Name Plate details as per IS 14697 (1999) and ICS DLMS ETD 13 (6211) for category C.
  vi. Load survey - The meter should be capable of storing in its non volatile memory at specified 15 minutes time integration period-
    a. Cumulative kWh
    b. Cumulative kvah,
    c. Kvarh lag ,
    d. Kvarh lead ,
    e. Kva MD
f. TOD parameter at the time of reset

g. kVA MD

Meter should be able to memorize the above parameters for a period of 6 months. The load survey with 15 minutes time integration period with 5 parameters like: RTC, Forward kWh, Forward KVARh-Lag, Forward KVARh-lead and Forward KVAh should be provided. This data should be stored in the memory, in First in First out (FIFO) manner.

- **Billing Parameters**- the meter should also memorize the following values on cumulative (since installation) basis for billing purpose for last and present billing period:

  i. TOD-Zone wise Cumulative Active energy KWH-

     a. for 24 Hours,
     b. for Night Hours and
     c. for Day Hours
     d. for Peak Hours

  ii. Cumulative Reactive energy KVARH (Lag)

  iii. TOD-Zone wise Cumulative Apparent energy KVAH (i.e. derived from Active energy and only lagging Reactive energy)

     a. for 24 Hours,
     b. for Night Hours and
     c. for Day Hour

- **Tamper & fraud records**-

  Must be kept recorded permanently without facility of resetting. The meter should record following tamper conditions with date, time & duration in FIFO/Roll over type method.

  i. Missing Voltage- Phase wise

  ii. Missing current -Phase wise

  iii. Voltage unbalance-

  iv. Current unbalance

  v. Current reversal- Phase wise

  vi. Over voltage

  vii. Low voltage

  viii. Neutral Disturbance

  ix. Magnetic Influence

**Note**: The meter should record minimum 100 tampers as per ICS events (occurrence and restoration) the temper persistence time for occurrence shall be 15 minutes and restoration should be 1 to 2 minutes. Recording should be with occurrence date & time & restoration date & time & snap shot.

The tamper of Magnetic Interference shall be communicated back to HES as and when they occur. These tamper events shall be sent as an alarm to the HES which shall store the same in its database.

- **Reset record**-

  Meter should keep permanent record of date & time of last at least 12 MD Resets & total no. of resets.
• Meter should have following facility:
  
  i. Snap shot - Facility to record snap shot for voltage, current & p.f & KWH at the time of occurrence & restoration of event of each tamper.
  
  ii. The meter shall be capable to register demand & energy consumption for minimum 3 different zones in a 24 hours cycle to record time of day consumption. It should be possible to change the time of day for these registers through base computer service center directly or via hand held MRI only after authentication through protected password from base computer. The meter should be able to record active energy consumption’s for MINIMUM 3 specified time of day to help application of proper tariff. The meter should have facility to have at least 8 zones programmable in future, however at present following 3 zones are to be provided.
  
  iii. Zones for TOD -
  
  • Peak hours -17.00 to 22.00 Hrs
  • Night hours - 22.00 to 06.00 hrs.
  • Balance Hours –06.00 To 17.00 Hrs

5.15. TAMPER FEATURES:

The meter should have the following special features to prevent/detect different ways of tamper and fraud.

• Phase sequence reversal :The meter shall keep working accurately irrespective of reversal of any phase sequence of supply .The date, time of such occurrence should be recorded by the meter. The last restoration of normal supply also should be similarly recorded.
• Polarity reversal: The Meter should register correct energy even though polarities are reversed.
• CT polarity reversal: The meter should keep registering correct energy even though all the CT polarities are reversed. This data should also be recorded in different register & with date & time of reversal for all events in the billing period.
• Meter must work in absence of neutral.
• The meter should record in event of voltage unbalance between any of the three phases. The meter should be capable of giving phasor diagram of the installation at which the meter is connected on a Laptop PC.
• The meter should be able to store at least 100 tamper events in its memory.
• The tamper logic and tamper condition are as per ANNEXURE-B.

5.16. CONNECTION DIAGRAM & TERMINAL MARKING:

The connection diagram of the meter shall be clearly shown in inside portion of the terminal cover & shall be of permanent nature. Meter terminals shall also be marked.

5.17. METER READING INSTRUMENTS:

Common MRI shall be supplied as per specification, i.e. Annexure-C attached herewith with minimum 4 MB static RAM. The qualified supplier shall have to supply one no. of MRI free along with each lot of 1000 nos. of meters.
5.18. **SAMPLE:**

The sample should be taken for testing as per recommended sampling plan as per Annexure-X of IS-14697 - 1999 and will be tested for the tests as per CBIP report 304 and IS-14697 - with latest revisions thereof.

**Proto type – inspection & testing:**

The supplier shall also have to manufacture 3 Nos of sample meters complying to all above technical specifications, type, rating, functional requirements, tamper features, display and design etc and shall have to offer for the inspection within 30 days from the date of placement of LOI and before commencement of bulk supply. The bulk manufacturing must be commenced only after written confirmation from APDCL authority. The 3 Nos of samples prepared as above shall have to be preserved till the completion of supply of last lot.

During the proto type sample testing all the display parameter and other parameters shall be checked and same shall be tested / observed for acceptance test & other tests as per 19 of this specification.

The supplier shall also have to offer one no. of MRI for functional testing and verification / testing and related software.

5.19. **TYPE TEST, ACCEPTANCE TEST and ROUTINE TESTS:**

- **Type test**-

  The bidder should submit Type Test Reports for all tests as per schedule of IS 13779/IS 14697/IS 15959 or BIS approved documents for the tests having been conducted on the sample meter, not prior to 3 (Three) years before the issue of tender, from reputed third party Govt. approved laboratory NABL only. All the type tests must have been conducted within One year’s tenure and on the sample as specified under Cl. No: 12.2.2.1 of IS-14697-1999. Offers without the Type Test reports shall be rejected. The type test report submitted shall be of the same type and design of the meter offered. Please note that the bidder in case of supplier having own NABL accredited lab, the type test certificate furnished with tender from such lab shall not be accepted. (I.e. Type test certificate from own NABL Lab.)

- **Routine test**-

  All routine tests as stipulated in the relevant standards shall be carried out and routine test-certificates/reports shall be submitted along with inspection call letter in the form of composite disk (CD) as per IS 14697-1999 (reaffirmed 2004)/IS 13779 / IS 15884 / with latest amendments and on the CD, A/T No. serial no. of meters to be offered etc. shall be provided with sticker pasted on the CD, to the purchaser for approval and also placed inside individual meter packing.

- **Acceptance test**-

  The meter should pass acceptance test as per IS 14697-1999 (reaffirmed 2004)/IS 13779 / IS 15884 / with latest amendments, CBIP 304 latest version and IEC-62053-21 & IEC 61036/2000 during inspection. Please note that the total energy i.e. fundamental + harmonics shall be measured as per Cl.no. 5.6.2.1 of IEC 61036/2000 along with other tests. If the facility for any of the tests is not available at supplier’s works, the testing shall be arranged at any of
the NABL/Govt. approved lab and for such tests all the expenditures i.e. test charges etc. shall have to be borne by the supplier.

In case order is placed on part or full quantity, Board reserves right to select sample as per relevant IS/IEC from the first lot (minimum 20% of the ordered quantity) offered by party and the samples will be tested at any Govt. approved laboratory which is approved be GEB for type tests and on successful passing the test the lot will be accepted or otherwise the whole lot will be rejected and in that case testing charges shall have to be borne by the party concerned.

5.20. MINIMUM TESTING FACILITIES:

Manufacturer should possess fully computerized meter test bench system for carrying out routine and acceptance tests as per IS 14697 or CBIP 304. In addition, this facility should produce test reports for each and every meter.

The bidder should have the necessary minimum testing facilities for carrying out the following tests:

- AC voltage test
- Insulation resistance test
- Test limits of errors
- Test on meter constants
- Test of starting condition
- Test of no-load condition
- Repeatability of error test
- Test of power consumption
- Vibration test
- Shock test
- The manufacturer should have duly calibrated ERS meter of class 0.1 accuracy.
- 10 KV Impulse voltage test facility.
- Test for Influences Quality.
- AC & DC Magnetic Influence test

5.21. MANUFACTURING ACTIVITIES:

- Meter should be manufactured using SMT (Surface Mount Technology) components and by deploying automatic SMT pick and place machine and Wave soldering process.

- Quality should be ensured at the following stages.
  
  i. At insertion stage, all components should undergo computerized testing for conforming to design parameters and orientation.
  
  ii. Complete assembled and soldered PCB should undergo functional testing using Automatic Test Equipment’s (ATEs).
  
  iii. Prior to final testing and calibration, all meters shall be subjected to aging test (i.e. Meters will be kept in ovens for 72 hours at 55deg. C temperature and atmospheric humidity under real life condition at its full load currents. After 72 hours meters should work satisfactorily) to eliminate infant mortality.
  
  iv. The calibration of meters shall be done in-house with a automated computerized test set-up.
v. All the components should be sourced directly from the reputed manufacturers or their authorized distributors.

vi. A detailed list of bought out items which are used in the manufacture of the meter should be furnished indicating the name of firm from whom these items are procured. The bidder shall also give the details of quality assurance procedures followed by him in respect of the bought out items.

5.22. DEVIATION STATEMENT:

The supplier should submit details of deviation (If any) in proforma as shown below. If it is observed that there are deviations in the offered in Guaranteed Technical particulars other than those specified in the deviation schedule then such deviation shall be treated as deviation offers with deviation are liable for rejection. If no deviation is there, they should mentioned as NIL and submit the proforma as shown below.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Specification</th>
<th>Details in Brief</th>
<th>Deviation</th>
<th>Reason for Deviation</th>
</tr>
</thead>
</table>

5.23. GUARANTEE:

Bidder should agree for 5 years guarantee and free replacement of any component / meters for smooth functioning of the meters. The meters & MRI found defective within the guarantee period shall be replaced / repaired by the suppliers free of cost within one month of receipt of intimation failing which the Board shall recover an equivalent amount plus 15% supervision charges from any of the bills of the supplier.

5.24. PACKING:

The meters shall be suitably packed in order to avoid damage or disturbance during transit and handling each meter should be suitably packed in the first instance to prevent ingress of moisture and dust and placed in a cushioned cartoon of a suitable material to prevent damage due to shocks during transit. The lid of cartoon should be suitably sealed as suitable member of sealed cartoons may be packed in a case of adequate strength with extra cushioning. The cases may then be properly sealed against accidental opening in transit. The packing cases may be marked to indicate the fragile nature of the contents.

5.25. SERVICES:

The supplier shall provide following services –

- Services free of cost shall be provided during guarantee period.
- To train APDCL staff for installation and handling of these meters.
- To assist APDCL Lab. staff to install calibration, checking etc.
- Ordered quantity of meters are to be supplied in stipulated time.
- To provide necessary personnel for taking reading, documentation of report and submission of the same to APDCL authority as required
- Inspection and test certificates will have to be submitted prior to dispatch of ordered material and each lot shall be inspected at your works prior to dispatch of material. All material shall be subject to acceptance after final inspection/ checking and testing as per ISS.
- They should provide necessary assistant to APDCL staff for any meter related problems and wrapped meter checking at lab., for taking data through MRI up to guarantee period of 5 years without any extra cost.
5.26. NAME PLATE AND MARKING:
Meter shall have a name plate clearly visible, effectively secured against removal and indelibly and distinctly marked with all essential particulars as per relevant standards. The manufacturer’s meter constant shall be marked on the Name Plate. In addition to the requirement as per IS, following shall be marked on the Name Plate.
- Purchase Order No.
- Month and Year of manufacture
- Name of purchaser.
- Guarantee Five Years
- ISI mark
- Category of Meter: Category C - HT (PT / CT) Consumer Meter. The lettering shall be bold in 3 mm font.

NOTE: The meters must be compliant to ICS DLMS ETD 13( 6211) for category C.

The suppliers shall have to submit necessary documents and certification in this regard along with their technical offer. The offers, not complying to above, shall be rejected without any further correspondence. In case of foreign bidders, the type test certificates, in respect of the tests conducted as per relevant international standard, i.e. IEC-62053 shall be acceptable. The suppliers shall have to submit the valid License in accordance with IEC-62053 issued by the respective country.

BIS MARK- The meter manufacturer having valid BIS license for tendered items shall only be considered. Meters offered must have ISI marking. The sample passed in electrical testing should be considered for further evaluation.
5.27. ANNEXURE – A Display Parameters for 3-Phase 4 wire HT CT Operated ToD Meter (TO BE PROVIDED IN FOLLOWING SEQUENCE)

<table>
<thead>
<tr>
<th>Mode : 1</th>
<th>Parameters of this mode should display on auto scrolling as well as manually up &amp; down scrolling using push button</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td>Parameter</td>
</tr>
<tr>
<td>1</td>
<td>Display check</td>
</tr>
<tr>
<td>1-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>1-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>1-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>2</td>
<td>Sr. No. of Meters</td>
</tr>
<tr>
<td>2-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>2-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>2-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>3</td>
<td>CT Ratio</td>
</tr>
<tr>
<td>3-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>3-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>3-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>4</td>
<td>RTC date &amp; time</td>
</tr>
<tr>
<td>4-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>4-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>4-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>5</td>
<td>R- Phase Voltage</td>
</tr>
<tr>
<td>5-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>5-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>5-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>6</td>
<td>Y- Phase Voltage</td>
</tr>
<tr>
<td>6-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>6-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>6-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>#</td>
<td>Description</td>
</tr>
<tr>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7</td>
<td><strong>B- Phase Voltage</strong></td>
</tr>
<tr>
<td>7-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>7-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>7-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>8</td>
<td><strong>R- Phase Line Current</strong></td>
</tr>
<tr>
<td>8-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>8-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>8-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>9</td>
<td><strong>Y- Phase Line Current</strong></td>
</tr>
<tr>
<td>9-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>9-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>9-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>10</td>
<td><strong>B- Phase Line Current</strong></td>
</tr>
<tr>
<td>10-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>10-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>10-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>11</td>
<td><strong>Inst. P.F. (Avg. of 3Ph.)</strong></td>
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<tr>
<td>11-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>11-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>11-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
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<tr>
<td>12</td>
<td><strong>Inst. Total active power</strong></td>
</tr>
<tr>
<td>12-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>12-B</td>
<td>24hrs. total reactive energy</td>
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<tr>
<td>12-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>13</td>
<td><strong>24hrs. apparent energy derived from Vectorial summation of total (fund+ Harm.) active energy and reactive (lag only)</strong></td>
</tr>
<tr>
<td>13-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>13-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>13-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>14</td>
<td>Rising demand in KW with elapse time</td>
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<tr>
<td>14-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
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<tr>
<td>14-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>14-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>15</td>
<td>KW-MD of last billing period i.e. billing MD of 24 hours recorded Between last two resets</td>
</tr>
<tr>
<td>15-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>15-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>15-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>16</td>
<td>Cumm KWH for Peak hours (Zone1)</td>
</tr>
<tr>
<td>16-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>16-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>16-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>17</td>
<td>Cumm. KWH for Night hours (Zone2)</td>
</tr>
<tr>
<td>17-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>17-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>17-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td>18</td>
<td>Cumm KWH for Balance hours (Zone3)</td>
</tr>
<tr>
<td>18-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>18-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>18-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
<tr>
<td></td>
<td>MD KW between last two resets – Peak Hours (Zone-1)</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>19</td>
<td>MD KW between last two resets – Peak Hours (Zone-1)</td>
</tr>
<tr>
<td>19-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
</tr>
<tr>
<td>19-B</td>
<td>24hrs. total reactive energy</td>
</tr>
<tr>
<td>19-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MD KW between last two resets – Night Hours (Zone-2)</th>
<th>T2 BMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>MD KW between last two resets – Night Hours (Zone-2)</td>
<td>T2 BMD</td>
</tr>
<tr>
<td>20-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>20-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>20-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD --------Kw</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MD KW between last two resets – Balance hours (Zone-3)</th>
<th>T3 BMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>MD KW between last two resets – Balance hours (Zone-3)</td>
<td>T3 BMD</td>
</tr>
<tr>
<td>21-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>21-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>21-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD --------Kw</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MD KW for Present Billing – Peak Hours (Zone-1)</th>
<th>T1RMD ------ Kw</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>MD KW for Present Billing – Peak Hours (Zone-1)</td>
<td>T1RMD ------ Kw</td>
</tr>
<tr>
<td>22-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>22-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>22-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD --------Kw</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MD KW for Present Billing – Night Hours (Zone-2)</th>
<th>T2RMD ------ Kw</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>MD KW for Present Billing – Night Hours (Zone-2)</td>
<td>T2RMD ------ Kw</td>
</tr>
<tr>
<td>23-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>23-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>23-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD --------Kw</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>24</td>
<td>MD KW for Present Billing – Balance hours (Zone -3)</td>
<td>T3RMD ------ Kw</td>
</tr>
<tr>
<td>24-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>24-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>24-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD -----------Kw</td>
</tr>
<tr>
<td>25</td>
<td>MD KW for Present Billing Period (After last reset)</td>
<td>RMD ------ Kw.</td>
</tr>
<tr>
<td>25-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>25-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>25-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD -----------Kw</td>
</tr>
<tr>
<td>26</td>
<td>Voltage failure count phase wise</td>
<td></td>
</tr>
<tr>
<td>26-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>26-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>26-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD -----------Kw</td>
</tr>
<tr>
<td>27</td>
<td>Current failure count phase wise</td>
<td></td>
</tr>
<tr>
<td>27-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>27-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>27-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD -----------Kw</td>
</tr>
<tr>
<td>28</td>
<td>Voltage unbalance Count</td>
<td></td>
</tr>
<tr>
<td>28-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>28-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>28-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD -----------Kw</td>
</tr>
<tr>
<td>29</td>
<td>Current unbalance Count</td>
<td></td>
</tr>
<tr>
<td>29-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>29-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>29-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD ---------Kw</td>
</tr>
<tr>
<td>30</td>
<td><strong>Current reversal count- phase wise</strong></td>
<td></td>
</tr>
<tr>
<td>30-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>30-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>30-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD ---------Kw</td>
</tr>
<tr>
<td>31</td>
<td><strong>Low Power factor count</strong></td>
<td></td>
</tr>
<tr>
<td>31-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>31-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>31-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD ---------Kw</td>
</tr>
<tr>
<td>32</td>
<td><strong>Magnet tamper count</strong>.</td>
<td></td>
</tr>
<tr>
<td>32-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>32-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>32-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD ---------Kw</td>
</tr>
<tr>
<td>33</td>
<td><strong>Total Tamper Count</strong></td>
<td></td>
</tr>
<tr>
<td>33-A</td>
<td>24hrs. total active energy (fundamental+ harmonics)</td>
<td>TC Kwh</td>
</tr>
<tr>
<td>33-B</td>
<td>24hrs. total reactive energy</td>
<td>TC Kvarh lg</td>
</tr>
<tr>
<td>33-C</td>
<td>MD of 24hours recorded (Cumulative MD)</td>
<td>CMD ---------Kw</td>
</tr>
<tr>
<td><strong>Mode : 2</strong></td>
<td><strong>Parameters of this mode should display manually up &amp; down scrolling using push button</strong></td>
<td></td>
</tr>
<tr>
<td>Sequence</td>
<td>Parameter</td>
<td>Notation</td>
</tr>
<tr>
<td>1</td>
<td>Inst. P.F.Phase 1</td>
<td>P.F1</td>
</tr>
<tr>
<td>2</td>
<td>Inst. P.F.Phase 2</td>
<td>P.F2</td>
</tr>
<tr>
<td>3</td>
<td>Inst. P.F.Phase 3</td>
<td>P.F3</td>
</tr>
<tr>
<td>4</td>
<td>Phase Sequence - Voltage</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Phase Sequence - Current</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Frequency</td>
<td>Hz</td>
</tr>
<tr>
<td>7</td>
<td>Cumm. KVARH ( Lead)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Cumm KVARH-lag for night hours (Zone2)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Cumm. KVARH-lag for peak hours (Zone1)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Cumm KVARH-lag for balance hours (Zone3)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Cumm KVAH for night hours (Zone2)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Cumm. KVAH for peak hours (Zone1)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Cumm KVAH for balance hours (Zone3)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Avg. PF for last billing – Peak Hours (Zone-1)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Avg. PF for last billing – Night Hours (Zone-2)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Avg. PF for last billing – Balance hours (Zone-3)</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>MD KVA after last billing – Peak Hours (Zone-2)</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>MD KVA after last billing – Night Hours (Zone-1)</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>MD KVA after last billing – Balance hours (Zone-3)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>MD KVA between last two resets – Peak Hours (Zone-2)</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>MD KVA between last two resets – Night Hours (Zone-1)</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>MD KVA between last two resets – Balance hours (Zone-3)</td>
<td></td>
</tr>
</tbody>
</table>

**Mode : 3**

Parameters of this mode should display manually up & down scrolling using push button

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Parameter</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Resolution display for KWH</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>High Resolution display for KVARH-Lag</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>High Resolution display for KVAH</td>
<td></td>
</tr>
</tbody>
</table>
5.28. **ANNEXURE-B**

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Type of Tamper</th>
<th>Requirement</th>
<th>Tamper Logics / Conditions &amp; (Occurrence &amp; Restoration) Persistence Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Occurrence</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage</td>
</tr>
<tr>
<td>1</td>
<td>Voltage Failure</td>
<td>Phase wise</td>
<td>$V_x &lt; 40%$ of $V_{ref}$ irrespective to any other phase voltage</td>
</tr>
<tr>
<td>2</td>
<td>Current Failure</td>
<td>Phase wise</td>
<td>All voltages &gt;75% of $V_{ref}$.</td>
</tr>
<tr>
<td>3</td>
<td>Voltage Unbalance</td>
<td>-</td>
<td>($V_{max}$-$V_{min}$) &gt;10% of max Voltage of 3 phase voltages and all voltages &gt;60% of $V_{ref}$.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>Current Unbalance</td>
<td>All voltages &gt;75% of Vref.</td>
<td>(Diff. of Actual Max current &amp; Actual Min current) &gt; 30% of Actual maximum current and all phase has value greater than 10% Ib i.e. 1 Amp</td>
</tr>
<tr>
<td>5</td>
<td>Current reversal</td>
<td>Phase wise</td>
<td>All voltages &gt;75% of Vref.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Magnetic Influence</td>
<td>-</td>
<td>When magnet influence start affecting the accuracy, meter should start recording at max i.e. 60 Amp</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Neutral Disturbance</td>
<td>-</td>
<td>Phase to Neutral voltage for any two phases remaining phase is&lt;50V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Low Voltage</td>
<td>-</td>
<td>Vx &gt; 40% of Vref &amp; Vx&lt; 75% of Vref</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>High Voltage</td>
<td>-</td>
<td>Vx&gt; 115% of Vref</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For tamper logics, following points shall be taken in consideration:

- During Neutral disturbance tamper, all voltage related tampers (i.e. Voltage Failure, Voltage Unbalance, and High Voltage & Low Voltage) shall not be logged.
• During High Voltage & Low Voltage tampers, Voltage unbalance tamper shall not be logged.
• During Voltage failure Tamper, Voltage Unbalance & Low Voltage tamper shall not be logged.
• During current failure Tamper, Current Unbalance tampers shall not be logged.
• During power failure duration, if any tampers persisting, those tampers shall not get recovered until it meets the logic for restoration and duration of respective tamper shall be from occurrence of that tamper irrespective of power failure duration.
• For tamper events logging, snap shot data i.e. instantaneous parameters, active energy register reading (Total kwh) & date & time should be corresponds to starting of occurrence and starting of restoration.
• Snap shot of date and time should be available for occurrences and restorations of events.

5.29. ANNEXURE – C HHU SPECIFICATIONS FROM ICS

• Requirement and Specification of DLMS/COSEM complaint HHU/CMRI

Communication standards in the Indian metering scenario require supporting considerations for the utilization of those standards in HHUs (Hand Held units) or in CMRI (Common Meter Reading Instrument). This annexure provides a suitable approach to the implementation of the IEC-62056 standards and this Indian Companion Specification in such devices.

The terms of this suggested implementation are as below.

i. HHUs may retrieve data from DLMS/COSEM Meters conforming to this standard using the same DLMS/COSEM communication port that is provided for remote meter reading.
ii. HHUs shall exclusively use the Meter Reading association (MR) and shall support all the features and specifications listed in this specification for the MR Association.
iii. HHUs shall have the same data access rights that are available to the MR Association, as that available for remote meter reading.
iv. HHUs shall implement the DLMS/COSEM communication standard conforming to this specification to provide a DLMS/COSEM client protocol driver to communicate with the meters to download billing data or perform other services available to the MR Association.
v. HHUs shall provide a DLMS/COSEM server interface to the BCS (Base Computer System – the Data collection software) over a suitable communication medium (Local serial port implementing the DLMS/COSEM CO 3-layer stack is suggested).
vi. HHUs shall internally map the individual meter data to logical devices (One logical device for each meter). Inside each logical device the structure and naming of the data shall be the same as that retrieved from the meter.
vii. The BCS shall maintain a mapping table that maps the individual meter identifications (the same IDs that are used to identify the meter during remote meter reading) to Logical device addresses. During upload of data from HHU to BCS, the BCS shall query each Logical device to download the data of each meter over the local serial port.

viii. Logical device addresses shall be allocated to each meter which shall be unique across all meters that are to be retrieved using one HHU. Other HHUs may re-use the same addressing from their own range of allocated meters. The BCS shall take care to ensure that the re-use of addresses does not create conflicts in meter.
5.30. ANNEXURE-I PREQUALIFICATION CONDITIONS FOR THREE PHASE STATIC METERS

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Particulars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bidders must have produced/ executed order of tendered item to any SEBS/power utility company in last 3 years. The bidder should submit the order copies along with their Bid as a evidence.</td>
</tr>
<tr>
<td>2</td>
<td>Bidders must have valid ISI license</td>
</tr>
<tr>
<td>3</td>
<td>Bidder preferably possesses ISO 9001 certification.</td>
</tr>
<tr>
<td>4</td>
<td>Bidder shall be manufacturer of static meters. Offer from traders / agents are not acceptable</td>
</tr>
<tr>
<td>5</td>
<td>Bidder shall have ISI license for similar design product and/or type test certificate for all the type tests as per IS 13779 or IEC-62053 from International or from Indian Govt. approved lab</td>
</tr>
<tr>
<td>6</td>
<td>Bidder shall have to submit type test report for AC/DC magnetic field as per CBIP 304 &amp; its latest amendments from independent Govt. Approved lab. as well as DC magnetic influence test for 0.5 tesla and total energy test. The tender without valid type test report should be out rightly rejected.</td>
</tr>
<tr>
<td>7</td>
<td>Bidders shall have dust free &amp; air conditioned environment for assembly as well as testing.</td>
</tr>
<tr>
<td>8</td>
<td>Bidders shall have automatic computerized test bench for lot testing of meters and oven for ageing test. The document evidence is to be attached along with the bid.</td>
</tr>
</tbody>
</table>

PLACE:

SEAL & SIGNATURE OF TENDERER
NAME:
DESIGNATION:

*Bidders are requested to read the following as the part of tender technical specifications document.*
At the end of the tender technical specification, following paragraph should be added and read as under:
The material supplied shall be conforming to Indian Standard Specification (except DLMS compliance, if any) and also with ISI marking and even after inspection of the lot, if the material received at site is found without ISI marking, the lot shall be rejected and no further correspondence shall be entertained in this regard.
6. Technical Specifications of Push fit type meter box made of engineering plastic

- The meter box shall be weather proof, tamper proof and made of transparent engineering plastic conforming to IS: 11731. Type test report of material is required to be furnished along with the bid.
- The meter box should be unbreakable un-deformable and should withstand the temperature up to 140 deg. cent.
- Thickness of the base should be at least 2 mm and cover should be of not less than 0.8 mm.
- Clearance of 30 mm shall be maintained from top and both sides of the meter. However, the clearance at bottom should be of 75 mm. from the meter and 45mm from the terminal block. Besides, there should be minimum clearance of 15 mm in the front from the face of meter.
- The top cover of the meter box should be of push fit type having at least 4 self locks so that once the top cover of the box is fitted with the base it cannot be removed without breaking the top cover. The cover and base shall have groove all along with the fitting edge, so that after fixing the top cover, no wire or any device can be, temporary or permanently, inserted in the box. The top cover of the box, provided with self-lock, should have arrangement/barrier so that after getting locked, it cannot be detached from latches even by applying external pressure through any means. The locks will be moulded in the cover and base and will not be separate pieces fixed later. There will be no holes to access the locks from any side.
- Additional provision to provide lash wire utility seals on meter box shall be made.
- Meter shall be fitted with the base of box through unidirectional type screw or by some other better means in such a way so that once the meter is fitted with the base; it cannot be removed from the base and become an integral part with base. The meters shall be supplied duly mounted on the base of meter box and the cover shall be placed separately in the cartoon.
- Suitable circular holes with adjustable cable glands shall be provided at the bottom of the meter box for inlet and outlet of consumer’s service cables. The incoming and outgoing gland shall be positioned such that they disable direct access to terminals through glands.
- The meter box cover or base shall have a barrier so positioned that any possibility of fiddling the meter terminal from outside of the meter box through cable entry holes is not possible. The barrier shall have reinforce/locked at both sides to restrict its movement up and down even by applying external pressure through any tools.
- The top cover of meter Box should have spring loaded push button with spindle in moulded barrel perfectly in alignment to operate push button of the meter to read display parameter on push button mode.
- Provision of down loading the data from the meter without opening the meter box, this access to meter optical port is provided by creating a depression on the meter box cover. This depression is aligned with the optical port on the meter. The CMRI optical probe fits into the depression directly and the data is downloaded from the meter.
- Note: Sealing arrangement must be provided to avoid external interruption.
- The boxes shall be specific to the meter mounted in it. Thus, the Serial Number of the meter should be indelibly engraved /marked on the base of meter box as well as on the cover of meter box.
- The box should have proper mounting arrangement so that it could be mounted on the wall or the pole, as the case may be.
- The meter box comprises of base and cover shall pass the following tests;
  i. **Unbreakability test:** Shall not get damage or deform while dropping from a height of 10 ft.
and hammered with 2 kg. Hammer to test its unbreakability.

ii. **Boiling water test:** - It should pass the boiling water test as prescribed in IS: 13010.

- The overall dimensions of the meter box shall vary according to the different make of meters. However, it shall comply with the minimum requirements as described above.
- The individual meter manufacturers shall submit the specific drawing and sample accordingly to accommodate there make meter only.

### 7. Technical Specifications for 100/5 Amp Ring Type Tape Wound Current Transformer

#### 7.1. General

<table>
<thead>
<tr>
<th></th>
<th>SCOPE</th>
<th>This specification covers design, manufacture and testing of 100/5A ratio Current Transformers of Ring Type.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>APPLICABLE STANDARD</td>
<td>IS 2705, 1992</td>
</tr>
<tr>
<td>2</td>
<td>CURRENT RATIO</td>
<td>100/5 Amp.</td>
</tr>
<tr>
<td>3</td>
<td>BURDEN</td>
<td>5 VA</td>
</tr>
<tr>
<td>4</td>
<td>ACCURACY CLASS</td>
<td>Class 0.5</td>
</tr>
<tr>
<td>5</td>
<td>SYSTEM VOLTAGE</td>
<td>440 V AC, 50 Hz</td>
</tr>
<tr>
<td>6</td>
<td>INSTRUMENT SECURITY FACTOR</td>
<td>Less than 5</td>
</tr>
<tr>
<td>7</td>
<td>RATED CONTINUOUS THERMAL FACTOR</td>
<td>1.2 Times Continuous</td>
</tr>
<tr>
<td>8</td>
<td>RATED SHORT TIME THERMAL CURRENT</td>
<td>3 KA r.m.s. for 1 Second 2.5 Times the rated Short Time Thermal Current (i.e. 7.5 ka Peak)</td>
</tr>
<tr>
<td>9</td>
<td>RATED DYNAMIC PEAK CURRENT</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>HIGH VOLTAGE POWER FREQUENCY TEST</td>
<td>3 kV for 1 Minute.</td>
</tr>
<tr>
<td>11</td>
<td>TEMPERATURE RISE TEST</td>
<td>70 Deg. C Maximum</td>
</tr>
<tr>
<td>12</td>
<td>INSULATION CLASS</td>
<td>Class- E</td>
</tr>
<tr>
<td>13</td>
<td>NUMBER OF TURNS</td>
<td>Primary – Single Secondary – For 100/5 A Ratio 20 Turns.</td>
</tr>
</tbody>
</table>

#### 7.2. Construction

<table>
<thead>
<tr>
<th></th>
<th>CORE MATERIAL</th>
<th>Low loss, CRGO M4 or better grade (Core Losses should not exceed 0.8 Watts/ Kg. At 1.5 Tesla)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COPPER WIRE MATERIAL</td>
<td>Enameled wire as per IS 4800 Part IX</td>
</tr>
</tbody>
</table>

---

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<table>
<thead>
<tr>
<th><strong>TEST CERTIFICATE</strong></th>
<th>To be submitted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CROSS SECTION AREA</strong></td>
<td>Minimum 1.6 mm²</td>
</tr>
<tr>
<td><strong>OUTER INSULATION</strong></td>
<td>Suitable for Class E or better insulation Class. Electrical Insulation grade tape.</td>
</tr>
<tr>
<td><strong>INNER DIAMETER OF CT</strong></td>
<td>For ratio 100/5 A – 30 mm Minimum.</td>
</tr>
<tr>
<td><strong>OPLARITY &amp; THERMAL MARKING</strong></td>
<td>Clear marking as, P2, S1 &amp; S2 with PVC Sticker.</td>
</tr>
<tr>
<td><strong>SECONDARY TERMINALS</strong></td>
<td>Winding wires to be bought out with 1 Meter lead length and to be provided with Red, Yellow &amp; Blue colored PVC sleeves constituting one set. Secondary leads to be terminated by tinned copper crimping pins.</td>
</tr>
<tr>
<td><strong>DIMENSION TOLERANCE</strong></td>
<td>Party has to submit drawing for CT along with tender offer. Overall dimension tolerance to be within ± 10%</td>
</tr>
</tbody>
</table>

| **NAME PLATE** | Metal plate (Aluminum / Brass) with following details. Embosses or printed on it :  
Ratio, burden, system voltage & frequency.  
1. Accuracy Class.  
2. B.I.L. & Insulation Class.  
3. Batch No. & Sr. No. of CT.  
4. Manufactures Name & manufacturing year.  
5. Words “ PROPERTY OF APDCL “  
6. A/T Number. |
| **DRAWING APPROVAL** | Party must get final drawing approval from APDCL before commencement of supply. No separate period for Drawing approval will be given. |

### 7.3. Tests:

- **Type Test Reports :-**
  
  Type test report as per IS 2705, 1992 must be submitted along with offer with duly certified drawing bearing all details of winding size, turns & dimensions with tolerance. All the Tests must be carried out on same sample unit. Type test report must not be older than 3 years from date of tender.

- **Routine Tests :-**
  
  The party has to submit routine test certificates along with inspection call in the form of CD.

- **Acceptance Tests :-**
  
  Party has to offer lot for inspection to APDCL 5% random samples shall be selected from the lot and acceptance tests as per IS 2705 – 1992 & latest amendments if any shall be carried out. On successful passing of the entire test, clearance will be given to dispatch the material by the
company. From each lot of CTs offered, one set of CT shall be selected, sealed & signed & handed over to supplier for onward deposit to Govt. approved lab for type testing. The testing charges shall be borne by the supplier (Bidder)

- **Testing Facilities:**

  The firm should have following Testing facilities.

  i. Automatic test set up (Class 0.1) for ration Error & Phase Angle Error

  ii. Standard CT of Class 0.2 or higher accuracy.

  iii. Burden Box having Full & Quarter Burden at 0.8 P.F.

  iv. High Voltage Tester.

  v. Test Facility for over Voltage Inter Turn testing.

All the test equipment and standard CT must be calibrated at the third party government approved laboratory at the stage of tender offer and along with call. Copy of the Calibration certificates must be submitted.

i. **List of Plant & Machinery and Test Equipments** with relevant details like make, capacity, accuracy, model must be submitted along with tender offer.

ii. **Quality Assurance Plan:**

   Party must submit Quality Assurance Plan for the checks carried out at various stage from Raw Materials to finish goods. Documents for the checks carried out may be verified by inspector at the time of inspection.

iii. **Guarantee:**

   The party should guarantee for free replacement / rectification for the CT under the guarantee period of 12 months from the date of installation or 18 months from the date of supply.

iv. **Packing:**

   A set of 3 CTs shall be packet in a box / carton marking serial number on each box.

v. **Tender Sample:**

   The bidder has to submit type reports of 100/5 Amp. CTs (total 6 Nos.) along with offer. The offer without submission of tender sample shall be out rightly rejected. The tender sample shall be verified for acceptance tests as per IS 2705/92 & latest amendments, if any. In case of discrepancy in any of the sample reports submitted, offer of bidder shall be considered as disqualified.
8. User Interface

8.1. General Requirements

This chapter describes the User Interface requirements for the Smart grid control centre. All smart grid integrated functions shall have common user interface, as user interaction shall be performed from Operator Consoles envisaged in this specification. All user interactions shall be from full graphics display.

8.2. System Users

The term "user" is applied to the personnel interacting with the smart grid control centre. These users shall be required to login in one or more of following user modes, which include:

- **Supervisor**: Personnel responsible for smart grid control centre administration and management such as assigning the access area to users, creating users etc.
- **Dispatcher**: Personnel responsible for real-time Power system operations including real-time study.
- **Engineer**: Personnel having access to certain smart grid control centre functions and maintenance of database/ displays and responsible for support activities such as post fault analysis, report generation, regular backup of database
- **Programmer**: Personnel responsible for continuing development and maintenance of the smart grid control centre functions, databases, displays and report formats.
- **Remote Managerial user**: Personnel having only monitoring access of real-time power system from smart grid control centre, reports.

The role, accessibility for each mode is defined as above, However, the Utility with login as supervisor shall be able to assign the operation of certain functions, or features of functions, to specific user modes. Utility shall maintain the privileges as specified to each user mode. Each individual user shall be assignable to anyone or more user modes. User access to all Smart grid control centre’s function shall follow a consistent set of common user access guidelines. A mechanism for defining and controlling user access to the smart grid control centre shall be provided. Password security shall be provided for access to the smart grid control centre, its operating system, layered products, and other applications. Each password shall be validated against the corresponding user information in the database. Users shall have the ability to change their own passwords.

8.3. Function and Data Access Security

After a user has successfully logged on, access to the smart grid integrated functions, displays, reports, and databases shall be restricted by pre-assigned operating jurisdictions. These operating area assignments shall be made when the function, display, report, or database element is defined. The access security function shall compare the user’s assigned operating jurisdiction against the Operating jurisdictions assigned to the function, display, report, or database element each time a user attempts a console action, such as:

- Calling a display.
- Entering or changing display data.
- Viewing, editing, or printing a report.
- Executing a supervisory control action.
There shall be no restrictions on the assignment of multiple jurisdictions to a console & user or the assignment of a jurisdiction to multiple consoles & users. The access security function shall ensure that each jurisdiction is at all times assigned to a least one console. If a console failure or manual reassignment of jurisdiction results in one or more jurisdictions not being assigned to at least one console, the unassigned jurisdictions shall be automatically assigned to a pre-assigned default console and suitable alarms shall be generated. Smart grid integrated users shall not require additional login (user name and password) to the other facility allowed as per operating jurisdictions such as ISR. “Single Sign-On” (SSO) technology be employed (i.e., a user logs on once to the smart grid integrated using individually defined user name and password) which permits appropriate level of access to smart grid integrated facilities, including IS&R. Further, the facility should be compatible with enterprise-wide SSO capabilities. Each log-on and log-off shall be reported as an event. Unsuccessful attempts to log-on shall also be reported as events.

8.4. Windows Environment

The user interface for Smart grid control centre shall be web enabled. The smart grid control centre displays shall operate within a windows environment and shall conform to the standards contained in the X Consortium’s Inter-Client Communications Conventions Manual (ICCCM). The window system shall work with the graphical user interface provided and shall allow windows created on the Workstations to communicate with processors equipped with X Windows- compatible software on their respective local area networks (LANs) and with future remote applications over the wide area network (WAN).

Alternatively, the Smart grid control centre can have the user Interface based on Microsoft Windows. The functionality in technical specification related to the GUI features of X-windows, shall be met by available features of Microsoft Windows.

It shall be possible to save window configuration in rooms. Rooms shall allow each user to configure and save a preferred layout, size, and location of windows and displays. The World Display Features shall provide two-dimensional graphic world displays that a user shall be capable of panning, zooming and rubber banding. The world display features such as Layers, De-clutter levels, Overlays shall be supported. Displays & navigation on VPS shall be same as on the operator workstations. The user interface software shall be based on state-of-the-art web-based technology to present interactive, full-graphics views of system data via LAN, corporate intranet or the Internet. The same displays shall be used. It is essential that the same web-based user interface (same navigator, same tools) be available to the operator either for local use in the dispatching center or remotely.

The web technology shall be natively supported by the Smart Grid product, which means that having the displays shown in the web browser shall not bring additional work to the maintenance engineer at display building time. Nor shall it require additional third-party software products like specific plug-ins. The web user interface shall support and enforce all security features described in the following sections.

8.5. Display interactions

Rapid, convenient, and reliable display requests shall be provided using the following methods:

- Display Request:
  - i. Selection of a display from a menu display.
  - ii. Cursor target selection on any menu, graphic, or tabular display.
iii. Selection of an alarm: in this case, it shall call up the one-line display containing the alarm’s location. Selection of an alarm or event message on a summary display followed by a display request command.
iv. Selection of display by Entering a display name or number.
v. Forward and reverse paging in a page-based display.
vi. Selecting a previous display by re call command.
vii. Selecting a point of interest from an Overview display for viewing on full screen (such as Viewing a SLD of a substation by selecting the Substation node from a Network diagram).
viii. Selecting function keys or cursor targets dedicated to displays.

- **Display navigation:**

Display navigation methods shall provide a consistent approach for moving within a display. The following methods shall be provided:

1. Panning with cursor positioning device or scroll bars
2. Zooming with cursor positioning device
3. Navigation window for rapid movement between portions of a world display
4. Rubber-band zooming.
5. Tool tip
6. Find & locate
7. Drag & drop

**Zooming** shall affect the magnification level of the data displayed. Panning shall move the viewed portion of a world map space. The size of the viewed portion of the map relative to the whole display shall be indicated by the width of the sliders in the scroll bars of the window displaying the sector. When a display is first called up in a window, it shall be automatically scaled as per default zoom level.

Both continuous and discrete panning and zooming control shall be provided. Continuous panning and zooming shall be done in a convenient and intuitive way using the mouse; and the resulting changes in the screen contents shall be “smooth” and instantaneous without any noticeable delay. Discrete panning and zooming in larger steps shall be possible by dragging the mouse, using the keyboard, and clicking on pushbuttons on toolbars.

When only a part of the display is shown in the active window, the user shall be able to request a “navigation” window for orientation. This window shall show a small replica of the complete display, with the displayed sector of the display highlighted. The user shall be able to move the navigation window anywhere on the screen, and shall be able to close it.

A **de-cluttering mechanism** that defines the visibility of a graphic construct as a function of its magnification shall be provided. As zooming changes the magnification of data displayed, the de-clutter mechanism shall cause levels of detail to be shown or suppressed. The magnification range corresponding to each de-clutter level shall be defined as system configuration parameter. Static and dynamic element within a display shall have associated with it a visibility designation as yes or no for each in addition to reaching the various de-cluttering levels through zooming, users shall also be allowed to request a specific level from a dialog menu. The user shall be able to scale (zoom) the image of a world co-ordinate space or display in a smooth fashion to any convenient scale factor. The scale factors shall allow the presentation of an entire world co-ordinate space or
display on the full screen or a window.

Static and dynamic data shall be displayed and updated during a scaling operation, and display text shall be scalable to be consistent with the scaled image. At defined scale factors, levels of de-clutter shall be invoked.

The user shall be able to select an area of a world co-ordinate display by cursor manipulation (“rubber-banding”) and cause the display to be redrawn with the selected area centered in the display and with the selected area magnified to best fit the full window. The window dimensions shall not be changed by such an action. A tool tip or equivalent method shall be provided for displaying information in English text & Numeral upon moving cursor on the device etc. Find & locate feature shall also be provided to take the user to the online/ network display where the particular component exists.

- **Permanent Indicators**

Several indicators, including those listed below, shall be permanently shown on each Smart grid control centre display screen as minimum:

  i. Date and Time: Date shall be presented in the format DD/MM/YY. Time shall be presented in the format HH:MM:SS with a resolution of one second, and shall be updated once per second.

  ii. Username: Name of the user logged in the Smart grid control centre.

  iii. Name of the active server

  iv. Name of the smart grid integrated display accessed.

  v. Name of the display window

- **Default Screen Layout:**

It shall be possible for each user to define a personal layout (Rooms) for the screens displayed on the screen(s) of the workstation, i.e. to define a personal default setup of the position, size, and contents of the screens.

The user’s default layout shall appear when the user logs on to a workstation. When a dispatcher takes over a new shift by logging on without the previous dispatcher logging off first, the current screen layout shall be preserved. It shall be possible to go to another room layout of the logged on user at any time.

- **Display Note pad:**

A user shall be able to place and edit a note on bays, devices etc on any display. A symbol shall appear on the display indicating the presence of Note on that display. The content of the note shall be callable using a cursor target.

- **Quality Code and Tag Indication**

All displays and reports containing telemetered analog values, device status and calculated values shall have a data quality code associated with each data field. The quality code shall reflect the condition of the data on the display or report. When more than one condition applies to the data, the symbol for the highest priority condition shall be displayed.

A separate indicator shall identify the devices that have supervisory control inhibit tags. When more than one tag are present on a device, the highest priority tag shall be displayed.
8.6. User Interaction Techniques

The user's interaction with the Smart grid control centre for power system operations shall primarily be accomplished using a menu item selection technique. The first step in the interaction will be selection of the item to be operated upon. The user shall then be provided a menu of operations applicable to the selected item. The required operation alternatives include:

- Supervisory control
- Data entry
- Device status entry
- Scan inhibit/enable
- Tag placement/removal
- Trend.

A set of parameters shall be presented appropriate to the item type and operation to be performed. For example, selecting a device for control shall cause a menu of control actions to be presented. Selecting an analog value for trending shall cause a menu of parameters, such as range and trend rate etc., to be presented.

As appropriate for the data and function requested, a menu containing output destinations such as screen, printer, or file shall be presented. When the destination is selected by the user, the requested action shall begin. It shall not be necessary to select an execute command to complete the interaction except for supervisory control actions.

The user shall be able to end the interaction sequence at any time by selecting a cancel command. The progress of all user operations shall be monitored. If the user does not complete to a step within a multi-step operation within a pre-defined time, the process shall reset, and the user shall be informed of the reset. A partially completed action shall be reset if the user begins another non-related sequence. A programmer-adjustable time-out cancel shall also be provided.

- User Guidance

The Smart Grid control centre shall respond to all user input actions indicating whether the action was accepted, was not accepted, or is pending. For multi-step procedures, the systems shall provide feedback at each step. User guidance messages shall be English text and shall not require the use of a reference document for interpretation. User shall be guided for multiple options. The use of mnemonics is prohibited, unless the mnemonics are industry-accepted or approved by employer. Provisions are required for administrators to edit the toolbars and menus, user guidance messages and to construct new ones through an interactive procedure and without programming.

- User Help:

In addition to the user guidance, general and specific context-sensitive on-line help shall be available to the Smart grid control centre user. Context sensitive means that the help information provided shall be applicable to the next step or steps in the sequence being performed. The Help menu shall present a list of topics available for reference. The topics shall refer to the Smart grid control centre user documents. The ability to scroll through the topic’s explanatory text shall be supported.

The Help button in a dialog box and help key shall present the text of the user documents where use of the dialog box is explained. The user shall be able to scroll through this text exit from the
help facility and shall return the user to the same point in the sequence for which help was requested.

Context sensitive help facilities shall be provided for each application software package and operator display. The capability to easily edit or add additional help facilities in the future shall be provided.

The help facility shall also support:

i. search mechanism
ii. navigation links between related topics within the help documents
iii. select/copy mechanism
iv. print facilities

- **Overlapping user access:**

  The ability to queue multiple commands from different consoles shall be provided. In this regard, however, interlocks shall be provided to avoid overlapping user access to certain Functions such as data entry and supervisory control as follows:

  i. **Data Entry:** Although the same data entry field, device status entry or fields (in the case of full-page data entry) may appear concurrently in multiple windows at multiple consoles, data entry for the field or fields shall be restricted to one window at one console at a time. An attempt to initiate data entry for the field or fields from another window shall result in a user guidance message. Concurrent data entry on different areas of a world display, however, shall be allowed.

  ii. **Supervisory Control:** Although the same power system device, such as a circuit breaker, may appear concurrently in multiple windows at multiple consoles, control of the power system device shall be restricted to one window at a console at a time. An attempt to initiate control of the power system device from another window shall result in a user guidance message.

- **Function Key Usage**

  Special functions shall be assigned to the 12 function keys on a standard keyboard. With extensions (e.g., Shift, Alt, Esc) this shall result in a minimum of 48 function key actions.

- **Trend**

  Trend shall be a display of series of values of parameters on a time axis. Both graphical trend and tabular trends shall be supported. The attributes of the trend display shall be user configurable. The trend application shall be able to show trends for any measurement type from more than one source, at least from real-time, historical and forecast sources. It shall be possible to combine this data showing data for comparison using a shared timeline simultaneously comparing for example yesterday (historic) and today (historic, actual and forecast) as two curves on the same time axis. It should be possible to trend different types of parameters (P, Q, V, I, F etc.) with associated Scales on the same display. The user shall be able to select a trend rate different than the sampling rate.

  i. **Graphical Trend**

     The user shall be able to select and configure trending on Graphical displays enabling user for entry of the following parameters:
     
     - Data value name
• Trend header
• Trend direction (horizontal or vertical)
• Scale (unidirectional and bi-directional)
• Zero offset
• Trace number, colour & texture
• Trend data rate
• Trend start time and date (historical data only)
• Total trend duration (historical data only)
• Reference lines or shading axes (With default to restrictive alarm limits)
• Windows/chart to be used.
• Simultaneous trending of different parameters with associated scales.

Trending of at least four values simultaneously, on a common axis or separate axes shall be supported. All scales corresponding to the values selected shall be visible on the Trend Display simultaneously. There shall be automatic movement of data down or across the screen as new values are generated. When the number of real-time trend samples reaches the limit that can be displayed, the oldest value shall automatically be removed as the display is updated. The magnitude & time of all the trended quantities at a particular time instant shall be displayed when the cursor is placed on the timescale on the trend display. When historical data is selected for trending, the user shall be able to page forward and backward, or scroll by the use of a scroll bar, through a non-updating snapshot of the data within the constraints of the data stored in the historical files. Shading between each trend value and user-definable axes shall be provided. Trend color shall be changeable based on a comparison of the trend value against associated alarm limits. It shall be possible to have at least data samples corresponding to 2 months on line storage for each of the trended variable. The user shall be able to print the trend without interfering with the continuing trending process.

ii. Tabular Trending

Tabular trending shall be a listing of the time-sequential values of a variable/variables. The tabular trend shall present the data in a tabular form with one column for Date/time and additional columns for each of the trended variable. The tabular trend shall contain at least rows for samples corresponding to 2 months on line storage. Each row shall contain the values of the trended variables. It shall be possible to scroll up and down to see the rows. The sampling rate shall be individually definable for each tabular trend.

The historical tabular trends, which shall be produced from the previously stored values in trend files, it shall be possible to choose the start time, the end time, and the sampling rate independently of the sampled rate of historical data.

It shall also be possible to save trend output to an ASCII file. The file output shall be in ASCII format, with date and time information and the engineering unit value of the trended variables for each collection interval. The user shall be able to print the trend on a user-selected printer without interfering with the continuing trending process.

8.7. Alarms

Alarms are conditions that require user attention. All alarms shall be presented to the user in a consistent manner. Alarm conditions shall include, but not be limited to, the following:
• Alarm message deleted from alarm summary when return-to-normal alarm is acknowledged.
• Alarm message deleted by user action.
• Telemetered or calculated value limit violations
• Values returning to normal from a limit violation state
• Un-commanded changes of a power system device state
• Smart Grid Integrated application program results
• Data source communication errors resulting in loss of data
• Smart Grid control centre hardware or software failures.

Each alarm shall be subjected to a series of alarm processing functions. A device or value’s alarming conditions shall be assigned to an alarm category and alarm priority levels. Alarms shall also be subjected to advanced alarm processing. The results of the alarm processing shall determine the console(s) that will receive and be authorized to respond to the alarm and the associated actions with the alarm.

All alarm messages shall be recorded on auxiliary memory of Smart Grid control centre and archived in chronological order & reverse chronological order. It shall be possible to sort, display and print user selected alarm messages from any console by the user.

• **Alarm Categories**

  An alarm category provides the logical interface that connects an alarm condition to a specific Area of Responsibility (AOR) or operational jurisdiction as defined and accordingly alarm shall be reported to user. Every alarm shall be assignable to a category. Each category shall, in turn, be assignable to one or more users. A means shall be provided for changing operating shifts without reassignment of alarm categories at a console. Each log-on and log-off shall be reported as an event.

• **Alarm Priority levels**

  Each alarm shall be assigned to an alarm priority level. Up to 8 alarms priority levels shall be supported. Each alarm priority level shall be presented in separate display. For each alarm, it shall be possible for the programmer to independently configure the following actions:
  
  i. Audible alarm tone type selection and its enabling/disabling.
  ii. Alarm messages to be displayed on an alarm summary return-to-normal alarm occur.
  iii. Alarm message deleted from alarm summary when Acknowledged.
  iv. This assignment shall determine how the alarm will be presented, acknowledged, deleted, and recorded.

• **User Interaction for Alarms**

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

  i. **Alarm Inhibit/Enable:**

     Inhibiting alarms for a value or device, including a complete Meter/ DCUs/ Repeaters or other data source, shall cause all alarm processing of that value or device to be suspended. The action shall be recorded in the event log. However, Scanning of the value or device shall continue and the database shall be updated.

  ii. **Alarm Acknowledgment:**
An alarm shall be acknowledged by selecting an alarm acknowledge command when the item in alarm is selected on:

- Any display showing the item in alarm
- Any display showing the alarm message.

User shall be able to acknowledge alarm individually, by page, user selected manner. It shall be possible for the user to distinguish persistent & reset alarms under acknowledged & unacknowledged conditions. All alarms shall be stored by the system.

iii. Audible alarm silencing:

User shall be able to silence alarm without acknowledgement and shall remain until the user enable the audible alarm. The silencing & enabling shall be recorded as event. The tones shall be definable on the console basis. For each console, multiple tones shall be available. Tones shall be of continuous & short duration type both. The former shall be of high priority condition & require operator intervention to stop. In case of short duration tone, it shall go off at its own.

iv. Change Alarm Limits

The user shall be able to change the alarm limits. When the user selects an item to change its alarm limits, a menu showing the alarm limits currently in use and a data entry field for the revised limits shall appear. All changes to alarm limits shall be subjected to data entry error checking and recorded as events. The alarms shall be annunciated according to the changed alarm limits. The user shall be able to reset alarm limits to the limits set in the smart grid database. However, these shall be treated as temporary changes & if the system is re-initialized, the original limits defined in the smart grid database shall be operationalized.

v. Alarm Presentation

Alarm presentation shall be determined by the alarm's category and priority. Displays shall highlight every alarm condition using a combination of color, intensity, inverse video, blinking and audible sound. The alarm condition highlighting shall show whether the alarm has been acknowledged. The highlighted alarm condition shall appear on all displays containing that device or value at all consoles regardless of the alarm's category. Alarm messages shall be a single line of text describing the alarm that has occurred and the time of occurrence. The alarm message shall be English text and shall not require the use of a reference document for interpretation.

8.8. Events

Events are conditions or actions that shall be recorded by the Smart Grid control centre but do not require user action. Events shall be generated under the following conditions:

Events shall be recorded in the form of an event message. The event message format shall be similar to the alarm message format. The same message format shall be used for displaying and printing events. Event messages shall be displayed on an events summary.

Event messages shall be stored on auxiliary memory of Smart Grid control centre and archived in chronological order and reverse chronological order. It shall be possible to sort, display and print event messages from any console.
8.9. **Hardcopy Printout**

The Smart Grid control centre shall have features to produce a print out of a display, reports, Alarms, Events etc. from a menu. Any of the available printers shall be selectable by the Smart Grid Integrated users from menus for taking printout.

It shall be possible to print a complete display or a selected portion of a display. The options for printing shall include at least choice for orientation, background colour, page size, colour/ black & white and print preview. Also any of the available printers shall be selectable from the print Menu.

8.10. **Report Generation**

The contractor shall be required to generate the Daily, Weekly, Monthly reports formats for Smart Grid control centre. The report formats shall be finalized during detailed engineering stage. The user shall be able to schedule periodic generation of reports, direct report to display, print report, and archive report using report-scheduling display. The report scheduling display shall enable entry of the following parameters, with default values provided where appropriate:

- Report name
- Report destination (printer or archiving device)
- Time of the system should produce the report.

The user shall be able to examine and modify the contents of reports for the current period and for previous report periods using displays. Any calculation associated with the revision of data in a report shall be performed automatically after data entry has been completed.

The report review displays shall accommodate formatted report pages up to 132 characters in width and 66 lines in length and shall contain headings that correspond to the printed report headings. For reports containing more columns or rows than the display, the system shall include a means to view the entire report in a graphic format. The report view and editing displays shall function with the initially supplied reports and all future reports added by APDCL.

8.11. **System Configuration Monitoring and Control**

The user shall be provided with the capability to review Smart Grid control centre’s computer system configuration and to control the state of the configuration equipment using displays. The following operations shall be possible:

- Failover of each server
- Monitoring of servers, device, including workstations, Meters/ DCUs/ Repeaters, status & loading of WAN LANs etc.
- Monitoring of the processor resource, hard disk & LAN/WAN utilization
- Control & monitor of smart grid control centre functions

8.12. **Dynamic Data Presentation**

It shall be possible to present any item in the database on any display. All supervisory control and data control capabilities shall be supported from any window of a world display. Device status or data values shall be displayable anywhere on the screen, excluding dedicated screen areas such as the display heading.

Only standard X Window system or Microsoft windows standard fonts shall be provided with the
Smart grid control centre. All fonts supplied shall be supported on the user interface devices and all printers supplied with the system. The types of fonts to be used in a particular display shall be selected at display definition time.

Status and data values shall be presented in the following formats as appropriate:

- Numerical text that presents analogue values shall have the provision for the format definition of the text which will include the number of characters, number of decimal places, and the use of positive/negative sign or flow direction arrows, etc.
- Normally the telemetered MW/Mvar values along with the sign/direction shall be displayed on the Single line diagram and Network diagram. However the user shall also be able to display all other telemetered and calculated/estimated analogue values (I, V, p.f etc. for each phase) on the Single line diagram (SLD) and Network diagram. All the displays shall be suitably designed to view 12 telemetered and 12 estimated/calculated values simultaneously for each feeder.
- Symbols, including alphanumeric text strings for an item, based upon state changes e.g., meter (connected/disconnected/not detected).
- Symbols, including alphanumeric text strings for indicating the data quality flags.
- Colours, textures, and blink conditions based upon state or value changes or a change of data quality, e.g., alarm limits.

8.13. Element Highlighting

Element highlighting techniques shall be provided to draw the attention of Dispatcher to critical state of the system. The highlighting technique shall include change of colour, colour intensity, blinking, character inversion, line texture, appended symbols etc. This feature shall be used to highlight alarms, power system device and measurement status, data quality, data entry locations on a display and error conditions.

8.14. Display Types

The following list describes the types of displays that are to be included in the Smart Grid Control Centre. The user interface shall support the capabilities of all displays as specified. The User mode, Current Time and date shall be displayed on a screen-basis, not on a display basis, and shall be always visible.

- **Smart Grid Control Centre Display:**
  A display shall be provided that lists all Smart Grid Control Centre directory displays. The displays shall be listed in alphabetical order with suitable separation in the list to enhance readability. Each entry in the list shall have a cursor target for display selection.

- **Distribution System Network Display**
  A graphic overview network display of the distribution system with substations, feeders, distribution network colour coded by voltage shall be provided. This display shall present the distribution system in a graphic format provided by employer. Telemetered and calculated data like real and reactive power flows shall be displayed as a value with a direction arrow/positive-negative signs. Lines that have exceeded their loading limits shall be highlighted. Substations and power stations shall be depicted by symbols that reflect the presence of alarms at that
substation or power station. Cursor selection of a substation/ power station symbol shall result in the associated Single line diagram display for that substation/ power station.

**Interchange Display**

The interchange display shall be provided as a schematic diagram showing power transfers among various utilities. This diagram shall show each power system as a block with actual and scheduled net interchange values outside the block. Symbolic arrows shall indicate power flow directions. The diagram shall also show schedule deviations. This display shall show the frequency values collected from all substations having tie-lines.

**Substation SLD displays Menu**

A display shall be provided of the lists of all substations that can be viewed via a SLD display. The name of the SLD displays shall be listed in alphabetical order, according to substation name, with suitable separation in the list to enhance readability. Each entry in the list shall have a cursor target for graphic display selection.

**Substation SLD Displays**

SLD displays shall be provided for each substation, including those for which telemetry may not be available but are required for running the DMS applications. Each display shall present telemetered, manually entered, and calculated power system data on a Single line diagram that shows substation layout in terms of its buses, switches, lines, and transformers. The feeder names in the SLD shall have linkage with remote substation end SLD, distribution network associated with that feeder. It shall be possible to move to remote-end substations SLD by selecting this feeder. The user shall be able to perform any user interaction defined by the specification on these displays.

**Control panel displays**

Control panel displays giving look-alike feeling shall be provided for operator to supervise & operate.

**Substation Tabular Displays**

Tabular displays shall be provided for each substation. These displays shall list the real-time values of telemetered, manually entered, and calculated data associated with the substation as well as related information such as alarm limits. The user shall be able to perform any user interaction defined by the specification on these displays.

**Alarm Summary Displays**

Displays that list or summarize all unacknowledged and acknowledged alarms shall be provided. The summary shall separate acknowledged and unacknowledged alarms. Capacity shall be provided for at least 200 alarm messages for each alarm summary type. If an alarm summary display becomes full, the oldest messages shall be automatically deleted and the newest messages shall be added. It shall be possible to perform any alarm interaction from this display. The user shall be able to select between viewing events in chronological or reverse chronological order.

**Event Summary Displays**

Event summary displays shall list the most recent events and shall be organized by category for
those categories assigned to a given console, as one summary display for all categories assigned
to a console, or by all conditions system-wide without reference to the categories assigned to a
console, as selected by the user. The user shall be able to select between viewing events in
chronological or reverse chronological order.

- **Help Displays:**
  Help displays shall be provided to aid the user in interpreting displayed information and to guide
  the user through a data entry or control procedure. Help displays shall be provided for each
display that is provided with the system. Each display shall have a prominent cursor target
that the user can select to request the associated help display. For standard displays, software
 aids (such as context sensitivity) shall be used to present pertinent help information in an
expeditious manner. A programmer shall be allowed to modify and create help displays.

### 8.15. Operating Information Summaries

The operating information summaries defined below shall be provided. Summary items shall be
listed in reverse chronological order with the most recent item shown on the first page. All summary
displays, except for Tag Summary shall be information-only displays; no user interaction, other than
display call up, shall be associated with them. The Tag Summary shall be interactive, i.e., the user
shall be able to place or remove tags on this summary.

- **Manual Override Summary**
  The manual override summary shall list all telemetered and calculated device status and data
  values for which a user has substituted a value.

- **Off-Normal Summary**
  The off-normal summary display shall list devices and values that are found to be abnormal, i.e.,
  are not in their normal state. Telemetered, calculated, and manually entered status and data
  values shall be included.

- **Out-of-Scan Summary**
  The out-of-scan summary display shall list device status and data values that are not currently
  being processed by the system. If an entire telemetry source such as an meters/communication
equipment is out-of-scan, the out-of-scan summary shall display the source
  without any of the individual device status or data values associated with the source.

- **Alarm Inhibit Summary**
  This display shall list devices and data values for which the user has suspended alarm
  processing.

- **Tag Summary**
  This display shall list and describe all active device tags.

- **Graphical Trending Summary Displays**
  The summary display shall list all items being trended, the list shall include the item name, trace
  number or colour, trend orientation, and trend range.

- **Tabular Trending Summary Displays**
The summary display shall list all items being recorded for tabular trends. The list shall include the item name and the file name.

- **Notes Display**
  This display shall include a minimum of 5 pages on which a user at any console may enter and edit messages. The contents of these pages shall be accessible by any console. The user shall have the ability to clear any page of this display and to type over previous messages.

- **Computer system Configuration, Monitoring Displays**
  Graphic and tabular displays shall be provided that allow the user to:
  i. Monitor and revise the configuration of the computer system
  ii. Monitor the system's resource utilization statistics

- **Meter/ DCUs/ Repeaters/ Modem Communication Channel Monitoring and Control Display**
  This display shall show information on the status of the system's communication interface devices (including communication channels), the accessibility of each Meter/ DCUs/ Repeaters/ Modem in a graphical form. The user shall be able to Enable/Disable any communication channel from this display.

- **Smart grid control centre Application Program Display**
  Application program displays shall be provided to satisfy the user interface requirements of the system functions stated throughout this Specification. Application program displays shall be based on a standard user interface designed across all applications to provide a common look and feel. The application's information shall be presented in such a way as to facilitate user operations.

### 9. **System Software Requirements**

#### 9.1. General

This section describes the characteristics of system software such as Operating system, RDBMS and support software (programming language compilers, database development and maintenance, display development, network services, report generation, diagnostics and backup utilities) to be provided by Contractor and the original software manufacturer as necessary to support the smart grid integrated applications. This section also describes the standards to be followed for all supplied software. The contractor shall make use of common applications such as security, networking etc. created under R-APDRP and other IT infrastructure. However, it is necessary that functional, availability & performance aspects are met. Bidder shall assess the adequacy of software specified & if any additional software is required to meet all the requirements of the technical specifications, the same shall also be included in the offer.

#### 9.2. **Software Standards**

All smart grid integrated software provided by the Contractor, including the Operating system, RDBMS and support software, shall comply with the industry-accepted software standards produced by national and international organizations, such as ANSI, ISO, IEC, IEEE, ECMA in order to facilitate maintenance and enhancement of the smart grid control centre being supplied. In areas where these organizations have not yet set standards, the software shall comply with those widely accepted de-facto 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 by using software products that are based on open standards.

9.3. **Design and Coding Standards for smart grid integrated applications**

All smart grid integrated applications shall be maintainable by employer using the supplied software utilities and documentation. The smart grid integrated software design and coding standards shall also address the following:

- **Expansion/scalability**: software shall be dimensioned to accommodate the ultimate size of smart grid control centre envisaged.
- **Modularity**: software shall be modular to minimize the time and complexity involved in making a change to a program.
- **User-Directed Termination**: Functions taking long execution times shall recognize and process user requests to abort the processing.
- **Programming languages**: The software shall be written using ISO or ANSI or ECMA standard programming languages and for Unix based systems the APIs shall be POSIX-conforming.
- **SOA architecture**: Software shall conform to SOA.
- **Enterprise service bus (ESB)**: ESB based architecture is essential to enable interaction of applications from different product manufacturer, platforms etc.
- **Portability & Interoperability**: The software shall be designed for hardware independence and operation in a network environment that includes dissimilar hardware platforms to the extent possible. The use of system services software shall be built on Open standards.

9.4. **Operating System**

The contractor shall use UNIX /Linux /Microsoft Windows operating system servers. The servers based on Unix O/s, shall generally comply with the evolving set of POSIX standards defined by IEEE.

9.5. **Time and Calendar Maintenance**

The smart grid control centre shall maintain time and date for use by various software applications. The GPS based time receiver shall be used for synchronizing the smart grid control centre time. All Servers and Operator workstation clocks shall be synchronized within the accuracy of +/-100 milliseconds. The smart grid control centre shall not be dependent on a particular server for time/calendar maintenance. The smart grid control centre shall include two redundant time and frequency standards. Failure of the online unit shall result in automatic switching to the redundant unit. The smart grid integrated shall periodically check if the backup unit is operational and failure of either unit shall be alarmed. The frequency reading shall be accessible by smart grid control centre applications with three post-decimal digits resolution. The system shall support communication protocols such as NTP and SNTP. The time and frequency standard unit shall support a common time code output format such as IRIG-B. A surge protection system shall be included to prevent the time and frequency standard equipment from lightning.

9.6. **Network Software**

The network software for smart grid control centre shall include software for network communication, security and services.

- **Network Communication**

  Users and various applications shall be able to communicate within the smart grid integrated local
area network and operate as described in this Specification. The network communications software shall use a standard network protocol such as TCP/IP. The software shall link dissimilar hardware nodes, including local and remote workstations, application servers, communication servers, and various peripherals (such as printers) into a common data communication network allowing communications among these devices.

- **Network Security**
  A user authentication scheme consisting at least of a user identification and password shall be required for the user to request a connection to any network node.

- **Network services**
  The following network services shall be provided for the users of smart grid control centre:
  
  i. Network file management and transfer, for files containing text, data, and/or graphics information.
  
  ii. Network printing management.
  
  iii. Network time synchronization.
  
  iv. Network backup over LAN.
  
  v. Task-to-task communications to external computers.
  
  vi. LAN global naming facilities.
  
  vii. Remote procedure call
  
  viii. Remote terminal session

- **Security Services**
  The security solution shall comprise of comprehensive solution for secured zone Firewalls i.e. LAN Firewall & Gateway Firewall, intrusion Prevention system IPS (Network based & Host based) & Strong Authentication (multi layered), LDAP, Encryption mechanism. The contractor shall provide a tightly integrated intrusion detection system to detect and prevent intrusion.

  Followings are the functional requirement for the security system:
  
  i. System shall have Multilayer (at least network, application layer) firewall which shall protect the complete system network from unwanted users. Further the separate firewall of different OEMs shall be provided to take care the security of all the servers & shall have high availability architecture with No Single Point of Failure (NSPOF).
  
  ii. Gateway Firewall should be capable of load balancing multiple links from different service providers.
  
  iii. LAN Firewall shall provide isolation/security services between the subsystems
  
  iv. Firewalls deployed should not become a bottleneck. It shall be Robust, Secure, Scalable and future-proof with Centralized Management.
  
  v. Two type of IPS Host based & Network based shall be deployed with minimum hardware & they should not go blind in peak traffics.
  
  vi. IPS should have hybrid technology to detect attacks. It should detect through a combination of Protocol Anomaly and Signature matching.
  
  vii. Shall have Gateway antivirus which will protect from inflow of virus from the
  
  viii. Internet and other WAN locations at the gateway itself with content filtering without any lag in data transmission.
ix. Shall have strong authentication containing user name and passwords which shall be very difficult to compromise.

x. SSL over VPN to provide secured link over public network if required.

• Features

Followings are the features specific to each component of security system-

i. Firewall:

The Firewall shall be hardware box Firewall system with following features:
- Firewall speed >250 Mbps.
- Data encryption supported DES (56 bits) 3 DES (168 bits) and hashing algorithm like MDS and SHA-1.
- Encryption to offload the main CPU.
- It shall have minimum 8 Ethernet 10/100 /1000 ports (4ports for connectivity to web servers & 4 Ports for connectivity to LAN.
- Support NAT and PAT
- Capability of working in Load sharing and hot standby mode
- Denial of service prevention
- DNS guard features
- JAVA and ActiveX blocking
- Radius integration
- Web based management interface
- Stateful inspection for web, mail, SQL application etc.
- Detailed system logging and accounting feature
- No. of concurrent TCP Sessions supported shall be more than 5000.

ii. Intrusion Prevention System (IPS)

The contractor shall provide a tightly integrated intrusion detection & prevention system Capable for detecting the intrusion attempt that may take place and intrusion in progress and any that has taken place.

Both Network based and Host based IPS should have centralized Management Console system which will be either the application server with NMS or any of the workstation. The Centralized management console shall have integrated event database & reporting system & it must be able to create and deploy new policies, collect and archive audit log for post event analysis. The system shall have Integrated Event Database & Reporting System. Automated Update of the signature for two years shall be provided and there should be provision for creating customized signature.

iii. Intrusion Prevention System (Network Based)

After detecting any intrusion attempt there should be provision to configure to perform the following functions:
- Capability for Detecting the intrusion attempt that may take place, intrusion in progress and the intrusion that has taken place.
- Reconfigure the firewall provided in this package.
- Beep or play a WAV file.
- Send an SNMP Trap datagram to the management console. The NMS server envisaged under the specification shall be used as management console also.
- Send an event to the event log.
- Send E-mail to an administrator to notify of the attack.
- Save the attack information (Timestamp, intruder IP address, victim IP address/port, protocol information).
- Save a trace file of the raw packets for later analysis
- Launch a separate program to handle the event
- Forge a TCP FIN packet to force a connection to terminate.
- Detect multiple forms of illicit network activity: -Attempted.
- The System shall support monitoring of multiple networks. The system shall also support the monitoring of additions or changes to addresses of devices on the network.
- The system shall have detection rules for monitoring faults, dangerous and malicious activity related to IP based protocols. The Contractor shall also apply its power control and security experience to enhance these detection rules for specific issues within the system.

iv. Intrusion Prevention System (Host Based)

Host based IPS shall run on the servers. After detecting any intrusion attempt there shall be provision to configure the IPS to perform following actions:
- Send an SNMP Trap datagram to the management console. The NMS server envisaged under the specification shall be used as management console also.
- Send an event to the event log. Send e-mail to an administrator to notify of the attack.
- It should be capable of creating 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,
- 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 shall be taken such as:
  a. Terminate user Login (intruder)
  b. Disable user Account (intruder)
  c. Administrator can define the action to be taken
  d. Forge a TCP FIN Packet to force an intruder connection to terminate.
- Should provide events check for suspicious file transfers, denied login attempts, physical messages (like an Ethernet interface set to promiscuous mode) and system reboots.

v. Gateway Antivirus:

This shall be used for Gateway scanning of viruses. Gateway antivirus shall have Centralized-user Administration which will communicate directly with centralized user directories such as LDAP. It shall have the all the essential/standard features of Latest
version of Gateway antivirus, some of the features are as following:

- It shall have Policy-based URL filtering and Dynamic Document Review.
- It shall protect web traffic with high-performance, integrated virus scanning and web content filtering at the gateway.
- It shall ensure protection by combining list-based prevention with heuristic content analysis for both virus protection and web content filtering.
- It shall eliminate unwanted content and malicious code & Scan all incoming and outgoing HTTP and FTP traffic etc.

The Security System shall use the best practices to prevent the System itself being a source of security compromise. The System shall be hardened, patched, tested, and designed with security as a primary objective. Communication with (GUI and notifications) and within (Agent reporting and updates) the System shall use encryption and authentication.

vi. Other aspects of security:

- **Application Security Monitoring**-
  
The standard operating system shall support the monitoring of security on host installed applications. The system shall support or allow the creation of monitoring for:
  a. Application Software Error Conditions
  b. Application Software Performance Issues
  c. Application Configuration Changes
  d. Application Logins, etc.

- **Security Alarms**-
  
The system shall be capable of annunciation, to include audible and visual alarms and remote paging whenever a security event takes place and shall support the following:
  a. Instant notification through email or pager
  b. Grouping of security events by time, location, and device, etc
  c. Interactive dashboard window for viewing and acknowledgement

- **Analysis and Reports**-
  
  a. The system with the stored information, shall be able to produce analyses and reports to meet security compliance requirements. The system shall be equipped with best practices ad-hoc reports widely used in the industry.
  b. The employer’s personnel shall be trained to be capable of creating new custom analysis and reports, and revising existing, without requiring external consultation.

- **Log Archiving**-
  
The security system shall archive, record, and store all security related events in raw form for at least one year. As a minimum, the event logger shall record all security related events from the perimeter security devices and the host IPS.
Graphical trend displays of each event shall be available along with specific information on the type of intrusion, the area affected and the source via IP address.

- **Data Access through intranet**-

  The Web server at Control Center is to function as source of information on the distribution network. It will be accessed by utility intranet user. Any additional client software, if required, at external clients/users ends, the same shall be made dynamically available from Web server for its downloading by these external clients. There shall not be any restriction to the number of clients downloading this software (i.e. Unlimited number of client downloads shall be provided).

  The external users shall be licensed users of the employer. The following features are Required:

  a. The Web servers shall be sized to support at least 500 concurrent external intranet clients/users for providing access to real-time data.

  b. External intranet clients/users shall be connected to the web servers through secure authentication such as VPN access. These users shall be denied direct access to the smart grid integrated protected LAN.

  c. Internal smart grid integrated users shall not have any dependency on the availability of the Web servers.

  d. For the purpose of transfer of data/displays/ from the smart grid control centre to the Web server system, the smart grid control centre shall initiate a session with the Web server and any attempt to initiate a session by the Web server shall be terminated by the Firewall in smart grid control centre LAN. Interface between Web server and smart grid integrated zone shall preclude the possibility of external clients defining new data/Report/Displays.

  e. For any sessions initiating from the DMZ LAN into the protected LAN, the servers shall be located in a separate DMZ LAN that will be isolated from common applications connected directly to ISP such as email. The Access to these servers from the external web will be through authorization of Virtual Private Network.

  f. The web server shall provide access to allowable real time data and displays, at defined periodicity, for viewing by external clients/users. The access to each display shall be definable on per user type basis. It shall be possible to define up to 100 users. Further the smart grid control centre administrator shall exercise control over the real-time displays which can be accessed through the Web server.

  g. The Web server at Control Center shall also facilitate exchange of email messages from ISP (Internet Service Provider) and other mail servers supporting SMTP.

  h. Suitable load balancing shall be provided among the web servers where each shall serve proportionate number of clients. However in case of failure of one of the servers, all the clients shall automatically switch to the other web server(s).
Typical displays/pages for Intranet access shall be same as that on the smart grid integrated. Real time smart grid data on web server shall be refreshed every minute.

The access to Web server/site shall be controlled through User ID and password to be maintained/granted by a system administrator. Further, different pages/data access shall be limited by user type (i.e. CMD, Mgmt user, in charge etc). The access mechanism shall identify and allow configuration of priority access to selected users.

Further, tools shall be provided for maintaining the website, web server configuration, E-mail configuration, FTP configuration, Mailing lists setup and customer support. Latest protections against viruses shall be provided.

- **Signature Updating Requirements**-

The system shall be able to accept timely updates. The updates shall keep the threat signatures current, providing the latest detection and protection. The updates shall also incorporate the latest security enhancements into the Security Management System. These enhancements shall increase security and functionality, without requiring redesign or reengineering efforts.

9.7. **Report Generation Software**

The smart grid control centre shall include report generation software to generate new report formats for smart grid integrated and edit existing report formats. The user shall be guided in defining the basic parameters of the report, such as the report database linkages as symbolic point names, the report format, the report activation criteria, the report destination (workstation, printer, or text file), and the retention period for the report data.

The user shall be able to construct periodic reports and ad-hoc queries via interactive procedures. The capability to format reports for workstations and printers shall be provided. The user shall be able to specify the presentation format for periodic reports and ad-hoc query reports as alphanumeric display format, graphical display format, or alphanumeric printer format. The user shall be able to specify that processing functions, such as summations and other arithmetic functions, be applied to portions of the report data when the report is processed for display, printing, or file storage. The software shall provide for generation of reports that are the full character width of the printers and that use all of the printer's capabilities, such as font sizes and styles and print orientation.

For report data editing, the user shall be able to obtain the data from a retained report, modify the data, repeat the inherent data calculations, reprint the report, and save it in a report retention file on auxiliary memory without destroying the original report. The user shall also be able to access a retained report, modify its point linkages to the database, modify its format, and save it in a report retention file on auxiliary memory as a new report without destroying the original report.

Executing the report generating functions shall not interfere in any server of the system with the on-line smart grid integrated functions.
9.8. **System Generation and Build**

System generation includes the activity of generating an executable object code of all databases, displays, and reports as required for smart grid control centre. System build is the process under which all the above executables and the executables provided for smart grid integrated application software are ported to the smart grid control centre hardware and configuring to make it operational.

The contractor shall do the complete system generation and build as required for successful operation of the smart grid control centre. The contractor shall also provide the complete backup of the smart grid control centre in electronic media such as tapes, CDs, MO disks etc. APDCL’s personnel shall be able to restore the smart grid control centre at site by using above backup tapes/CDs etc. The contractor shall provide the procedures necessary to restore the system from the backup tapes/CDs etc. The DR system shall always have updated set of system build. It shall be synchronized with the smart grid integrated control centre.

9.9. **Software Utilities**

All software utilities used to maintain smart grid integrated software, whether or not specifically required by this Specification, shall be delivered with the system. The software utilities shall operate on-line (in background mode) without jeopardizing other smart grid integrated application functions that are running concurrently. This utility software shall be accessible from workstations, programming terminals, and command files on auxiliary memory. Multiple users shall have concurrent access to a utility program task, provided there are no conflicts in the use of peripheral devices.

- **File Management Utility**-
  File management utilities shall be provided that allocate, create, modify, copy, search, list, compress, expand, sort, merge, and delete program files, display files, and data files on auxiliary memory and archive storage.

- **Auxiliary Memory Backup Utility**-
  A utility to backup auxiliary memory of server and workstation files onto a user-selected auxiliary memory or archive device shall be supplied. The backup utility shall allow for user selection of the files to be saved based on:
  
  i. Server and workstation
  ii. File names (including directory and wildcard designations)
  iii. File creation or modification date and time
  iv. Whether or not the file was modified since the last backup.

  A backup utility that can backup all server and workstation auxiliary memories on to a single target auxiliary memory or archive device shall be provided. The backup utility must ensure that the source auxiliary memory files are captured properly regardless of caching activity.

- **Failure Analysis Utility**-
  Failure analysis Utility shall be provided to produce operating system and application program status data for analyzing the cause of a fatal program failure. The failure information shall be presented in a condensed, user-oriented format to help the user find the source of the failure. The information shall be presented on displays and recorded for historical records and user-
requested printed reports.

- **Diagnostic Utility**-
  The system shall have suitable auto diagnostic feature, on line & offline diagnostic Utility for on-line and off-line monitoring for equipments of smart grid control centre shall be provided.

- **System utilization Monitoring Utility**-
  Software utility shall be provided in each server and workstation to monitor hardware and software resource utilization continuously and gather statistics. The monitoring shall occur in real-time with a minimum of interference to the normal smart grid integrated functions. 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. The statistics shall be available for printout and display after each period and on demand during the period.

- **Other Utility Services**-
  On line access to user and system manuals for all software/Hardware products (e.g., Operating System and Relational Database Software/hardware) and smart grid integrated applications shall be provided with computer system.

10. **Configuration and System availability**

10.1. **General**
This chapter describes the requirement of monitoring and managing the smart grid control centre with regard to its configuration and availability under normal conditions and under hardware and software failure conditions.

10.2. **System Redundancy**
The redundancy requirement for hardware of smart grid control centre shall be as follows:

- Servers: The servers for SMART GRID application, servers for DMZ/ security system Shall be configured as redundant system except (development server).

- LAN and device interface: LAN shall be configured as redundant. All equipment, except (Development system shall have single LAN).

- Printers: All Printers shall be non-redundant devices.

- Operator workstations: These shall be configured as non-redundant devices.

- Time and frequency system: The GPS receiver of time and frequency system shall be configured as a redundant device at smart grid control centre.

- WAN Router: The WAN router connected to dual LAN shall have channel redundancy.

- DAT Magnetic tape autoloader shall be non-redundant drive

Every critical function must be supported by sufficient hardware redundancy to ensure that no single hardware failure will interrupt the availability of the functions for a period exceeding the automatic transfer time. Non-critical functions are those that support maintenance and development of database, application software and training of users. No hardware redundancy is envisaged for these functions.
10.3. **Functional Redundancy**

Every critical function must be supported by sufficient hardware redundancy to ensure that no single hardware failure will interrupt the availability of the functions for a period exceeding the automatic transfer time. Non-critical functions are those that support maintenance and development of database, application software and training of users. No hardware redundancy is envisaged for these functions.

10.4. **Backup Databases**

Copies of all databases shall be maintained on the Backup server so that system operations may continue in the event of Primary server, peripheral device or software failure. The backup databases shall be updated with the current contents of the primary databases such that all changes to a primary database are reflected in the backup database within 60 seconds of the change. The backup databases shall be maintained in such a manner as to be protected from corruption due to server and device failure. Backup databases shall be preserved for system input power disruptions of any duration. The information maintained in the backup databases shall include:

- Telemetered, calculated, and manually-entered values and their attributes, including quality codes, control inhibit state, and tag data.
- Data and associated attributes maintained by the Information Storage and Retrieval function.
- Alarm, event, and summary displays (such as off-normal, control inhibit, and alarm inhibit displays) or sufficient information to rebuild the displays in their entirety (including the time and date of the original data entries, not the time and date the display is newly created)
- Application function execution, control, and adaptive parameters and input and output data.
- Changes resulting from the addition or deletion of items and restructuring of databases in an existing database shall be automatically accommodated in the backup database.

10.5. **Error Detection and Failure Determination**

All servers, peripheral devices, on-line software functions, and maintenance functions in smart grid control centre shall be monitored for fatal error and recoverable errors. All errors shall be recorded for review by maintenance personnel. Each type of error (e.g., server failure, memory access violation, device reply time-out, or message checksum error) shall be recorded separately with a date and time tag.

10.6. **Server and peripheral device Errors**

The Server/Device shall be declared as failed in case of fatal error. Server and peripheral device failure shall be detected and enunciated to the user within 10 seconds of the failure. For each type of recoverable error the programmer shall assign a threshold. When the count of consecutive recoverable errors exceeds this threshold, a warning message shall be issued to the operator.

10.7. **Software Errors**

Execution errors in on-line and maintenance functions that are not resolved by program logic internal to the function shall be considered fatal software errors. Examples of errors that may be resolved by internal program logic include failure of a study function to achieve a solution due to violation of an iteration limit or arithmetic errors (such as division by zero) which are
caused by inconsistent input parameters or data. These errors shall produce an alarm informing
the user of the error but shall not be considered fatal software errors. Fatal software errors shall
result either in termination of the function or shall be handled as a fatal Server error. The action
to be performed shall be defined by the programmer for each on-line function and each
maintenance function. If the function is to be terminated, future executions of the function shall
also be inhibited until the function is again initiated by the programmer.

On the occurrence of each fatal software error, Server and operating system error codes and
messages shall be recorded in the smart grid control centre.

10.8. **Server Redundancy and Configuration Management**

Each server or server group supporting the critical functions described in the specifications, shall
include at least one redundant server. The redundant server shall normally be assigned to the
backup state and shall take the role of a primary server in the event of failure or upon user
command.

When a failure of a primary server in a redundant group is detected, the smart grid integrated
computer system shall invoke the appropriate failover and restart actions so that online functions
assigned to the failed server are preserved. The on-line functions of the failed primary server shall
be assigned to the backup server by execution of a function restart within 30 seconds after
detection of server failure. In case of failure of smart grid sever, the data shall be stored in the
smart grid control centre till the failover of Primary server is completed to avoid data loss. This
stored data shall be transferred to the smart grid server automatically after restoration of Smart
grid server. If on-line functions are restarted in a backup server, the server’s state shall be
changed to primary. If backup servers are not available to perform the required functions, the
smart grid integrated computer system shall attempt to restart the failed primary server. A
complete restart of the System, including full update from the field, shall not more than the
stipulated time as specified above. No data shall be lost during the transfer of operation.

A failover (transfer of critical functions) to an alternate Server shall occur, as a minimum, under
any one of the following situations:

- Non-recoverable failure of a server performing a critical function
- User request for a transfer of servers
- Failure of a periodic / scheduled function to execute on schedule.
- Violation of a configurable hardware device error counter threshold.

Failure of non-critical function shall not cause server failover. Functions assigned to a failed server
in a non-redundant group may be lost until the failed server is restored to service. Failure of
server operating in the backup state shall not initiate failover action. Failed server shall be
switched from down to any other state by user command only. All server reinstatement actions
shall result in operator message. The messages shall identify the server(s) affected, all server state
changes, and the success or failure of any restart operations.
11. TEST AND DOCUMENTATION

11.1. Testing

- **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:
  i. Test schedule on a day-to-day basis
  ii. Responsibilities of Project Implementing Consortium and APDCL personnel.
  iii. Record-keeping assignments, procedures, and forms
  iv. Procedures for monitoring, correcting, and retesting variances
  v. Procedures for controlling and documenting all changes made to the hardware and software after the start of testing
  vi. Block diagrams of the hardware test configuration, the external communication channels, and any test or simulation hardware.

- **Test Procedures**-
  The test procedures shall describe the individual tests segments and the steps comprising each segment, particularly the methods and processes to be followed. The test procedures shall include the following items:
  i. Name of function to be tested.
  ii. References to the functional, design, user, and any other documents describing the function.
  iii. List of test segments to be performed and the purpose of each test segment.
  iv. Set-up conditions for each test segment, including descriptions of the test equipment.
  v. Descriptions, listings, and instructions for test software tools and displays if any.
  vi. Step-by-step descriptions of each test segment, including user actions for each test step
  vii. Expected results for each test segment, including pass/fail criteria.
  viii. Descriptions of the techniques and scenarios to be used to simulate system field inputs and controlled equipment.
  ix. Copies of any certified test data to be used in lieu of testing.

- **Test Records**-
  The complete record of all factory and field acceptance tests results shall be maintained by the Project Implementing Consortium. 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:
  i. Reference to appropriate test procedure.
  ii. Date of test.
  iii. Description of any test conditions, input data, or user actions differing from that described in the Test procedure.
  iv. Test results for each test segment including a pass/fail indication.
  v. Identification of Project Implementing Consortium's test engineer and APDCL's representative if any.
  vi. Provision for comments by APDCL's representative.
vii. Copies of any variance reports generated
viii. Copies of reports, display copies, and any other hardcopy generated as part of the test.

- Reporting of variances-

Starting from the dry run test period, a variance report shall be prepared by Project Implementing Consortium 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 APDCL 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:

i. Sequential identifying number assigned to the variance.
ii. Date and time the variance was detected.
iii. Appropriate references to the test procedures and this Specification.
iv. Description of test conditions at the time the variance was detected.
v. Identification of Project Implementing Consortium and APDCL representatives.
vi. Estimated date and time when variance is expected to be fixed.
vii. Description of the corrective actions taken (to be completed as part of the variance resolution process).
viii. Dated signature lines for APDCL and Project Implementing Consortium 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:

- **Class 1:** Testing will immediately stop and the Project Implementing Consortium will evaluate and correct the variance before testing is resumed
- **Class 2:** Testing will continue and the variance will be evaluated and corrected by the Project Implementing Consortium at the end of the current session but prior to further testing
- **Class 3:** Testing will continue and the variance will be evaluated and corrected at a mutually agreed upon time.

The class shall be assigned by the Project Implementing Consortium with APDCL approval.

Variance reports shall be available to APDCL for review and comment at all times and shall be submitted by the Project Implementing Consortium to APDCL at the start of the availability test. The Project Implementing Consortium 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 Project Implementing Consortium. Sufficient information shall be provided to enable an APDCL 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 APDCL and the Project Implementing Consortium and APDCL Representatives have acknowledged correction of the variance on the variance report.

- **Test Initiation**
  The following conditions must be satisfied before starting any test:
  i. All test plans and procedures for the test shall be approved by APDCL.
  ii. All hardware and software engineering design change orders shall be incorporated into the system under test.
  iii. All relevant documentation including drawings, lists of deliverables, and software functional and design documents, and user manuals shall be approved by APDCL.
  iv. A complete regeneration of the software under test shall be performed immediately prior to the start of factory testing.
  v. All operating system parameters, files, and configuration information shall be saved to archive media so that the Smart Grid Systems operating environment can be recreated starting with an un-initialized system. The existence and completeness of this data shall be demonstrated to APDCL.
  vi. All database, display, and report definitions shall be saved to archive media so that the databases, displays, and reports can be recreated if necessary.
  vii. The image backup of all applications of Smart Grid Systems shall be taken on the archive media so that Smart Grid systems software can be regenerated if necessary.
  viii. A complete dry run of each factory test (excluding the integrated system test) shall be conducted by the Project Implementing Consortium using the approved test plans and test procedures. Written certification that the dry run has been successfully completed shall be provided to APDCL at least one week prior to the start of each factory test. At APDCL’s option, APDCL representatives will witness and participate in the dry run of any test.

- **Test Completion**
  A test shall be deemed to be successfully completed only when:
  i. All variances have been resolved to the satisfaction of APDCL
  ii. All test records have been transmitted to APDCL
  iii. APDCL acknowledges, in writing, successful completion of the test.

- **Test Suspension**
  Any time APDCL 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 Project Implementing Consortium and APDCL.

- **Factory 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:
  i. Verification of all functional characteristics and requirements specified.
ii. Inspection and verification of all construction, wiring, labeling, documentation and completeness of the hardware. Before the start of factory testing, the Project Implementing Consortium 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 APDCL representatives to verify proper operation of the equipment under conditions not specifically tested in the above structured performance test. The Project Implementing Consortium’s test representative shall be present and the Project Implementing Consortium’s technical staff members shall be available for consultation with APDCL personnel during unstructured test periods. All special test facilities used during the structured performance test shall be made available for APDCL’s use during unstructured testing.

• Factory Test Requirements-

The database, displays and the report formats developed by the Project Implementing Consortium shall be demonstrated and verified by APDCL before factory testing.

All Field Device, smart grid systems functions, communication & networking systems as well as performance shall be tested and demonstrated. APDCL will participate in and witness these tests.

The Project Implementing Consortium 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 Project Implementing Consortium for Central System shall be verified by APDCL before factory testing. All hardware and software associated with smart grid systems shall be staged and completely tested with simulated data at the Project Implementing Consortium’s facility.

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. The Project Implementing Consortium is responsible for conducting all factory tests. APDCL will witness all tests and will perform selected test procedures. Knowledgeable Project Implementing Consortium personnel shall be present at all times to assist APDCL representatives with factory testing as needed. APDCL will not accept unwitnessed 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.

• Hardware Integration Test:

The hardware integration test shall confirm that the computer hardware conforms to this Specification and the Project Implementing Consortium-supplied hardware documentation. The hardware integration test shall be performed when the computer hardware has been installed in the SI’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.

i. **Functional Performance Test:**

   The functional performance test shall completely verify all features of the Smart Grid Systems hardware and software. As a minimum, the following items shall be included in the functional performance test:
   
i. Inspection of all equipment for conformance to drawings/document and satisfactory construction and appearance.
   
ii. Testing of the proper functioning of all software, including test cases with normal and exception user-entered inputs and responses.
   
iii. Simulation of local error and failure conditions
   
iv. Verification that ultimate expansion requirements are met.
   
v. Verification of data link interfaces with other Central systems.
   
vi. Verification of Field Device communication interfaces and data link interfaces with other central systems.
   
vii. Simulation of Field Device and data link communication errors and channel failures, including incorrect check codes and random channel noise bursts.
   
viii. Testing of all user interface functions, including random tests to verify correct database linkages.
   
ix. Simulation of hardware failures and input power failures to verify the reaction of the system to Server and device failure.
   
x. Demonstration of all features of the database, display, and report generators and all other software maintenance features.
   
xi. Demonstration of the software utilities, libraries, and development tools.
   
xii. Verification that the computer system meets or exceeds APDCL's performance requirements.
   
xiii. Verification of the accuracy of hardware and software documentation via random tests.
   
xiv. Testing of spare parts.

ii. **Integrated System Test:**

   The integrated system test shall verify the stability of the Smart Grid Systems hardware and software after the functional performance test has been successfully completed. During the integrated system test, all Smart grid Systems functions shall run concurrently and all Project Implementing Consortium-supplied equipment shall operate for a continuous 100-hour period. The test procedure shall include periodic repetitions of the normal and peak loading scenarios defined in specification. This minimum level of activity may be augmented, at the discretion of APDCL, 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 APDCL 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 non-commanded 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.

iii. Unstructured Testing:

Periods of unstructured testing shall be allocated to allow APDCL representatives to verify proper operation of the Smart Grid Systems under conditions not specifically included in the approved test procedures. Unstructured testing shall be conducted in compliance with the following conditions:

i. A minimum of 25 percent of the actual test period shall be reserved for unstructured test of the system by APDCL representatives.

ii. The Project Implementing Consortium's test representative shall be present and the Project Implementing Consortium's other technical staff members shall be available for consultation with APDCL personnel during unstructured test periods.

iii. All simulation software, test cases, and other test facilities used during the structured portions of the factory tests shall be made available for APDCL's use during unstructured testing.

iv. Unstructured testing shall not begin prior to the start of the functional performance test.

v. Unstructured testing shall be allowed at APDCL's discretion both at the end of a structured test segment and after completion of the functional performance test.

iv. Field Performance Test:

After the equipment has been installed, the Project Implementing Consortium 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 Project Implementing Consortium'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.

v. Field Tests:

The Project Implementing Consortium's maintenance records shall be reviewed prior to field (also referred as site) testing to identify all hardware and software modified, repaired, or replaced between the completion of factory tests and the start of field testing. Interfaces to all communications circuits shall be established by the Project Implementing Consortium and the proper operation of these circuits shall be verified. For the purpose of interpreting the requirements for test plans, test procedures, test records, test initiation, and test completion, field testing shall be considered a single test accomplished for each computer system in three phases:

i. Field installation test.

ii. Pre-field performance test.

iii. Field performance test.
Field Installation Test:
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 Project Implementing Consortium. APDCL will witness all tests and will perform selected test procedures. Knowledgeable Project Implementing Consortium representatives shall be present at all times to assist APDCL 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 APDCL functions. All hardware shall be tested by running diagnostics. The exact content of the field installation test shall be determined jointly by the Project Implementing Consortium and APDCL.

Pre-Field Performance Test:
After the field installation test, the Project Implementing Consortium shall: (1) verify the operation of field device, data links and remote consoles (2) correct and update the database, reports, and displays (3) install and test APDCL/owner-developed software if any and (4) establish connectivity with smart grid systems and other IT application provided by APDCL/owner. The Project Implementing Consortium shall be responsible for providing and installing corrections for all variances found during this period prior to the start of the field performance test. Further the Project Implementing Consortium shall also train the dispatchers before field performance test starts.

Field Performance Test:
After the completion of activities as per the clause “Test Duration and Criteria for Acceptance” clause, the Project Implementing Consortium shall conduct the field performance test to verify those parts of the functional performance test (as mentioned in the above clause of Pre-Field Performance Test) that were not fully tested as part of the field installation test. All variances found during this period shall be fixed by the Project Implementing Consortium or otherwise resolved to APDCL’s satisfaction prior to the start of the availability test.

The field performance test shall concentrate on areas of Smart Grid Systems operations that were simulated or only partially tested in the factory (e.g., system timing and loading while communicating with a full complement of Field Devices and data links and system reaction to actual field measurements and field conditions). The validity of factory test results determined by calculation or extrapolation shall be examined. The Project Implementing Consortium shall be required to repeat selected portions of the field installation test during the field performance test if APDCL believes that previously tested functions have since been modified and are not operating in accordance with the Specification. Provisions for unstructured testing by APDCL personnel shall be provided.

vii. Availability Test:
After field performance test, a 1000-hour availability test 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 and, under these conditions, verify system availability for 99.5%. Further each server and device & field Devices if applicable shall meet a minimum availability of 98% individually. In case of Field Devices, if applicable, downtime of individual Field devices is to be excluded from system availability calculations, however, minimum 50% Field Devices shall be reporting for test to continue.

viii. Test Responsibilities:

APDCL will be responsible for conducting the availability test. The test shall consist of normal Smart Grid Systems operations without special test equipment or procedures. Test records defined in the availability test plan and procedures will be maintained by APDCL personnel. APDCL/Owner will operate and maintain the system according to procedures described in the approved Project Implementing Consortium documentation. Smart Grid Systems maintenance on an on-call basis shall be provided by the Project Implementing Consortium during the availability test period. When on-site maintenance is needed, qualified Project Implementing Consortium personnel shall arrive at the site within maximum four (4) hours of notification and shall keep APDCL/Owner 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” & “Hold time”.

The Project Implementing Consortium 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 Project Implementing Consortium’s inventory.

During the availability test period, APDCL reserves the right to modify the databases, displays, reports, and application software. Such modifications will be described to the Project Implementing Consortium 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.

- **Downtime:**

Downtime occurs whenever the criteria for successful operation defined in Section “Project Implementing Consortium’s Maintenance Responsibility till Operational Acceptance” mentioned below are not satisfied. Downtime shall be measured from the start of diagnostic procedures until full service is restored. In the event of multiple failures, the total elapsed time for repair of all problems (regardless of the number of maintenance personnel available) shall be counted as downtime. For onsite response the delay in response time (more than four hours) shall be added to downtime.

- **Hold time:**

During the availability test, certain contingencies may occur that are beyond the control of either APDCL or the Project Implementing Consortium. These contingencies may prevent successful operation of the system, but are not necessarily valid for the purpose of measuring smart grid systems availability. Such periods of unsuccessful operation may be declared "hold time" by mutual agreement of APDCL and the Project Implementing Consortium. Specific
instances of hold time contingencies are:

i. **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 Project Implementing Consortium-specified procedures within 30 minutes.

ii. **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.

iii. **Intermittent Failure**: Periods during which an intermittent, recurring software or hardware failure is experienced will be considered hold time, provided that the Project Implementing Consortium is engaged in remedial action and normal functions can be restored by Project Implementing Consortium-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.

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

v. **Service Response Time**: A maximum four (4) hours of hold time will be allowed for the Project Implementing Consortium 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 APDCL’s personnel

vi. **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 Project Implementing Consortium 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.

- **Test Duration and Criteria for Acceptance**:

After the elapse of 1000 hours of cumulative test time, the availability shall be calculated considering the downtime recorded. Should availability falls short of specified percentage, the Project Implementing Consortium 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 Project Implementing Consortium may restart the test for 1000 hours, however, more than two such restart 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 un-commanded fail over shall have occurred within 240 hours of the test’s conclusion.
• **Criteria for successful operation:**

The Smart Grid system shall be designed to meet the total system availability of 99.5%. That is, the ratio of total operational time minus downtime to total operational time shall be equal to or greater than 0.999. Total operational time shall not include the hold time. The system shall be considered available as long as all the functional requirements defined in the section of 3.10 are available. Further each server and device and Field Devices shall meet a minimum availability of 98% individually.

• **Project Implementing Consortium’s Maintenance Responsibility till Operational Acceptance:**

During this period, the Project Implementing Consortium shall make available resident Project Manager, hardware & software specialists, who shall be available upon notification by APDCL/Owner about any problem(s) that may exist. The Project Implementing Consortium's specialists shall be required to respond to APDCL/Owner's notification in line with the provisions of technical specifications. The Project Implementing Consortium shall replace or repair all defective parts and shall have prime responsibility for keeping the system operational.

• **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:

i. The Project Implementing Consortium 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 APDCL 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.

ii. Type Tests shall be performed for all equipment types for which certification is not provided as required in (a) above, or if it is determined by APDCL 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 Project Implementing Consortium. The Project Implementing Consortium shall quote testing charges for each type test individually.

iii. 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 APDCL. The test procedures shall be formatted as in the specifications and shall include a complete list of the applicable reference standards and submitted for APDCL approval at least four (4) weeks before commencement of test(s). The Project Implementing Consortium shall provide APDCL at least 30 days written notice of the planned commencement of each type test.

iv. The Project Implementing Consortium shall provide a detailed schedule for performing
all specified type tests. These tests shall be performed in the presence of a representative of

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

vi. The Project Implementing Consortium shall ensure that all type tests can be completed within the time schedule offered in his Technical Proposal.

vii. In case of failure during any type test, the Supplier 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 his own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.

viii. Documentation for all factory, field, and availability tests that apply to Owner’s system shall be provided in accordance with the requirements defined in this section of specification.

• Project Evaluation:

High and low costs and benefits must be developed for each Smart Grid capability, including the evaluation of distribution system, environmental and customer benefits derived from the Pilot Project in terms of KPI improvements. After completion of Evaluation period we should be able to determine:

i. Value propositions of each functionality

ii. Overall cost-benefit of a full deployment of smart grid capabilities

iii. Key assumptions that drive this value

iv. Risks involved

v. Additional steps required to replicate Smart Grid project in other parts of country

11.2. Documentation

The Project Implementing Consortium shall submit a comprehensive list of the documents as applicable for the offered system for APDCL’s approval after signing of the contract and the documents shall be finalized as per the approved list. The schedule for submission/approval of documents shall be in line with the overall project schedule.

To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Project Implementing Consortium shall submit documentation describing the systems to APDCL for review and approval. Further the Project Implementing Consortium 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 Project Implementing Consortium shall obtain approval of APDCL for the relevant document at each stage before proceeding for purchase, manufacturing, system development, factory testing, erection, site testing, training etc.

Each document shall be identified by a Project Implementing Consortium document number, APDCL document number, and APDCL purchase order number. When a document is revised for any reason, each revision shall be indicated by a number, date, and description in a revision block along
with an indication of official approval by the Project Implementing Consortium’s project manager. Each revision of a document shall highlight all changes made since the previous revision.

The Project Implementing Consortium shall submit two hard copies of each document/drawing for APDCL’s review and approval along with soft copy with each submission. After approval two set of all the documents shall be submitted as final documentation, however, for site specific documents two sets of documents shall be provided for each site. Any changes observed during field implementation shall be incorporated in the as-build drawing and required sets of same shall be submitted to APDCL. In addition to hard copies all documentation shall be provided in electronic form preferably in pdf format. These documents shall be editable, searchable and printable. For this web based “Document Management System” (DocMS) software shall be supplied and installed at APDCL’s facility by the Project Implementing Consortium along with minimum 5 number of client access licenses. DocMS shall have multi-user capability with user role and privileged management. DocMS shall have complete capability of tracking the documents version, Ownership and editing. This DocMS shall be used as central document repository for the entire lifecycle of the Project for easy managing and referencing of the project documentation. This Document Management System shall have a facility to integrate APDCL’s made documentation for system Operation to be used by Operator. In case any documentation requirement is specified in the relevant section the same shall apply for the equipment/system defined in that section.

The following document shall be submitted in soft (Editable and printable) as well as hard copy as applicable for the subsystem.

- Document Plan
- Document identification plan
- System Description Documents (Overview)
- Functional Cross Reference Document
- Data Requirement sheets
- Data base Documents
- Drawings/Documents for manufacturing/Assembly of the equipment/system
- Drawings/Documents for installation of the equipment/system at site
- Software description/design documents for each module
- Factory Test report
- Manuals for each equipment
- System Configuration Parameter Details
- Site Testing documents
- System Security Manual
- System Maintenance Manual including preventive and breakdown maintenance procedures
- Training documents
- System Administrator Documents
- User guide for Operator
- Software Licenses
- Type test reports
- Sizing calculations
- Inventory of the hardware
- Panel General and Internal Arrangement drawing indicating modules, components location etc.
• Installation drawing.
• Schematic drawing.
• Communication Channel Plan
• Firewall and security setup and configuration check list

The Project Implementing Consortium shall also supply two sets of User manuals/guides, O&M manuals and manufacturer’s catalogues for all the hardware & software supplied under the contract one set each of which shall be at all the locations where the System has been installed. 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 project briefly the following documents/drawings shall be required under the project. It is not acceptable to supply user manuals of systems, functions and applications as it exists. The user manuals shall be oriented towards system users and elements & system deployed.

The documentation pertaining to third party or OEM products may be supplied in the format as available from the third party/OEM. If both formats (Paper/electronic) are available then the above mentioned copies of documents shall be supplied in both the formats, however, in exceptional cases where the Project Implementing Consortium is not able to get more copies due to copyright laws restriction & or industry practice, the issue will be mutually agreed upon on case to case basis.

The documents to be submitted shall include the following information:

11.2.1. Software Inventory:

An inventory of all software shall be maintained by the Project Implementing Consortium. The Project Implementing Consortium shall submit the following inventory lists: the preliminary inventory list at the time of the FDS 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 Project Implementing Consortium documents and an indication of whether the program is to be standard, modified, or custom.

11.2.2. Functional Description:

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

i. Introduction describing the purpose of the function with references to other documentation.

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

iii. Complete description of the operation, data and logic interfaces.

iv. Sample displays wherever applicable.

11.2.3. Software Design:

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

i. The overall organization and structure of the software logic.

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

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

v. Interfaces with other software modules.

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

11.2.4. Database Documentation:

Database documentation shall describe the structure of the database and Information Model. The documentation shall define the individual elements (files, records, fields, and tables) and their interrelationships. Portions of the database developed specifically for APDCL'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:

i. The overall organization of input records.

ii. The format of each data record.

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

Sufficient database documentation shall be provided to enable the database to be updated or regenerated when inputs are changed and added, programs are modified, and new programs are added. Database access documentation shall be supplied such that software developed by APDCL may use the same access tools used by the Project Implementing Consortium-supplied software.

11.2.5. User Documentation for Operators:

User documentation for Operators shall contain detailed operating instructions and procedures. Information in the documentation shall be presented in terms that are meaningful to users. Each system function of this Specification and all other functions designed for operators use shall be included in this documentation. 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:

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

ii. The user interface including displays and keyboard operations used to control and review input to and output produced by the function

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

iv. Procedures to be followed as a result of computer system restarts, failures, and failovers.

Dispatcher documentation shall be customized separately for APDCL’s system and shall be based on the delivered systems. It is not acceptable to describe the Project Implementing Consortium’s standard system and then identify differences between the standard and delivered systems for operator’s documentation. The documentation shall not include standard or other descriptions that do not apply to the delivered systems.
11.2.6. **System Administration Documentation:**

System administration documentation shall be provided to guide APDCL 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:

i. Software management  
ii. Network communications management  
iii. Processor configuration  
iv. System performance monitoring  
v. System restart/failover management and diagnostic procedures  
vi. System generation and management  
vii. Database generation and management  
viii. Report, Display generation and management  
ix. Diagnostic programs  
x. Software maintenance  
xii. Application software parameters and tuning guides  
xii. Other Project Implementing Consortium-supplied system software not included above.

11.2.7. **Test Documentation:**

Documentation for all factory, field, and availability tests (procedures and reports) that apply to APDCL’s system defined in this section.

i. **Documentation for Auxiliary Power Supply System:**

The following specific document for items covered under this section shall be submitted which shall be in addition to the applicable general document-

a) Data Requirement Sheets (DRS)  
b) Inventory of the hardware  
c) General Arrangement drawing indicating modules, major devices/ components location etc.  
d) Installation drawings  
e) Schematic drawings  
f) Type Test reports  
g) FAT plan & procedure  
h) SAT plan procedure  
i) External cable laying & termination schedule details  
j) Availability test plan & procedure

ii. **Training Documentation:**

Training documentation shall be provided for all courses in accordance with the requirements defined in specification.
12. TS OF THE SMART GRID CONTROL CENTER AND ASSOCIATED HARDWARE

➢ **Technical Specifications of Systems:**

**Consumer Portal**

The goal is to provide a high quality experience for the customers and business associates that will provide them a user friendly portal that will make it easy for them to communicate with the utility though the web instead of direct phone calls or visits. This portal will also act as a source of information for the customers regarding policies and procedures. This in turn will improve customer satisfaction and reduce work load on the employees.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Functionality</th>
<th>Description</th>
<th>Criticality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Home</td>
<td>This page provides a brief description about the site, the various functionalities it provides and promotional features or any kind of advertisement for special programs can be placed in this page. Login Component is provided and registered users may login using their username and password. New Users can also register by clicking on the First Time Users Register link. The Forgot Password link helps the user to retrieve their password.</td>
<td>Vital</td>
</tr>
<tr>
<td>2.</td>
<td>Log In</td>
<td>The Log In page asks the registered users for their username and password while the new members can also register through this page.</td>
<td>Vital</td>
</tr>
<tr>
<td>3.</td>
<td>Registration</td>
<td>The user is asked for personal, security and account information in this page before registering.</td>
<td>Vital</td>
</tr>
<tr>
<td>4.</td>
<td>Forgot Password</td>
<td>The user is asked for his first name, last name, zip code, birthday and his primary email address before being provided with the security question.</td>
<td>Vital</td>
</tr>
<tr>
<td>5.</td>
<td>Security Question Answer</td>
<td>The new password is sent to the user by email (his primary email address as in his profile) on answering the question correctly.</td>
<td>Vital</td>
</tr>
<tr>
<td>6.</td>
<td>Change Password</td>
<td>Once the user has logged in, he can change his credentials i.e. Username and Password by clicking on the Change Credentials link.</td>
<td>Vital</td>
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<tr>
<td><strong>7.</strong></td>
<td><strong>My Accounts</strong></td>
<td>This is the landing page for the users with multiple accounts. The screen contains a brief summary of all the accounts such as the account name, address, balance, due date and the account status.</td>
<td>Vital</td>
</tr>
<tr>
<td><strong>8.</strong></td>
<td><strong>Single Account</strong></td>
<td>This is the landing page for the customers. The screen contains a description of the account. Any status messages pertaining to the account involving immediate user action is also presented here.</td>
<td>Vital</td>
</tr>
<tr>
<td><strong>9.</strong></td>
<td><strong>Consumption History</strong></td>
<td>The page provides an account of the usage for the last 12 months graphically. A more detailed analysis is provided in a tabular format listing the meter reading date, the reading, consumption, number of days, charges etc.</td>
<td>Vital</td>
</tr>
<tr>
<td><strong>10.</strong></td>
<td><strong>Consumption Calculator</strong></td>
<td>The consumption calculator popup is provided to help the user calculate the usage between any two given dates.</td>
<td>Vital</td>
</tr>
<tr>
<td><strong>11.</strong></td>
<td><strong>Bill Summary</strong></td>
<td>The Bill Summary page gives a record of the Billing amounts and Payments made by the customer over the last few months.</td>
<td>Vital</td>
</tr>
<tr>
<td><strong>12.</strong></td>
<td><strong>Online Billing Registration</strong></td>
<td>The user is provided with the options of registering in Online Billing and also continues with paper bills.</td>
<td>Vital</td>
</tr>
<tr>
<td><strong>13.</strong></td>
<td><strong>View and Pay Bill</strong></td>
<td>The View and Pay Bill page presents a short summary of the bill. The user can also view the bill in PDF format by clicking on the link ‘View Bill as PDF’.</td>
<td>Vital</td>
</tr>
<tr>
<td><strong>14.</strong></td>
<td><strong>Pay Bill</strong></td>
<td>The user is provided with 2 modes of payment namely Credit Card and Debit card. On providing the valid credentials payment can be made directly from the site. The online payment shall be processed through secured payment gateways.</td>
<td>Vital</td>
</tr>
<tr>
<td>No.</td>
<td>Feature</td>
<td>Description</td>
<td>Importance</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>15</td>
<td>Multiple Pay Bill</td>
<td>Payments for all the accounts can be directly made from this page. For each of the account the user is provided with 2 modes of payment namely Credit Card and Debit card. On providing the valid credentials payment can be made from the site directly.</td>
<td>Vital</td>
</tr>
<tr>
<td>16</td>
<td>Manage Accounts</td>
<td>The page lists all the accounts for the user and the preferences for the accounts.</td>
<td>Essential</td>
</tr>
<tr>
<td>17</td>
<td>Service Requests</td>
<td>This page allows customer to lodge request for services such as new connection, disconnection, load change, name change, category change, meter shifting etc. Depending on the regulatory/utility requirements user is required to submit the documents.</td>
<td>Vital</td>
</tr>
<tr>
<td>18</td>
<td>Service Request Status</td>
<td>This is a read only screen which the user can view. Status of various pending requests for the customer such as load change, name change, category change, meter shifting etc are listed here.</td>
<td>Vital</td>
</tr>
<tr>
<td>19</td>
<td>Complain</td>
<td>Under this page user can log his complaint using a drop down menu and also enter some text.</td>
<td>Vital</td>
</tr>
<tr>
<td>20</td>
<td>Complaint Status</td>
<td>This is a read only screen in which user can view the complaint status.</td>
<td>Vital</td>
</tr>
<tr>
<td>21</td>
<td>Report Power Failure</td>
<td>This screen contains static data related to the power failure. The contact number is mentioned in case any power failure occurs.</td>
<td>Vital</td>
</tr>
<tr>
<td>22</td>
<td>Report Street Light Outage</td>
<td>This screen allows the user to report any street light outage incident. The user has to fill up the specific information provided in the screen in order to locate the street light and then report it.</td>
<td>Vital</td>
</tr>
<tr>
<td>23</td>
<td>Update Profile</td>
<td>This screen enables the user to update his/her profile information. The user can edit the personal information and click on Update Changes button to save those changes.</td>
<td>Vital</td>
</tr>
</tbody>
</table>
## Identity and Access Management System
Refer clause no. 2.8.1 at page no.35 of RfP Volume 2

## Metering, Billing and Collection System
Refer “Billing System” of point no. 9 of clause no. 2.2 at page no.273 of RfP Volume 2

## Analytics System
Refer point 1 to 7 at page no.299 of RfP Volume 2.

## System Security Requirement

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>24.</td>
<td>Commercial Information</td>
<td>This screen displays the applicable policies, acts and rules prescribed by the utility, regulator and the law, which are helpful for customers.</td>
</tr>
<tr>
<td>25.</td>
<td>Associated Sites</td>
<td>This screen provides the link to all the associated sites such as SERC. CERC, Ministry of Power etc.</td>
</tr>
<tr>
<td>26.</td>
<td>Contact Us</td>
<td>This screen displays the information of the contact persons, who should be contacted for any information or for providing any feedback.</td>
</tr>
<tr>
<td>27.</td>
<td>Privacy Policy</td>
<td>This screen shows the different privacy policies to which the website adheres. This screen displays only static content. The user can navigate to other pages by clicking on the breadcrumb or the left navigation.</td>
</tr>
<tr>
<td>28.</td>
<td>Business Associate</td>
<td>This screen enables business associates (contractors) to register online, view tenders, purchase tenders, submit tenders, etc.</td>
</tr>
<tr>
<td>Sr.No.</td>
<td>Functionality</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1.</td>
<td>Tracking key system accesses</td>
<td>The system must be capable of generating log trails, which contain details about any read / write access to sensitive data. Details must relate activity to an identifiable person. They must be configurable, so that filters and switches can be used to lower performance overheads and focus on areas of concern. It is important that the audit trail that is generated contain enough information to support after-the-fact investigation of loss or impropriety.</td>
</tr>
<tr>
<td>2.</td>
<td>Time-stamp based auditing method</td>
<td>Where equipment uses a real-time clock to timestamp audit and other time related events, the clock should be regularly checked for synchronization with both connected systems and reference clock outside of the system, in this case the Indian Standard time. For daily reporting, this would ensure that the reports generated have some sanity given continuous data input</td>
</tr>
<tr>
<td>3.</td>
<td>Exception reporting</td>
<td>Where the security audit trail becomes unavailable for any reason, the system shall continue to operate but will trigger an alarm. Action shall be taken as soon as possible to rectify the situation.</td>
</tr>
</tbody>
</table>
| 4. | Detailed system access tracking | System and application use and attempted use will be monitored. To ensure that the integrity and security of the client and customer data is maintained. The documented process shall include details of: who will monitor what event and how, the frequency of monitoring, what to do when suspicious activity is noted, when to escalate and the escalation path. All events logged in the audit data shall be taken into account when deciding what to audit and the appropriate actions to take. The log must record the user or process responsible for the event, terminal ID where available, and the date and time of the event. The following shall be monitored:

- Enabling and disabling of the audit process
- Any changes to the type of events logged by the audit trail
- Any changes to the audit trail itself
- Start up parameters and any changes to them
- System or application start-up and shut-down
- Use of selected transactions
- Changes to any of the data base or records | Essential |
<p>| 5. | Maintaining audit trails | Audit records and journals shall be retained in a tamper proof environment in accordance with the Purchaser’s policy for a reasonable amount of time to allow for accountability and evidential purposes. Backup copies shall also be maintained to protect against any accidental or deliberate loss of data. | Vital |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Disaster recovery</td>
<td>A recovery options analysis shall be carried out to produce the practical options for those systems and networks, which are deemed to require recovery in the event of a disaster. The most effective option shall be chosen, taking into account the cost of recovery and the cost to the business of unavailability of the application.</td>
<td>Vital</td>
</tr>
<tr>
<td>7.</td>
<td>User process protection</td>
<td>The system should be able to protect the user process and local data from other user.</td>
<td>Essential</td>
</tr>
<tr>
<td>8.</td>
<td>Version consistency checks</td>
<td>Mechanisms should be in place to ensure that the currently installed software has remained consistent with the delivered product.</td>
<td>Essential</td>
</tr>
<tr>
<td>9.</td>
<td>Versioning</td>
<td>Software used on systems/applications shall be subject to version and change control to ensure that only the current authorized software is used at all user locations.</td>
<td>Essential</td>
</tr>
<tr>
<td>10.</td>
<td>Modification of the system</td>
<td>Modification or replacement of the software provided with the system would require special privileges</td>
<td>Desirable</td>
</tr>
<tr>
<td>11.</td>
<td>System maintenance</td>
<td>Execution of system maintenance and repair software would require special privileges</td>
<td>Essential</td>
</tr>
<tr>
<td>12.</td>
<td>Basic checks on data input</td>
<td>Data input to an application shall be validated by the application to ensure that the data is correct and appropriate. As a minimum, an application shall check input data is complete. Within the required ranges, and contains no invalid characters. Procedures shall be established to deal with any input data violations.</td>
<td>Vital</td>
</tr>
<tr>
<td>13.</td>
<td>Time stamping modifications</td>
<td>The system should be able to track the date and time at which a resource was last modified.</td>
<td>Essential</td>
</tr>
</tbody>
</table>
### 14. Integrity of data passed over a communication channel

The system should have in-built mechanisms e.g. checksums to verify the integrity of data passed over a communication channel.

**Vital**

### 15. Data transfer lock

Where an encryption process used for data transfer fails and cannot be automatically corrected, then the transfer should not be completed.

**Essential**

### Confidentiality

### 16. Use of encryption

The system should have the flexibility of encrypting the data stored online.

**Essential**

### 17. Approval for cryptographic techniques

Any cryptographic techniques or encryption systems used to safeguard information shall have been approved by relevant authority on data security prior to their use.

**Essential**

### 18. Approval for security components

Only security components which have been approved by the Purchaser shall be used to protect the Purchaser's sensitive information and processes.

**Essential**

### 19. Documentation of encryption procedures

The procedures used to maintain confidentiality should be documented and access to them restricted.

**Essential**

### Networking and Data Transfer

### 20. Authorized data transfer

All data transfers must be documented and authorized by the owner of the donor system. They must only be authorized where the receiving system has the capability to protect the data.

**Vital**
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>21.</td>
<td>Inter system data Transfers</td>
<td>Data which is to be passed between systems shall be labeled to indicate the type and sensitivity of that data. The security policy for a system will state what data may be sent to, or received from, another system and will state the translation, if any, between the labeling of the two systems. Interfaces that have been built - i.e. the data migration systems should have defined access rights. The interfaces should have a fixed enabling procedure - including the frequency with which the migration happens to and from the system, the data flow that would happen and the data items that would be frozen during such a migration.</td>
</tr>
<tr>
<td>22.</td>
<td>Documentation of risks and its mitigation strategy</td>
<td>System developers responsible for customization should consider and document the risks and associated mitigation in the design.</td>
</tr>
<tr>
<td>23.</td>
<td>Installation and configuration</td>
<td>Developers will document instructions on how the system is to be delivered, installed and configured in a secure manner.</td>
</tr>
<tr>
<td>24.</td>
<td>Startup documentation</td>
<td>Developers will document instructions for the secure start-up, re-start and operation of the system.</td>
</tr>
<tr>
<td>25.</td>
<td>Interface designing</td>
<td>Interface designs must include the capability to selectively deny access to certain types of data.</td>
</tr>
<tr>
<td>26.</td>
<td>Scope control</td>
<td>Vendor supplied software packages must not be modified outside of the scope recommended by the Purchaser.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A mechanism for controlling software changes during development shall be implemented. This mechanism shall as a minimum ensure that:</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| 27. | Software change control | - The change is reviewed by appropriate groups prior to authorization,  
- Changes are properly authorized prior to implementation.  
- All change requests are logged.  
- All associated documentation is altered along with the software change.  
- Version control records are maintained. |

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>All applications shall be designed to minimize the risk of corruption by processing errors by building in validation checks, reconciliation checks etc., where necessary.</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.</td>
<td>Internal data</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>All new and modified software to be used on system/application shall first be tested by expert personnel to ensure that the software have been subjected to the rigor of test and thereby –</th>
</tr>
</thead>
</table>
| 29. | Module and product testing | - Does not introduce added security risks.  
- Functions according to design specifications.  
- Does not adversely affect the operation of the system.  
- Introduces no unauthorized system changes. |

|   | Security of web services |   |
Data warehousing and Business Intelligence:
BI applications should include the activities of decision support systems, query and reporting, online analytical processing (OLAP), statistical analysis, forecasting, and data mining.

Essentially, a BI solution is normally implemented with following components.

- An Extraction, transformation and loading (ETL) component which extracts data from OLTP systems, transforms it and load it to the data warehouse.
- A data warehouse component which will host the data.
- A reporting component which will allow on-the-fly reporting on the data from data warehouse.

The MIS should utilize the BI solution and data ware house for management information, data analysis, reporting and estimating what if scenario.

Specific areas which BI should include:

- Customer credit analysis.
- Daily, weekly and monthly report generation to access the performance of sub divisions/division and circles.
- Load forecasting
- Customer segmentation and analysis for SLAs
- Customer complaint analysis
- Network planning
• Capacity expansion planning
• Accurate manpower planning
• Material Planning

Suggested Architecture of BI-

The above figure depicts the data flow vis-à-vis the system. As depicted, there are various sources of data (OLTP systems) from where the data flows to the Master Data Warehouse. Before loading to master data warehouse, the data goes through cleansing and transformation to maintain data integrity. Loading process also does simple data aggregation. Once data is loaded to master DW, then it is again aggregated and loaded to reporting DW. The reports requiring only aggregate data refers only to report DW but the reports requiring data at most granular level will fetch data from master DW.

➤ Technical Specification 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 SNMPVer. 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 have 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:

1) Such changes/updates shall be proposed and approval obtained from Employer along with the approval of Drawings/documents.
2) The proposed equipment shall be equivalent or with better features than the equipment included in the Contract.

3) Complete justification along with a comparative statement showing the original and the proposed hardware features/parameters including brochures shall be submitted to the Employer for review and approval.

4) Changes/updates proposed will be at no additional cost to the Employer.

5) The porting of software shall be at no additional cost in case of replacement of hardware during the FMS period.

**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, Time & Frequency system, Firewalls etc.

The redundant hardware such as Servers, Firewall, and LAN etc. shall work in hot standby manner. All the servers and networking equipment (Firewalls, LAN equipment etc.) shall be mounted in rack panel.

**Servers**

The Servers shall have provision for expansion of the Processor, auxiliary memory and Main memory (RAM) by 100% of the delivered capacity. This expandability shall be possible at site with addition of plug in modules only. Initially USB ports of all work stations shall be disabled.

Servers shall be mounted in a rack (panel) and a single rack mountable TFT monitor, keyboard and mouse using a KVM (switch to access all servers & peripherals) in the panel. However the grouping of servers in a rack shall be such that the primary and backup servers for a system function are located in different racks.

All servers shall have dual redundant power supplies, capable to operate on single power supply module. There shall not be any interruptions in the operation of servers when there is a failover between the two AC Power Supply of the server.

**Web Server:**

Web server shall be provided to allow the access of system data (AMI/MDM/PLM/OMS), displays and reports by Remote VDUs/external users.

Web server is connected on one side to AMI/OMS/dual LAN and on other side to Web server dual LAN. Web server shall be provided with suitable firewalls on both sides (i.e. towards AMI/MDM/PLM/OMS dual LAN and towards Web server dual LAN) in order to block the possible entry into AMI/MDM/PLM/OMS system by an intruder.

Web server shall also be provided with host based Intrusion detection system (HIDS) and network based Intrusion prevention system (NIPS). The HIDS will be installed in the Web-server. The NIPS shall be installed for the AMI/MDM/PLM/OMS dual LAN and the Web-server dual LAN.
All necessary hardware & software for Web Servers with firewalls and HIDS/NIPS shall be installed by the contractor.

A separate Computer shall be supplied to be used as Centralized management console for the HIDS/NIPS and firewall. The management console shall perform the following functions:

- Create and deploys new policies
- Collect and archive audit log for post event analysis
- Maintain an Integrated Event Database
- Provide an integrated Reporting System.
- Performance monitoring

**Networking Equipment:**

a. **Firewall**

   Firewalls shall be provided as per BOQ. It is required that both side firewalls (Internal and External). All firewalls shall be hardware box firewall as per the requirements mentioned in the table below

b. **Routers**

   Routers shall be capable for data exchange between various communication media such as copper cable, PSTN /leased line, fiber optic cable, VSAT etc. Routers shall have the built-in firewall features as required.

c. **Host based Intrusion Detection System & Intrusion Prevention System (Network Based)**

   The contractor shall provide host based intrusion detection system & Intrusion Prevention system as per the parameters mentioned in this technical specification.

d. **Local Area Network (LAN) and device interfaces**

   Servers and peripheral devices are connected to each other on local area network (LAN). LAN switches shall be as per the features mentioned in this Technical Specification.

**Data concentrator unit (DCU) specification:**

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 at the Smart Grid Control Centre.

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

a. **Hardware & Power Supply**

   - Enclosure/box of DCU shall be IP55 compliant. The installation of DCU shall be suitable for clamp mounting on poles as well as DIN-rail mounting on distribution panels.
   - Power supply shall be suitable for 3-phase, 3x240V phase to neutral, -40% +20%, 50 Hz AC, so that even in case of outage in one or two phases, DCU can be powered through the healthy
phase. 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 site
maintenance.
- DCU shall consume minimum power for its operation. It shall also have rechargeable
battery/Super Capacitors with backup for 1 hour for normal meter reading and to push tamper
event and carry out on demand reading and the network health status / connectivity
continuity & check. DCU should have feature to send power outage and restoration message
to the HES. The battery shall have a guaranteed life of 10 years.
- DCU shall have built in Real time Clock (RTC) with separate battery backup. The battery
shall have a guaranteed life of 10 years. It shall have self-diagnostic feature for RTC, memory,
battery, communication module, etc.

b. Configuration, Functionality & Interface
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 DCU. The data acquisition (Push/Pull)
frequency shall be programmable. DCU shall be capable to prioritize control commands.
- The successful bidder will provide the communication protocol between the DCU and the Head
  end system to APDCL.
- DCU shall have internal memory for storing interval data for at least 5 days. It shall be Non
  Volatile Memory (non-battery backed up) with 10 years data retention in absence of power.
- DCU shall support on demand read and ping of individual/group of meters.
- DCU shall push events like tamper, power off etc. to HES immediately on occurrence/receipt
  from field devices/meters.

c. Communication
- The DCU also shall have Wide Area Network (WAN) connectivity to the HES through
  RF/PLC/digital cellular GPRS communication. It shall have provision for modem with SIM slot for
  supporting Dual-band GPRS module (in case of GPRS communication) with a valid
  communication terminal port i.e. RJ45/RS232 for other communication option as well. DCU
  modem should support GPRS SIM card. It shall support SIM card from any service provider.
- DCU shall be able to communicate with meters.
- DCU 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 DCU shall establish communication
  with underlying devices as well as upstream application (HES) automatically.
- The retry attempts for meter data acquisition shall be configurable globally or individual meter.
- DCU shall keep record of:
  i. No of packet failures
  ii. Retry attempts
  iii. Missed periodic reading
  iv. Failure to connect
  v. For each meter upto a period of 3 days and update the same to HES periodically.
- DCU shall be capable to handle data of minimum 50 nos of any type of smart meter
  (1ph/3ph/CT operated). DCU shall be able to acquire and send data to HES for full capacity (No.
of meters/field devices it is designed for) within a period of 3 minutes. Full capacity of DCU is required to be indicated in the offer.

- DCU shall be able to communicate with the nearest meters at a distance of at least 50 m, 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 formation.
- Remote Firmware Upgrade: The DCU shall support remote firmware upgrades as well as remote configuration in order to add new features and functions to DCU remotely from the control centre.
- Configuration of programmable parameters of Smart Meters shall be done through DCU

d. Testing of the DCU
DCU shall be tested for EMC and EMI capability as per IEC 61000 for following:

   i. Fast transient burst test
   ii. Test of immunity to electrostatic discharges.
   iii. Test of immunity to electromagnetic HF field
   iv. The contractor shall provide IP 55 compliance test certificate.

DCU functionalities shall ensure AMI/PLM system to achieve performance criteria as specified during performance testing of MDM.

**Specification of External RAID Mass storage device (for 12 months online backup)**

- Storage Array
- Controller Cache: 512 MB per controller standard
- Integrated RAID controller with an LCD/LED status display and 256 MB, read/write battery-backed cache (expandable to 512 MB per controller),
- Host Interface: Fiber Channel connection per controller from the host side Host Ports per Controller: Dual 2 Gb/s
- RAID Levels EXCEPT RAID (0) Redundant Controller: Yes

**TABLE 1: SERVERS**
MDAS, MDM, PLM, PQM and other software & analytics:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description of the Features</th>
<th>Minimum Quantity of the features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specification</td>
<td>x86 processor with minimum 2 no of processors having 8 core in each processor and minimum 2 GHz frequency</td>
</tr>
<tr>
<td>2</td>
<td>RAM</td>
<td>64 GB (expandable up to 100 %)</td>
</tr>
<tr>
<td>3</td>
<td>Internal memory capacity (in RAID-1) configuration</td>
<td>2 x 300GB delivered, the server should support 600GB drives</td>
</tr>
<tr>
<td>4</td>
<td>Optical Drive</td>
<td>DVD or Blue-ray (R+W)</td>
</tr>
<tr>
<td>5</td>
<td>PCI slot and Interfaces</td>
<td>Minimum 3 PCI slots with 100% scalability. 1 Gb quad Ethernet ports</td>
</tr>
<tr>
<td>6</td>
<td>HBA Port</td>
<td>Dual port FC HBA for connecting storage</td>
</tr>
</tbody>
</table>
### TABLE 2: WORKSTATION CONSOLES

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description of the Features</th>
<th>Minimum Quantity of the features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spec</td>
<td>As per the latest Standard Specifications above CPU 2006 Benchmark Standard.</td>
</tr>
<tr>
<td>2</td>
<td>RAM</td>
<td>8GB</td>
</tr>
<tr>
<td>3</td>
<td>Internal Auxiliary memory</td>
<td>150GB delivered, expandable up to 300GB</td>
</tr>
<tr>
<td>4</td>
<td>Internal Optical Drive</td>
<td>DVD/Blu-ray (R+W)</td>
</tr>
<tr>
<td>5</td>
<td>Speakers</td>
<td>Two external speakers</td>
</tr>
<tr>
<td>6</td>
<td>Interfaces</td>
<td>1 Gb dual Ethernet ports USB Ports</td>
</tr>
<tr>
<td>7</td>
<td>Power Supply</td>
<td>Dual AC Power Supply</td>
</tr>
<tr>
<td>8</td>
<td>User interface</td>
<td>Two 24” wide screen (16:9 aspect ratio), HD Resolution (1920x1080) TFT Colour monitors, keyboard &amp; optical mouse.</td>
</tr>
<tr>
<td>9</td>
<td>Mounting</td>
<td>Desktop mounting</td>
</tr>
</tbody>
</table>

### TABLE 3: MONITOR FOR SERVERS

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description of the Features</th>
<th>Minimum Quantity of the features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diagonal Viewable size</td>
<td>17”</td>
</tr>
<tr>
<td>2</td>
<td>Colour support</td>
<td>16.7 million</td>
</tr>
<tr>
<td>3</td>
<td>On screen control</td>
<td>Required</td>
</tr>
<tr>
<td>4</td>
<td>Anti glare &amp; anti static</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Tilt, Swivel</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>Aspect ratio</td>
<td>16:9</td>
</tr>
<tr>
<td>S.No</td>
<td>Description of the Features</td>
<td>Minimum Quantity of the features</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Specification</td>
<td>8 Ethernet Ports (1gbps) and 4 Fiber Optic Ports</td>
</tr>
<tr>
<td>2</td>
<td>Data encryption support</td>
<td>3DES (168 bits), AES 128-, 192-, 256- bit and hashing algorithm like MD5, SHA-1, IKE, PKI (X.509) and IKEv2 with EAP</td>
</tr>
<tr>
<td>3</td>
<td>Support Active-Active mode</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>High Availability &amp; Load balancing</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Support NAT, PAT &amp; Policy based NAT/PAT, Mapped IP (MIP), Virtual IP(VIP) &amp; MIP/VIP grouping</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>IP address assignment features</td>
<td>PPPoE, DHCP</td>
</tr>
<tr>
<td>7</td>
<td>Support VoIP protocols</td>
<td>H.323, SIP, MGCP, SCCP</td>
</tr>
<tr>
<td>8</td>
<td>IPv6 features</td>
<td>Syn Cookie, Syn-proxy DoS attack detection, SIP, RSTP, Sun-RPC, ALG’s, RIPng, BGP4, DHCPv6 Relay, IPv4 to IPv6 translations &amp; Encapsulations.</td>
</tr>
<tr>
<td>9</td>
<td>System management</td>
<td>Using web UI, Command Line interface (console/telnet/SSH).</td>
</tr>
<tr>
<td>10</td>
<td>Filtering of packets based on Source address, destination address, protocol type, user, port number, URL.</td>
<td>Yes</td>
</tr>
<tr>
<td>11</td>
<td>Filtering of protocols</td>
<td>FTP, SMTP, HTTP, HTTPS, SNMP, UDP, ICMP, RPC, DNS, DHCP, ARP, TCP, POP3</td>
</tr>
<tr>
<td>12</td>
<td>Authentication protocols</td>
<td>RADIUS, LDAP and PKI methods</td>
</tr>
<tr>
<td>13</td>
<td>Dynamic routing protocols</td>
<td>RIPv2, OSPF, &amp; BGP</td>
</tr>
<tr>
<td>14</td>
<td>DoS &amp; DDoS prevention</td>
<td>Yes</td>
</tr>
<tr>
<td>15</td>
<td>TCP reassemble for fragmented packet protection</td>
<td>Yes</td>
</tr>
<tr>
<td>16</td>
<td>Brute Force attack mitigation</td>
<td>Yes</td>
</tr>
<tr>
<td>17</td>
<td>SYN cookie protection</td>
<td>Yes</td>
</tr>
<tr>
<td>No.</td>
<td>Feature Description</td>
<td>Minimum Quantity of the features</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>18</td>
<td>Zone based IP spoofing</td>
<td>Yes</td>
</tr>
<tr>
<td>19</td>
<td>Malformed packet protection</td>
<td>Yes</td>
</tr>
<tr>
<td>20</td>
<td>DNS guard features</td>
<td>Yes</td>
</tr>
<tr>
<td>21</td>
<td>Content filtering</td>
<td>JAVA &amp; ActiveX blocking</td>
</tr>
<tr>
<td>22</td>
<td>Antivirus, anti-worm, anti-spam and anti-spyware protection</td>
<td>Yes</td>
</tr>
<tr>
<td>23</td>
<td>System Logging &amp; monitoring</td>
<td>Syslog, Email, SNMPv2 and VPN Tunnel Monitor.</td>
</tr>
<tr>
<td>24</td>
<td>Stateful packet inspection</td>
<td>Yes</td>
</tr>
<tr>
<td>25</td>
<td>Assign zones to virtual &amp; physical interfaces</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**TABLE 5: SIZING PARAMETERS FOR EACH FIREWALL**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description of the Features</th>
<th>Minimum Quantity of the features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No. of unique users</td>
<td>Unlimited</td>
</tr>
<tr>
<td>2</td>
<td>Minimum number of concurrent sessions</td>
<td>500</td>
</tr>
<tr>
<td>3</td>
<td>Minimum new sessions per second processing</td>
<td>500</td>
</tr>
<tr>
<td>4</td>
<td>Minimum Firewall throughput</td>
<td>1 Gbps</td>
</tr>
<tr>
<td>5</td>
<td>Minimum 3DES/AES VPN throughput</td>
<td>250 Mbp</td>
</tr>
<tr>
<td>6</td>
<td>No of VLANs</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>Minimum IPSec VPN peers</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>Number of 1 Gbps LAN ports</td>
<td>12</td>
</tr>
</tbody>
</table>
TABLE 6: ROUTER

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description of the Features</th>
<th>Minimum Quantity of the features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Functions</td>
<td>High performance Routing for data exchange</td>
</tr>
<tr>
<td>2</td>
<td>Routing Capability</td>
<td>Layer -2 &amp; Layer-3 routing &amp; Dynamic discovery of routing</td>
</tr>
<tr>
<td>3</td>
<td>Processing capacity</td>
<td>Minimum 2 Mbps</td>
</tr>
<tr>
<td>4</td>
<td>Features to support</td>
<td>QoS, MPLS, Security, Broadband, Multiservice, Voice, IP to IP Gateway</td>
</tr>
<tr>
<td>5</td>
<td>Routing protocols</td>
<td>EIGRP, IGRP, IS-IS, OSPF, BGP, ARP, IPCP, IP forwarding, VLAN &amp; MPLS etc.</td>
</tr>
<tr>
<td>6</td>
<td>Network protocols</td>
<td>TCP/IP, IPv6, IPv4, OSI, Telnet, UDP, DHCP</td>
</tr>
<tr>
<td>7</td>
<td>Network management</td>
<td>Using SNMP Protocol</td>
</tr>
<tr>
<td>8</td>
<td>Inbuilt security features</td>
<td>• Data encryption supported DES (56 BITS) 3des (168 bits) and hashing algorithm like MD5 and SHA-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Filtering of packets based on Source address, Destination address, Protocol type, User, Port number, URL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Filtering of Protocols such as FTP, SMTP, HTTP, SNMP, UDP, ICMP, RPC, DNS, DHCP, ARP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Min. 100 IPSec VPN tunnels support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Detailed system logging</td>
</tr>
<tr>
<td>9</td>
<td>Speed configurability at each port</td>
<td>All ports shall be configurable from 64kbps to 2Mbps</td>
</tr>
<tr>
<td>10</td>
<td>Interface ports</td>
<td>1000 Mbps LAN ports – 2 V.35/G.703 Ports as per the system requirement. There shall be 50% spare ports.</td>
</tr>
<tr>
<td>11</td>
<td>Mounting</td>
<td>Rack Mountable</td>
</tr>
</tbody>
</table>
TABLE 7: PANELS-42 U RACK

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description of the Features</th>
<th>Minimum Quantity of the features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Functions</td>
<td>For mounting or placement of equipment</td>
</tr>
<tr>
<td>2</td>
<td>Mounting</td>
<td>Floor mounted with front &amp; rear access to hardware and wiring</td>
</tr>
<tr>
<td>3</td>
<td>Cable entry</td>
<td>Bottom</td>
</tr>
<tr>
<td>4</td>
<td>Internal lighting lamp</td>
<td>Yes, with door interlock</td>
</tr>
<tr>
<td>5</td>
<td>230V AC, 15/5 A Internal power socket with switch</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>All material used in the panel are flame retardant</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>All Louvers provided with suitable wire mesh</td>
<td>Yes</td>
</tr>
</tbody>
</table>

TABLE 8: SWITCH

Servers and peripheral devices are connected to each other on a local area network (LAN). Dual LAN is envisaged for the System.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description of the Features</th>
<th>Minimum Quantity of the features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Functions</td>
<td>24 ports for connecting Workstation, servers, screen &amp; peripheral devices on Local Area Network (LAN).</td>
</tr>
<tr>
<td>2</td>
<td>Conform to standards</td>
<td>ISO8802 or IEEE 802 Series Standards</td>
</tr>
<tr>
<td>3</td>
<td>Switching capability</td>
<td>Layer-3 switching &amp; VLAN</td>
</tr>
<tr>
<td>4</td>
<td>Interface ports</td>
<td>** Minimum 8-1Gbps Ethernet ports</td>
</tr>
<tr>
<td>5</td>
<td>Cable standard</td>
<td>Cat 6 or higher bandwidth cable</td>
</tr>
</tbody>
</table>

** However, the no of ports in a LAN switch shall be as per the network architecture & the no of servers/devices on that LAN.
V. Section E: Training Requirement

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

1. General

- Training shall be conducted by Project Implementing Consortium personnel who are experienced instructors and fluently speak English understandable to APDCL personnel.
- All necessary training material shall be provided by the Contractor. Each trainee shall receive individual copies of all technical manuals and all other documents used for training.
- Class materials, including the documents provided to the trainees as well as class handouts, shall become the property of APDCL. APDCL reserves the right to copy such materials, but for in-house training and use only.
- Hands-on training shall utilize equipment similar to that being supplied under the contract. In general training duration shall be 50% for hands on except database and dispatcher which could go up to 80% for hands on training.
- For all trainees the travel (e.g., airfare) and daily expenses will be borne by the employer.
- The Project Implementing Consortium shall quote training prices individually for each of the courses as per the abovementioned table.
- The schedule, location, detailed contents and batches for training for each course shall be finalized during detail engineering. The number of participants in the training program may undergo change.
- APDCL shall have the option to cancel any or all training courses. In the case of cancellation, the rate quoted against the respective course will not be paid to the successful bidder.

The training topics and plan are summarized as follows:

<table>
<thead>
<tr>
<th>Training Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Hardware Training</td>
</tr>
<tr>
<td>AMI for residential/ Commercial</td>
</tr>
<tr>
<td>Billing System</td>
</tr>
<tr>
<td>Energy Accounting</td>
</tr>
<tr>
<td>Demand Side Management/Demand Response</td>
</tr>
<tr>
<td>Load Forecasting &amp; RE Integration</td>
</tr>
</tbody>
</table>
The training courses, their duration, and the number of APDCL’s personnel to be trained in each course are identified in the abovementioned table. Training course requirements are described below in terms of the contents of each course to be provided. Training shall be provided on topics including but not limited to supply system database for the application software course, database and display building, the operator training course, the associate training courses, and any other courses suggested by the Project Implementing Consortium or requested by APDCL for successful implementation and operation of the Solution in the long run.

2. **Report and Analytic Building Course:**

The Database and Report and Analytic Building course shall be primarily a hands-on course. The course shall be designed to train APDCL personnel on how to develop the databases, displays, reports and configure analysis for the supplied smart grid system component. Course objectives shall include:

- How to build report and displays.
- How to do online editing of databases and report.

On course completion, all participants shall be able to prepare the necessary input data to define the system operating environment, build the system database, build business intelligence case analysis and reports and prepare the database administrator to maintain and modify the database and its structures.

3. **Smart Grid Component Hardware and Software:**

The training course shall be designed to give APDCL personnel sufficient knowledge of the overall design and operation of the Solution so that they can correct the problems, configure the hardware, perform preventive maintenance, run diagnostic programs and communicate with contract maintenance personnel. The following subjects shall be covered:

- **System Hardware Overview:** Configuration of the hardware of the Solution. Preventive maintenance techniques and diagnostic procedures for each element of the system, e.g.,
processors, auxiliary memories, LANs, DCU, meters, routers, firewall, IPS, IDS and printers.

- **System Expansion**: Techniques and procedures to expand and add equipment such as meter, printer, communication channels, router ports, and router firewalls, DCU, work stations and control centers.

- **System Configuration and Maintenance**: Procedures of configuring router ports, VLANs, firewall policy definitions and Interfacing web services. Basics of operation and maintenance of the redundant hardware configuration fail over and fail over switches.

- **Operational Training**: Practical training on preventive and corrective maintenance of all equipment, including use of special tools and instruments. This training shall be provided on employer equipment, or on similarly configured systems.

- **Diagnostics**: Including the execution of diagnostic procedures and the interpretation of diagnostic outputs.

- **Software Documentation**: Orientation in the organization and use of system software documentation.

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

- **System Hardening and Cyber Security**: Orientation in changing defaults parameters (hardware and Operating System) to harden the systems cyber security posture.

4. **Application Software Course**:

The Project Implementing Consortium shall provide a comprehensive application software courses covering all applications. The training shall include-

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

- **Application Functions**: Functional capabilities, configuration, and associated maintenance and expansion techniques.

- **Software and Protocol Administration**: Techniques and conventions to be used for the preparation and integration of new software functions including Application Program Interface (API) interfaces and Web services. This shall also include configuration of system for security web services, OPC and other standards specified in the specification.

- **Software Documentation**: Orientation in the organization and use of system software and Application software documentation.

- **Cyber security related features of application**: e.g. user authentication, encryption, etc.

5. **Functionality Training**:

The Contractor shall provide functionality course that covers the following subjects as a minimum:

- Theory of operation of all functions.

- Operational procedures for various modes of operation, including diagnostic tests and interpretation of the associated test results.

- Addition/ deletion of equipments/ meters in the system

- Details of functionalities:
  - i. AMI for residential/ Commercial
  - ii. Billing System
  - iii. Energy Accounting
iv. Demand Side Management/Demand Response
v. Load Forecasting & RE Integration
vi. Consumer Portal
vii. Power Quality
viii. Analytics & Reports
ix. System Integration
x. Cyber Security Training

- Over view of smart grid project

6. **Operator Training:**

Operator training shall familiarize APDCL’s personnel for operation of delivered system operation. The training shall include user displays, on demand data acquisition, remote and local configuration, management and download as well as connect disconnect.

The training shall include:

- **System Overview:** Configuration of the system, a functional overview, and an overview of system capabilities and performance.
- **General Operating Procedures:** Hierarchical structure of displays, display capabilities and features, user procedures, log-on and user access restrictions, and error messages.
- **System Applications:** Theory of operation, capabilities, and operating procedures for each application function.
- **Handling of Equipment:** Minor maintenance operations, such as removal of stuck paper in printers etc., which do not require spares/specialized skills.
- **Operator Documentation:** Orientation in the organization and application of all user documentation for Operator and verification of the information contained therein.

The course shall focus on hands-on training on the system. The trainees shall perform instructor-defined procedures with the help of the dispatcher documentation.

7. **Communication system training:**

The training shall focus on critical aspects associated with installation, testing & commissioning of communication network equipment is however, responsibility of service provider & contractor who has signed SLA with utility, but required level of knowledge for troubleshooting, up keeping the equipment will be required. This shall include the state-of-the art techniques employed in laying, splicing & testing of communication network equipments etc. The owner’s personnel shall be trained in such a way that the basic maintenance of terminal equipments & cable etc. can be carried out effectively

8. **Network Security and Cyber Security Training Course:**

The course shall familiarize trainees with requisite skills for network partitioning, configuration and diagnostics for security equipment such as IPS, IDS, and firewalls, signature as well as patch update for equipment. The course shall familiarize and develop participant’s skills about possible cyber incidences, response and mitigation methods for delivered systems and components including but not limited to SQL injection, virus, buffer overflow etc.
VI. **SECTION F: FACILITY MANAGEMENT SERVICE (FMS) AND SERVICE LEVEL AGREEMENT (SLA)**

1. **Facility Management System**

   This section describes general requirements describes the project’s spares and maintenance requirements.

1.1. **Introduction:**

   The Contractor shall be required to provide the services through Facility Management Service provider so as to manage smart grid control centre including all equipments, installations including hardware, software: & networks installed & commissioned by Contractor for the utility in order that they meet the availability requirement as specified in the document.

   System Management Services shall be provided by FMS Contractor in order that maximum uptime & performance levels of Smart Grid systems installed are ensured. As such, FMS Contractor is expected to provide services as per ITIL (IT Infrastructure Library) standards with performance levels meeting or exceeding those mentioned in Service Level Agreement (SLA) agreed between utility & Contractor.

   To achieve the desired Service Levels, the Contractor may need to interact, coordinate and collaborate with the other Service Providers as required. The Contractor will act as the Single Point of Contact for all issues relating to the Service Levels. The Contractor will have the responsibility to deal with the other vendors (during warranty period) / other vendors as selected by utility (after warranty period) as the case may be, to provide the services at agreed service levels. However, the prime responsibility of providing desired services shall be that of lead Contractor during warranty period. The role of FMS Contractor shall start immediately after systems are installed, commissioned and handed over to the owner after Operational acceptance of the smart grid control centre.

1.2. **Scope of Work:**

   The Scope of Work shall include the software and hardware maintenance support (complete cover warranty of all equipment’s / software without any commercial burden to APDCL) to be provided by the Contractor in respect of the system supplied under this project during five year Facility Management Services (FMS) period along with Supervision & Operationalizing five year warranty of the Smart Grid System after the Operational Acceptance of the smart grid control centre.

   The maintenance of the smart grid control centre under FMS period shall be comprehensive, as set forth herein, in nature and would broadly include but not be limited to diagnosis and rectification of the hardware and software failures. The Scope also includes:

   i. Co-ordination with equipment supplier for Repair/ replacement of defective equipment.

   ii. Services to bring up any or all smart grid control centre upon its failure and to restore the functioning of smart grid control centre including Data Centers etc.

   iii. Database sizing should be modified/ upgrade as and when required.

   iv. The support for the all types of meters/ Communication equipments etc.
v. All Software modules under the smart grid control centre and the associated Hardware supplied under this project.

vi. Routine works like database building, addition of analog and status points and other such day-to-day operational activity would primarily be the responsibility of Utility and in case of any difficulty in this regard the same shall be referred to the Contractor for support.

1.3. Hours of Cover:

The Contractor’s on-site support standard hours of service, the timings for Emergency Software Support would be 24 hours a day, 7 days a week throughout the year (i.e. 24x365). At least three Engineers including Site Manager along with one on-site support personnel for Hardware and one on-site personnel for Software shall be deployed at each control center. The support personnel so deployed shall be qualified personnel having experience in the delivered smart grid control centre. The Contractor shall submit the CV’s of all such personnel to Utility for approval before deployment at site.

The Contractor shall be responsible for 24*7*365 management of all the systems as per scope of work with services rendered at least as per Service Level Agreement between utility & Contractor. The Scope does not include management of physical security for access to the said facilities. The following facilities will be provided at the start of contract to FMS Contractor by Utility for carrying out the FMS responsibilities:

   i. Appropriately secured lockable storage/setup area.
   ii. Sufficient Sitting/office space in neat & clean environment.
   iii. PC (other communication facilities like P&T telephone & internet facility are to be arranged by FMS Contractor)

1.4. Essence of the Agreement:

The essence of the Agreement (to be entered) is to provide FMS for the designated hardware and software, with the goal of meeting the Availability as set forth herein and to provide system tuning and configuration to accommodate a growing system.

1.5. Service Delivery Management:

FMS Contractor shall provide detailed description for service delivery management for the complete project including transition plan and deliverables and project management methodology.

1.6. Project Management:

FMS Contractor will assign a Project Manager for the entire State who will provide the management interface facility and has the responsibility for managing the complete service delivery during the contractual arrangement between utility and the FMS Contractor. Project Manager will be responsible for preparation and delivery of all monthly/weekly reports as well as all invoicing relating to the service being delivered. Project Manager’s responsibilities should essentially cover the following:

   i. Overall responsibility for delivery of the Statement of Work/s (SOW) and Service Level Agreement (SLA).
   ii. Act as a primary interface to Utility for all matters that can affect the baseline, schedule and cost of the services project.
iii. Maintain project communications through Utility’s Project Leader.
iv. Provide strategic and tactical recommendations in relation to technology related issues.
vi. Resolve deviations from the phased project plan.
vii. Conduct regularly scheduled project status meetings.
viii. Review and administer the Project Change Control Procedure with utility Project Leader.
ix. Identify and resolve problems and issues together with utility Project Leader.
x. Responsible for preparation and delivery of all monthly reports as well as all invoicing relating to the services being delivered.

1.7. Transition Management:

During initial two weeks viz. initial period of taking over by FMS Contractor after completion of all installation & commissioning jobs by consortium members, FMS Contractor shall provide minimum agreeable services. Formal SLA shall be enforced only after initial transition period.

1.8. Install, Moves, Adds, Changes (IMAC) Services:

This Service provides for the scheduling and performances of install, move, add, and change activities for Hardware and Software. Definitions of these components are as follows:

i. **Install**: Installation of desktop machines/workstations, servers, peripheral equipment, and network-attached peripheral equipment, which form part of the existing smart grid control centre (new equipment needs to be procured by the Utility).

ii. **Move**: Movement of desktop machines/workstations, servers, peripheral equipment, and network-attached peripheral equipment.

iii. **Add**: Installation of additional hardware /software after initial delivery.

iv. **Change**: Upgrade to or modification of existing hardware or software on desktop/workstations and servers etc.

Requests for IMAC shall be prepared by FMS Contractor depending on customer/ system requirements & shall be approved by utility. Utility shall formulate guidelines for IMAC & communicate it to FMS Contractor. All procurements shall be done by utility.

1.9. Contractor Management Services:

As part of this activity, for efficient and effective warranty implementation, the FMS Contractor’s Team will:

i. Manage the vendors for escalations on support.

ii. Logging calls and co-ordination with Contractors.

iii. Contractor SLA tracking.

iv. Management of assets sent for repair.

v. Maintain database of the various vendors with details like contact person, Tel. Nos., response time and resolution time commitments. Log calls with vendors, Coordinate and follow up with the vendors and get the necessary items exchanged.

vi. Analyze the performance of the Contractors periodically (Quarterly basis).

vii. Provide MIS to utility regarding tenure of completion of warranty/AMC with outside vendors for software, hardware & networks maintenance in order that utility may take necessary action for renewal of warranty/AMC. FMS Contractor shall also provide MIS regarding performance of said Contractors during existing warranty/AMC.
viii. Since during initial five years, warranty is in scope of OEM vendors there will be no AMC for smart grid control centre. During such period, FMS Contractor has to interact with such vendors for maintenance services and spares. After warranty period, if required Utility can award the suitable AMC and FMS Contractor has to interact with Contractors as selected by utility for providing AMC for the said system on mutually agreed terms & conditions.

1.10. FMS Contractor’s Responsibilities:
   i. Provide a single-point-of-contact for responding to Utility’s queries or accepting its problem management requests. FMS Contractor’s specialist will respond to utility’s initial request within agreed service level objectives set forth.
   ii. Monitor availability & Escalate to service provider and Notify Utility for communication failures.
   iii. Review the service levels of the service provider (as per pre-defined schedules on SLA performance) along with APDCL.
   iv. Provide network availability incident reports severity wise to utility in a format mutually agreed.
   v. Provide SLA performance management report of the Service Provider.
   vi. Fault Detection and Notification: The Contractor shall diagnose problems that could arise as part of the LAN/WAN network. These include connectivity problems due to failures in communication transport links, routing configuration points, or from software bugs etc.
   vii. Fault Isolation and Resolution: All faults that have been identified need to be isolated and rectified appropriately. The resolution measures undertaken by the Contractor and results produced accordingly shall be documented in the report.
   viii. Carrier Coordination: Carrier Coordination implies providing a single point of contact to resolve network related problems involving carrier circuits, whether equipment or circuit related. When a problem is diagnosed because of a WAN circuit, the Contractor must coordinate with the corresponding carrier to test and restore the circuit. The Contractor must take the responsibility and ensure that the problem is resolved.
   ix. Hardware/Software Maintenance and Monitoring: This would include problem determination, configuration issues, and hardware and software fault reporting and resolution. All such issues would need to be recorded and rectified.
   x. 24x7 Network Monitoring and reporting: The Contractor shall monitor the network on a continuous basis using the NMS and submit reports on a monthly basis with instances from the NMS system. System performance is to be monitored independently by the Contractor and a monthly report mentioning Service up time etc. is to be submitted to Utility. The report shall include:
      • Network configuration changes.
      • Network Performance Management including bandwidth availability and Bandwidth utilization.
      • Network uptime.
      • Link uptime.
      • Network equipment health checks report.
      • Resource utilization and Faults in network.
      • Link wise Latency report (both one way and round trip) times.
• Historical reporting for generation of on-demand and scheduled reports of Business Service related metrics with capabilities for customization of the report presentation.
• Generate SLA violation alarms to notify whenever an agreement is violated or is in danger of being violated.
• Any other reports/format other than the above mentioned reports required by utility.

1.11. Backup/Restore management:

FMS Contractor will perform backup and restore management in accordance with mutually FMS Contractor shall ensure:

i. Backup and restore of data in accordance to defined process /Procedure.
ii. 24 x 7 support for database restoration requests.
iii. Maintenance and Upgrade of infrastructure and/or software as and when needed.
iv. Performance analysis of infrastructure and rework of backup schedule for optimum utilization.
v. Generation and publishing of backup reports periodically.
vi. Maintaining inventory of onsite tapes.
vii. Forecasting tape requirements for backup.
viii. Ensuring failed backups are restarted and completed successfully within the backup cycle.
ix. Monitor and enhance the performance of scheduled backups.
x. Real-time monitoring, log maintenance and reporting of backup status on a regular basis.
xi. Management of storage environment to maintain performance at optimum levels.
xii. Periodic Restoration Testing of the Backup.
xiii. Periodic Browsing of the Backup Media.
xiv. Management of the storage solution including, but not limited to, management of space, volume, RAID configuration, configuration and management of disk array etc.,
xv. Interacting with Process Owners in developing / maintaining Backup & Restoration Policies / Procedures
xvi. To provide MIS reports as per agreement.

1.12. Restoration of Control Centre in case of Failure:

The FMS Contractor shall ensure that all the relevant data is transferred from control centre at regular frequency to Data Recovery Centre (DR) which is required for restoration of Control Centre in case of complete failure of Control centre. The FMS Contractor shall carry out system build in order to build the smart grid control centre from scratch utilizing DR Centre.

1.13. Performance Monitoring & Reporting:

i. Regularly monitor and maintain a log of the performance monitoring of servers including but not limited to monitoring CPU, disk space, memory utilization, I/O utilization, Central Storage etc.

ii. Regular analysis of events and logs generated in all the sub systems including but not limited to servers, operating systems, databases, applications etc. The system
administrators shall also ensure that the logs are backed up and truncated at regular intervals.

The administrators shall undertake actions in accordance with the results of the log analysis to ensure that the bottlenecks in the infrastructure are identified and fine-tuning is done for optimal performance.

1.14. Reporting to utility for all system performance monitoring:

The Contractor must adhere to well-defined processes and procedures to deliver consistent quality services throughout its contractual period. Any hardware/software to meet the requirements under this section must be provided by the Contractor. The Contractor is expected to have the following system management controls in place-

i. **Availability Management**-

The Contractor must define the processes/procedures which ensure the service delivery as per the required SLAs or exceed it. It should cover various equipments such as all the servers, networks, switches, routers, Modems & other site specific services, and the critical services and their supporting hardware, and software components, as defined in scope of work. Industry standard SLA management tools should be deployed and shall have following essential features:

- Ability to create an escalation.
- Ability to workflow the SLAs.
- Ability to create new action types, if needed.
- Ability to define sets of actions that are grouped together in a specific sequence.
- Ability to associate an escalation point with one or more actions through the action group.

ii. **Performance Management**-

The recording, monitoring, measuring, analyzing, reporting, and forecasting of current levels, potential bottlenecks, and enhancements of performance characteristics for the services, networks, applications, system software, and equipment within the scope shall be required. System tuning and optimization is an inherent part of this contract. Where warranted, the Contractor will utilize capacity management data in combination with performance management data to identify ways to improve performance levels of the resources, extend their useful life, and request utility to approve revisions/upgrades to the computing and communications hardware, software and other equipment such that higher levels of performance of the resources are obtained.

iii. **Security Management**-

The protection from unauthorized usage, detection of intrusions, reporting as required and proactive prevention actions are to be provided by the Contractor.

1.15. **Support Services:**

i. **Emergency Support**-

The severity levels are defined later in this chapter. 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. The team comprise of experienced technical staff that are skilled in troubleshooting SCADA/DMS systems. Severity 1 problems shall be reported by telephone for rapid response; target response times. The Contractor shall submit the process details to meet the above requirements along with the offer. 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 Utility through a call tracking system to be provided by the Contractor. The Emergency Support service goal is to meet the availability targets greater than specified in this document (minimum 99% for Overall Smart grid control centre). Resolution of problems may also be provided by an individual fix that will be installed by the Contractor at no extra cost to Utility.

ii. Monitoring-

The Contractor shall conduct the following monitoring, for the Smart grid control centre.

iii. Error Log Monitoring-

To monitor the performance of smart grid control centre on a bi-weekly basis, the Contractor shall review the following, analyze the results, and communicate to Utility:

- System logs for a selected day.
- System history log.
- Aggregate data collection.
- Events Collection.

During monitoring if any defect is found, the Contractor shall undertake corrective action for the same. The Contractor shall submit the process details to meet the above along with the offer.
2. **Service Level Agreement**

The scope of maintenance work shall include a comprehensive maintenance of all the software and hardware provided by the contractor for the various systems and components of Smart Grid Pilot under this project. The maintenance practices to be followed shall be as per ISO 20000 Standard. The essence of the maintenance services is to provide maintenance support for the designated hardware and software, with the goal of meeting the availability as set forth herein. Project implementing consortium is to hand holding the Utility team to take over maintenance and support services after completion of Project implementing consortium’s FMC 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.

2.1. **Purpose of this Agreement:**

The purpose of this SLA is to clearly define the levels of service to be provided by Supplier to Purchaser for the duration of this contract or until this SLA has been amended. The benefits of this SLA are to:

i. Trigger a process that applies Purchaser and Supplier management attention to some aspect of performance only when that aspect drops below an agreed upon threshold, or target.

ii. Makes explicit the performance related expectations on performance required by the Purchaser.

iii. Assist the Purchaser to control levels and performance of services provided by Supplier.

iv. This SLA is between Supplier and Purchaser.

2.2. **Description of Services Provided:**

Supplier shall provide service as defined in Section G in Volume 1- Scope of Work, in accordance to the definitions and conditions as defined in volume 1.

2.3. **Duration of SLA:**

This Service level agreement would be valid for entire period of contract.

2.4. **Maintenance support:**

The period of maintenance support shall be the five year comprehensive complete cover Warranty period for hardware commencing from Operational Acceptance and five year Maintenance period for software and other thereafter. The nature of maintenance support required for the different type of systems and components are described in the Table below:

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>System</th>
<th>System availability Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Smart Grid IT, Communication and Surveillance</td>
<td>99%</td>
</tr>
</tbody>
</table>

The system availability shall be measured for entire System. Similarly, the availability of various systems of Smart Grid System elements Hardware and Software, Field devices, Communication & Networking Systems shall be considered separately control Centers wise. Individual device availability shall be at least 98%. For all third party equipment (Hardware & Software) and services
(communications) Vendor/ Consortium shall have back to back support along with supply of spare and service level agreement with appropriate response time from OEM/OEM Authorized representatives. Vendor /Consortium shall be responsible for coordination with the OEM for all matter related to that equipment but the Vendor / Consortium shall be responsible for meeting the overall response times and availability requirements specified in sections below.

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:

i. Preventive Maintenance Activity (performance monitoring, system backup, patch management, updates and troubleshooting).
ii. Maintaining a minimum no. of specified spares.
iii. Integration of new equipment (Field devices, central systems, Communication & networking systems) and integration of a new or existing central system.

2.5. Performance Requirements of Solution:

Project implementing consortium is to clearly indicate the performance parameters of the proposed solution in terms of size, scalability, latency, response time, user interface features. Devices and systems which are mission critical to the delivery of project objective should have sufficient redundancy to meet the specified availability of the IT, surveillance and communication system as 99.5% and desired response time. The suggested performance parameters for some functions are as given below:

<table>
<thead>
<tr>
<th>User Interface Requirements</th>
<th>Response time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any real time display and application display on workstation console, Complete display &amp; data values shall appear on screen</td>
<td>Within 2 sec after acknowledgement of request</td>
</tr>
<tr>
<td>Manual Data entry of the new value shall appear on screen</td>
<td>Within 2 sec</td>
</tr>
<tr>
<td>Display update rate</td>
<td>Every 2 sec for 4 displays together</td>
</tr>
<tr>
<td>Response time for display of Alarm and event after receipt in system.</td>
<td>Within 1 sec of receipt in system</td>
</tr>
<tr>
<td>Alarm and event acknowledgement</td>
<td>Within 2 sec</td>
</tr>
<tr>
<td>Requests for printing of displays (to be acknowledged with an indication of request is being processed)</td>
<td>Within 2 sec</td>
</tr>
<tr>
<td>Requests for generation of reports (to be acknowledged with an indication of request is being processed)</td>
<td>Within 2 sec</td>
</tr>
</tbody>
</table>

The software execution rates, response times and performance requirements shall not deteriorate during the peak loading conditions. The following conditions as applicable shall define the additional peak level of system activity:

i. **System Alarms**-
   - 300 alarms in a scan cycle starting the five-minute period (50% status changes and 50% analog limit violations).
• 200 alarms per minute for five minutes.
• 50% of the alarms shall be acknowledged within the five-minute period (automatic acknowledgement is unacceptable).

i. **Display Requests**: 6 display requests per minute per console.

ii. **Supervisory Control**: 4 Supervisory control actions per minute.

iii. **Communication System Disturbances**: 10 disturbances within the five minute period.

2.6. **Preventive Maintenance Activity**:
The preventive maintenance activities are to be performed by the Contractor to keep the system running at optimum level by diagnosis and rectification of all hardware and software issues and would broadly include:

i. There should not be any unnecessary and unscheduled downtime of system services.

ii. 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.

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

iv. Providing all necessary assistance to Employer for addition and modification of database and Displays, Database sizing activities including Backup and restore of the system.

v. Restoration of the systems upon its failure and to restore the functioning of the various systems at the central systems.

vi. Log analysis to zero in developing issues.

vii. Routine works and other day-to-day operational activity would primarily be the responsibility of Owner and in case of any difficulty in this regard the same shall be referred to the Vendor/Consortium for support.

2.7. **Hours of Cover**:
The Vendor/Consortium shall provide engineers who have an experience and skill to maintain the Smart Grid System to the desired level of availability. The Vendor/Consortium’s on-site support for central systems shall be standard hours of service i.e. Monday to Saturday- 10:30 am to 6:30 pm local time (IST), excluding public and Owner Company holidays, throughout a year. At least one experienced personnel having expertise in Smart Grid System shall be available during the standard hours of service. 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 5 years of experience in the delivered smart grid elements/parts. The contractor shall submit the CV’s and recommendation letter from customers for all support personnel(s) to Utility for approval before Deployment at site. The Utility can ask the Contractor to replace the personnel deployed for maintenance support if his performance is not found to be satisfactory.

2.8. **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. The team shall comprise of experienced technical staff that are skilled in troubleshooting of the various systems covered under AMC. Severity 1 problems shall be reported by telephone for rapid response; target response times are defined in this section. 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 Owner/Employer through a call tracking system to be provided by the Vendor/Consortium. Resolution of problems may also be provided by an individual fix that will be installed by the contractor at no extra cost to Utility.

2.9. Monitoring:
The operation and performance of the various systems under AMC shall be monitored on a bi-weekly basis; the contractor shall review the following, analyze the results, and submit report to Utility. The contractor shall conduct at least the following monitoring, for the Control Centers:

i. Log Monitoring:
   - System logs for a selected day
   - System history log
   - Aggregate data collection
   - Events Collection

During monitoring if any defect/abnormality are found, the Vendor/Consortium shall undertake corrective maintenance for the same.

ii. Resource Monitoring:
Resource Monitoring services comprises checking the system’s major node resources, gather log data, analyze results, and advise Utility on the appropriate actions to be taken and undertake any agreed upon actions. The supplied system tools shall be used to continuously collect the following information:

   - CPU loading (Peak and Average)
   - Memory utilization (Peak and Average)
   - Disk utilization (Peak and Average)
   - LAN utilization (Peak and Average)
   - Operating system resource utilization
   - System error log

The Project implementing consortium shall submit the procedures details to meet the above along with the offer.

iii. Cyber security System monitoring:
The Vendor/Consortium 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 employer.

The monitoring shall encompass the various cyber security devices installed at Control Centre such as firewalls, Intrusion prevention system (both network based and host based), routers. 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. Contractor shall implement the recommendations/remedial actions suggested by the Auditor after audit.
2.10. **Patch Management:**

The Vendor/Consortium 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 Employers network. Other products like IPS, Network IPS, and Host based IPS, 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 also be provided and shall be shown in System Architecture diagram submitted during Bid submission.

Software updates and patches shall be applied while the system is in operation and shall not require a reboot (e.g. applied to one processor in a dual processor configuration). A secure (e.g. https) remote method of initiating a rollback to the software prior to the update or patch shall be provided. Project implementing consortium to describe the method proposed to securely apply software updates and patches. Project implementing consortium to also specify the method proposed to use to securely initiate a rollback to the software state prior to an update or patch.

The Contractor shall describe 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 as part of cyber security documentation. Any patch shall be applied only with express permission of the employer’s representative.

2.11. **Physical maintenance:**

The contractor shall undertake physical maintenance of all equipment/modules under the scope of this contract, in accordance with this section. The physical maintenance shall include cleaning, dusting, inspection of equipment for loose connections, damage to insulation, pest infections etc. Equipment shutdown approval for preventive maintenance shall be required from Employer.

2.12. **Spares inventory:**

The Contractor shall maintain a spares inventory at his 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. The Contractor shall decide the items and components to be maintained as spare but a minimum number of spares as given Table below shall be kept at the respective Centers. This shall be periodically verified by the Employer. If the replenishment of the spare takes more than 30 days then it will be considered as non-availability as per Severity-2.

**Table-Mandatory Spares inventory at Control Centers**

<table>
<thead>
<tr>
<th>S.no</th>
<th>Item description</th>
<th>Unit</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Servers</td>
<td>Lot</td>
<td>1*</td>
</tr>
<tr>
<td>2</td>
<td>Work Station</td>
<td>Lot</td>
<td>1*</td>
</tr>
<tr>
<td>3</td>
<td>Router and Switches</td>
<td>Lot</td>
<td>1*</td>
</tr>
<tr>
<td>4</td>
<td>Communication Equipment</td>
<td>Lot</td>
<td>1*</td>
</tr>
<tr>
<td>5</td>
<td>Field Devices</td>
<td>Lot</td>
<td>1*</td>
</tr>
<tr>
<td>6</td>
<td>Meters DCU and other field devices</td>
<td>Lot</td>
<td>1*</td>
</tr>
</tbody>
</table>
2.13. Integration of new equipment:
All future Field devices & other System integration shall be the responsibility of Vendor/Consortium
and shall be part of the maintenance charges.

2.14. Problem/Defect Reporting:
The Project implementing consortium shall propose an appropriate problem/defect reporting
procedure to meet the requirement of all severity level cases along with the offer. The problems will
be categorized as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity 1 – Urgent</td>
<td>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.</td>
</tr>
<tr>
<td>Severity 2 – Serious</td>
<td>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. Non-availability of Man-power at Central system during working hours, non-availability of spares.</td>
</tr>
<tr>
<td>Severity 3 – Minor</td>
<td>Any other system defect, or unexpected operation not covered under severity 1 or 2.</td>
</tr>
<tr>
<td>Severity 4 – General/Technical Help</td>
<td>Request for information, technical configuration Assistance, “how to” guidance, and enhancement requests.</td>
</tr>
</tbody>
</table>

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

i. **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 central system. For example, loss of data to the operator due to any problem software/Hardware-related in Smart Grid System, outage of any important software functionality which is required to discharge operational functions, outage of both main and standby routers, and loss of data exchange with other computer systems or other Central systems would be included under this category. The failure of complete UPS (uninterrupted Power Supply) system resulting into loss of UPS output supply at both Output ACDB is covered under this category. Upon receiving intimation, the representative of the contractor would immediately attend to the problem. The problem shall be attended by the contractor at the earliest, and it shall arrange all resources and take all steps to restore the data availability and functionality at the earliest.

ii. **Severity-2**
Degradation of services or critical functions such as to negatively impact system
operation. Failure of one Data Server, stoppage of data collections for archiving, at the respective Central system, and outage of other applications not covered under severity-1 are included in this category. Failure of one UPS system, Failure of Battery System and failure of any other system of Auxiliary Power supply not covered under Severity-1 is included in 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. Failure of any redundant system component affecting the critical redundancy would also be included in this category. Non-availability of designated contractor’s Man-power at central system as well as required inventory of spares specified here will also be covered under this category.

iii. 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.

iv. Severity-4 (General Technical Help)
Request for information, technical configuration assistance, “how to” guidance, and Enhancement requests are included under this category.

2.16. Response and 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 between the initial receipt of the support request (through approved communications channels) and the acknowledgment of the contractor. The Action Resolution Time is the period between the initial response and the contractor delivering a solution. 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.

### Table-Support Response/Resolution Time

<table>
<thead>
<tr>
<th>Severity</th>
<th>Initial Response Time (Working Hours)</th>
<th>Initial Response Time (Non-working hours)</th>
<th>Action Resolution Time</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 minutes</td>
<td>30 minutes</td>
<td>2 hours</td>
<td>An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored may be by workaround.</td>
</tr>
<tr>
<td>2</td>
<td>5 minutes</td>
<td>2 Hours</td>
<td>24 Hours</td>
<td>Attempt to find a solution acceptable to Owner/ Employer (dependent on reproducibility), as quickly as practical.</td>
</tr>
</tbody>
</table>


2.17. **Availability and maintenance charges payment Calculation:**

It is the endeavor of both the contractor and Owner to maximize system availability to the extent possible. The contractor shall provide guaranteed availability for various types of Severity levels as specified in section above. The non-availability hours for availability calculation shall be counted from the end of the allowed Action Resolution time. A standardized register shall be maintained at each site containing full details of each outages, actions taken by Owner to correct the problem, applicable Severity level, time of reporting to the contractor support engineer/support centre pursuant to the appropriate methods in the Agreement, allowed Response time as per the Response times defined in above section, actual Resolution time, and signature of Engineer-in-charge as well as the contractor’s support engineer of the site. Duration of outages over and above the Action Resolution time in each of the Severity levels shall be counted for the non-availability computation and shall be clearly brought out in the register. The resolution may be accomplished by a workaround, and such solution shall mark the end of non-availability. 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. Note: While calculating Availability following shall be considered:

The overall smart grid system shall be considered as available if:

i. All Smart Grid applications are available.

ii. All Smart Grid functions described in the specification are executed at periodicities specified in the specification without degradation in the response times.

iii. Requests from available Operator Consoles & VPS are processed.

iv. Information Storage and Retrieval applications are available.

v. Data exchange with other system is available.

vi. One of the redundant hardware is available so that all the Smart Grid applications are functional to ensure the design & performance requirement as envisaged in the MTS.

2.18. **Availability computation for System:**

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

\[
\text{Availability (per site)} = (1 - [(\text{downtime total time} - \text{maintenance time})] \times 100)
\]

2.19. **Payment of maintenance charges (based on Smart Grid System availability):**

In the event of availability below a certain level, the maintenance charges would be proportionately reduced as follows: The same shall be applicable for the Auxiliary Power supply system with the
availability specified for the respective systems.

A) For overall system availability

<table>
<thead>
<tr>
<th>Availability Per quarter</th>
<th>Deduction as % of the apportioned price of total FMS to be paid annually (Software Portion) for central system portion of the contract applicable (quarterly software price)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 99%</td>
<td>NIL</td>
</tr>
<tr>
<td>Less than 99%</td>
<td>Deduction of 2% of the apportioned price of the apportioned FMS (which is to be paid annually) for every 1 % or part there of decrease in availability under 99 %. However, the deduction as % shall be limited to a maximum of ten percent [10%] of the apportioned FMS for one year after the warranty period.</td>
</tr>
</tbody>
</table>

B) For individual hardware & non critical functions:

<table>
<thead>
<tr>
<th>Availability Per quarter</th>
<th>Deduction as % of the apportioned price of total FMS to be paid annually (Hardware portion) for central system portion of the contract applicable for that site (quarterly hardware price)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 98%</td>
<td>NIL</td>
</tr>
<tr>
<td>Less than 98%</td>
<td>Deduction of 2% of the apportioned price of the apportioned FMS (which is to be paid annually) for every 1 % or part there of decrease in availability under 98 %. However, the deduction as % shall be limited to a maximum of ten percent [10%] of the apportioned FMS for one year after the warranty period.</td>
</tr>
</tbody>
</table>

2.20. Computation of Availability / Non-availability:

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

<table>
<thead>
<tr>
<th>Service</th>
<th>Parameters</th>
<th>Service</th>
<th>Validation</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Management</td>
<td>Submission of monthly Project Status reports &amp; Conducting</td>
<td>100%</td>
<td>1. Minutes of Meetings 2. Approval of Status reports by Engineer-in-Charge</td>
<td>2% of monthly FMS charges for every default.</td>
</tr>
<tr>
<td>Help Desk</td>
<td>Resolution of ticket logged as per the Severity definition chart</td>
<td>99%</td>
<td>Reports generated from Ticket logging system</td>
<td>95%-99% calls resolved in specified time: {mention day/hour, define criticality}2% penalty on the monthly FMS charges. 90%-95% calls resolved in specified time: 5% penalty on the monthly FMS charges.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Install, Moves, Add, Changes (IMAC) Services</td>
<td>Should be part of Monthly project status report</td>
<td>95%</td>
<td>Report</td>
<td>0.2% of monthly FMS charges</td>
</tr>
<tr>
<td>Asset/Inventory Management</td>
<td>Provide monthly MIS Asset Inventory</td>
<td>95%</td>
<td>Report</td>
<td>0.2% of monthly FMS charges</td>
</tr>
<tr>
<td></td>
<td>Provide monthly MIS on new requirements with procurement time</td>
<td>95%</td>
<td>Report</td>
<td>0.2% of monthly FMS charges</td>
</tr>
<tr>
<td></td>
<td>Conduct Annual Physical Asset verification</td>
<td>100%</td>
<td>Management Approval of Physical asset Verification report</td>
<td>0.5% of Yearly FMS charges</td>
</tr>
<tr>
<td>Supplier Management Service</td>
<td>Evaluation</td>
<td>100%</td>
<td>Management Approval of Supplier Performance evaluation report</td>
<td>0.5% of Quarterly FMS charges</td>
</tr>
<tr>
<td></td>
<td>Tracking of Supplier SLA &amp; tickets logged with suppliers</td>
<td>95%</td>
<td>Status of tickets logged with suppliers</td>
<td>0.5% of monthly FMS charges</td>
</tr>
<tr>
<td></td>
<td>MIS reporting on AMC tenure</td>
<td>95%</td>
<td>Report</td>
<td>0.2% of monthly FMS charges</td>
</tr>
</tbody>
</table>
### Desk Side Technical Support Services
- **Resolution of ticket logged as per the Severity definition chart**
  - 95%
- **Reports generated from Ticket logging system**
- **2% of monthly FMS charges**

### Antivirus Management
- **Rollout of latest anti-virus definition file on workstations and Servers on being made available on Supplier’s**
  - 98%
- **Reports generated from Anti-Virus software console**
- **1% of monthly FMS charges**

### LAN & Local Server Administration
- **Resolution of ticket logged**
  - 99%
- **Reports generated from Ticket logging system**
- **Covered under S. No. 1**

### Network Monitoring & Management
- **Project implementing consortium to monitor the availability of the network link for uptime. Project implementing consortium should measure link availability on a monthly basis.**
  - 99%
- **Downtime Reports on the Network performance**
- **Penalty of 2% per month will be deducted from the monthly FMS charges of that utility, if the reports are not submitted by the Project implementing consortium.**
  - **Important:** A separate SLA will be signed with bandwidth provider.

### Data Centre Network Availability
- **Minimum of 99.8% uptime measured on a monthly basis.**
  - 98%
- **Report**
- **2% of monthly FMS charges for less than 99.8%.**
- **3% of monthly FMS charges for less than 98.0%.**
- **5% of monthly FMS charges for less than 95%.**
- **2% of monthly**
### Data Centre Operation

<table>
<thead>
<tr>
<th>Service Area</th>
<th>Requirement</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Availability</td>
<td>Minimum of 97% uptime measured on a monthly basis</td>
<td>97% Report</td>
</tr>
<tr>
<td>Divisional &amp; Other Offices Network Availability</td>
<td>FMS charges for less than 98%, 3% of monthly FMS charges for less than 97%, 5% of monthly FMS charges for less than 95%</td>
<td></td>
</tr>
<tr>
<td>MIS reporting on physical and environmental conditions</td>
<td>95% Report</td>
<td>0.2% of monthly FMS charges</td>
</tr>
<tr>
<td>MIS reporting of health checkups of all systems &amp; modules installed with existing</td>
<td>95% Report</td>
<td>0.2% of monthly FMS charges</td>
</tr>
<tr>
<td>Rollout of patches (OS, infra level) on workstations and Servers after patch being approved on test environment</td>
<td>98% Patch update reports</td>
<td>0.5% of monthly FMS charges</td>
</tr>
<tr>
<td>Service Description</td>
<td>Service Details</td>
<td>% of Monthly FMS Charges</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>UP time of server</td>
<td>99.8% Report</td>
<td>2% of monthly FMS charges for less than 99.8% 3% of monthly FMS charges for less than 98% 5% of monthly FMS charges for less than 95%</td>
</tr>
<tr>
<td>Database Administration services</td>
<td>MIS report of database scheme, disk space, storage and user role 99% Report</td>
<td>0.5% of monthly FMS Charges</td>
</tr>
<tr>
<td>Backup / Restore Management</td>
<td>The Supplier should take backup as per the backup schedule defined by utility 99% Report</td>
<td>If the negligence is found in monthly audit, the Supplier would be penalized a sum of Rs. 5,000/- per negligence.</td>
</tr>
<tr>
<td>Utility would periodically (once a quarter on a random day) request the Supplier to restore the backup data</td>
<td>100% Report</td>
<td>2% of monthly FMS charges</td>
</tr>
<tr>
<td>Management utility’s EMS</td>
<td>Daily MIS of server and device health checkups (CPU, disk space, memory Utilization, I/O utilization, Central Storages etc.) 100% Reports generated from EMS system</td>
<td>0.5% of monthly FMS charges</td>
</tr>
<tr>
<td>Incident Management</td>
<td>Resolution of ticket logged in Incident management tool</td>
<td>99%</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------------------------------</td>
<td>-----</td>
</tr>
</tbody>
</table>
| Problem Management  | Supplier shall analyze all the incidents and provide a root cause report every month if there are more than 10 incidents of the same type. Supplier shall take the needed corrective action to prevent further issues due to the same cause. | 100% timely submission on covering all Incident tickets logged in that month | Root cause report, Incident report stating problems faced by the users Document detailing corrective Action | 5% penalty on the monthly FMS charges of that Project Area, if the Supplier does not submit a problem report for that month
<p>|
| Change Management   | Resolution of Change Management ticket logged in     | 99% | Reports generated from Change Management System | Covered under S. No. 1 |
| Release Management  | Resolution of ticket logged in                       | 99% | Reports generated from ticket logging system     | 0.5% of monthly FMS charges of that Project Area, if the Supplier does not perform the corrective action for more than one calendar month |
| Availability Management | Should be part of Monthly                       | 95% | Report                                         | 0.2% of monthly FMS charges |</p>
<table>
<thead>
<tr>
<th>Performance Management</th>
<th>Should be part of Monthly status report</th>
<th>95%</th>
<th>Report</th>
<th>0.2% of monthly FMS charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity Management</td>
<td>Should be part of Monthly status report</td>
<td>95%</td>
<td>Report</td>
<td>0.2% of monthly FMS charges</td>
</tr>
<tr>
<td>Security Management</td>
<td>Should be part of Monthly status report</td>
<td>95%</td>
<td>Report</td>
<td>0.2% of monthly FMS charges</td>
</tr>
<tr>
<td>Resource Management</td>
<td>Number of shift days for which resource present at the designated location / Total number of shift days</td>
<td>98% averaged</td>
<td>Overall resource is designate for Project implementing consortium services calculated on a monthly basis</td>
<td>Attendance track, Call Log, Audit calls/ visits measured on a monthly basis</td>
</tr>
<tr>
<td></td>
<td>Resource provided is not as per given</td>
<td>100% of the resource given</td>
<td>Experience Certificate of FMS personnel submitted by Supplier to Utility</td>
<td>Per day deduction = 0.5% (Monthly value for that man power as per SOR)/ 30</td>
</tr>
<tr>
<td>Meter Data availability for the period of declared Go-Live to start of FMS charge</td>
<td>Meter data availability is at server end visible in application.</td>
<td>95%</td>
<td>Measured on monthly basis for each meter</td>
<td>Per month deduction= 2% of the (Smart meter Cost + Communication cost) for each meter</td>
</tr>
</tbody>
</table>
2.21. Breach of SLA:

In case the Supplier does not meet the service levels mentioned in one of the section of SLA, for three (3) continuous time-periods as specified in the relevant clause, the Purchaser will treat it as a case of breach of Service Level Agreement. The following steps will be taken in such a case:-

i. Purchaser issues a show cause notice to the Supplier.

ii. Supplier should reply to the notice within three working days.

<table>
<thead>
<tr>
<th>Meter Data availability for the period of FMS charge</th>
<th>90%</th>
<th>Measured on a Quarterly basis for each meter</th>
<th>Per Quarter deduction= 5% of the (Smart meter Cost + Communication cost) for each meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%</td>
<td></td>
<td>Measured on a half yearly basis for each meter</td>
<td>Per Quarter deduction= 50% of the (Smart meter Cost + Communication cost) for each meter</td>
</tr>
<tr>
<td>98% and Above</td>
<td>95%</td>
<td>Measured on a quarterly basis for total meters</td>
<td>Incentive= 1% of the quarterly FMS Charge</td>
</tr>
<tr>
<td>98% and Above</td>
<td>95%</td>
<td>Measured on a monthly basis for total meters</td>
<td>Deduction= 2% of the monthly FMS Charge</td>
</tr>
<tr>
<td>90%</td>
<td></td>
<td>Measured on a quarterly basis for total meters</td>
<td>Deduction= 3% of the quarterly FMS Charge</td>
</tr>
<tr>
<td>90%</td>
<td></td>
<td>Measured on a half yearly basis for total meters</td>
<td>Deduction= 5% of the half yearly FMS Charge</td>
</tr>
</tbody>
</table>
iii. If the Purchaser authorities are not satisfied with the reply, the Purchaser will initiate termination as per termination clause in volume 1.

2.22. Exclusions:
The Supplier will be exempted from any delays or slippages on SLA parameters arising out of following reasons:-
   i. Delay in execution due to delay (in approval, review etc) from Purchaser’s side. Any such delays will be notified in written to the IT Team.
   ii. The network links will be provided by a third party and the Supplier will monitor and report any problems on behalf of third party. If Supplier notifies and Purchaser approves that the delay or fault was due to the third party link services then such loss will not be considered for tracking Supplier’s SLA parameters (Also reduced from total service time).

2.23. Monitoring and Auditing:
IT Team of Purchaser will review the performance of Supplier against the SLA parameters each month, or at any periodicity defined in the contract document. The review / audit report will form basis of any action relating to imposing penalty or breach of contract. Any such review / audit can be scheduled or unscheduled. The results will be shared with the Supplier as soon as possible. Purchaser reserves the right to appoint a third-party auditor to validate the SLA.

2.24. Reporting Procedures:
The Supplier’s representative will prepare and distribute SLA performance reports in an agreed upon format by the 10th working day of subsequent month of the reporting period. The reports will include “actual versus target” SLA performance, a variance analysis and discussion of appropriate issues or significant events. Performance reports will be distributed to the Purchaser’s IT Team.

2.25. Issue Management Procedures:
   i. General-
   This process provides an appropriate management structure for the orderly consideration and resolution of business and operational issues in the event that quick consensus is not reached between Purchaser and Supplier. It is expected that this pre-defined process will only be used on an exception basis if issues are not resolved at lower management levels.
   ii. Issue Management Process-
   - Either Purchaser or Supplier may raise an issue by documenting the business or technical problem, which presents a reasonably objective summary of both points of view and identifies specific points of disagreement with possible solutions.
   - Purchaser and the Supplier’s representative will determine which committee or executive level should logically be involved in resolution.
   - A meeting or conference call will be conducted to resolve the issue in a timely manner. The documented issues will be distributed to the participants at least 24 hours prior to the discussion if the issue is not an emergency requiring immediate attention.
   - Management of Purchaser and Supplier will develop a temporary, if needed, and the permanent solution for the problem at hand. The Supplier will then communicate the resolution to all interested parties.
   - In the event a significant business issue is still unresolved, the arbitration procedures described in the Contract will be used.
2.26. SLA Change Control:
   i. General-
      It is acknowledged that this SLA may change as Purchaser’s business needs evolve over the course of the contract period. As such, this document also defines the following management procedures:
      • A process for negotiating changes to the SLA.
      • An issue management process for documenting and resolving particularly difficult issues.
      • Purchaser and Supplier management escalation process to be used in the event that an issue is not being resolved in a timely manner.
      
      Any changes to the levels of service provided during the term of this agreement will be requested, documented and negotiated in good faith by both parties. Either party can request a change. Changes will be documented as an addendum to this document and consequently the contract.
   
   ii. SLA Change Process-
      Both the parties may amend this SLA by mutual agreement in accordance. Changes can be proposed by either party. Normally the forum for negotiating SLA changes will be Purchaser’s monthly review meetings.

2.27. Version Control:
   All negotiated SLA changes will require changing the version control number. As appropriate, minor changes may be accumulated for periodic release (e.g. every quarter) or for release when a critical threshold of change has occurred.

2.28. Management Escalation Procedures:
   The purpose of this escalation process is to provide a quick and orderly method of notifying both parties that an issue is not being successfully resolved at the lowest possible management level. Implementing this procedure ensures that purchaser and Supplier management are communicating at the appropriate levels. Escalation should take place on an exception basis and only if successful issue resolution cannot be achieved in a reasonable time frame.
   
   i. All issues would be raised to the project management team, which is completely responsible for the day to day aspects of the implementation. The project management team shall classify the issues based on their severity level and resolve them within appropriate timelines.
   
   ii. If project management team is unable to resolve an issue, the issue would be escalated to the top management with options/ risks detailed for decision. Top management will make decisions based on the options/ risks presented by the IT team.
   
   iii. In case one or both the parties are unsatisfied with the decision of the top management of the Purchaser, the dispute will be resolved.

2.29. Contractor’s Obligations:
   In order to optimize and improve the response of the system, the contractor may re-install the program modules in consultation with and after making the Owner / Employer engineer aware of the consequence (like data loss, database rebuild etc). Any modification of Field devices, software/Operating System required to restore functionality due to hardware upgrades, patches, or arising out of a necessity to fix FPRs (Field problem reports), would be done by the contractor at no extra cost to Owner /
Employer. The contractor will submit FSR (Field Service Report) and the steps taken to solve the problem, along with details of code changes.

2.30. **Responsibilities of Owner /Employer:**

The responsibilities of the owner during the maintenance period are as follows:

i. Employer shall ensure that proper Environmental conditions are maintained for the system.

ii. Employer 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 Employer representatives (or persons under their supervision) are allowed to operate the system.

iii. Employer shall provide access to the sites of installation for purposes of providing Support Services.

iv. Employer shall provide the contractor with Space for Office for their maintenance staff and storage for spares.

2.31. **Responsibility Matrix:**

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

**Legends:**

- This indicates who has primary responsibility to perform this function.
- This indicates who will provide assistance.

<table>
<thead>
<tr>
<th>Item</th>
<th>Task</th>
<th>Employer</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>PROBLEM IDENTIFICATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>Root cause analysis to determine whether the fault is attributable to Hardware or Software.</td>
<td>----</td>
<td>●</td>
</tr>
<tr>
<td>0.2</td>
<td>Resolution of problems involving third party maintainer where there is uncertainty whether the root cause is hardware or software.</td>
<td>----</td>
<td>●</td>
</tr>
<tr>
<td>1.0</td>
<td>SOFTWARE PROBLEM RESOLUTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Report problem and assist with problem Identification</td>
<td>●</td>
<td>A</td>
</tr>
<tr>
<td>1.2</td>
<td>Provide or recommend corrections, temporary patches, workarounds or other fixes to system problems</td>
<td>----</td>
<td>●</td>
</tr>
<tr>
<td>1.3</td>
<td>Install and test corrections, temporary patches, work around or other fixes to system problems</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>ROUTINE SOFTWARE SUPPORT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Build and maintain database, displays and reports</td>
<td>A</td>
<td>●</td>
</tr>
<tr>
<td>2.2</td>
<td>Perform system back-ups</td>
<td>----</td>
<td>●</td>
</tr>
<tr>
<td>2.3</td>
<td>Restore or reinstall software from back-Ups</td>
<td>----</td>
<td>●</td>
</tr>
<tr>
<td>2.4</td>
<td>Monitor system logs (part of remote monitoring service)</td>
<td>----</td>
<td>●</td>
</tr>
<tr>
<td>2.5</td>
<td>Maintain system logs</td>
<td>----</td>
<td>●</td>
</tr>
</tbody>
</table>
### 3.0 HARDWARE PROBLEM RESOLUTION

| 3.1 | Report problem and assist with defining Problem | • | A |
| 3.2 | Troubleshoot problem to diagnose if it is software-related or hardware-related | • | |
| 3.3 | Identify failed component, Replace Failed components in online system using parts from spares inventory | • | |
| 3.4 | Restore operation of repaired/replaced Equipment | • | |

### 4.0 HARDWARE SPARE PARTS

| 4.1 | Manage local spares inventory | • | |
| 4.2 | Replenish local spares inventory | • | |

### 5.0 INTEGRATION AND DATABASE WORK AT CONTROL CENTRE END

| 5.1 | Field device Integration | • | |
| 5.2 | Other system Integration | • | |

### 6.0 AUXILIARY POWER SUPPLY SYSTEM

| 6.2 | Troubleshoot problem to diagnose | • | |
| 6.3 | Replenish local spares inventory | • | |

### 7.0 CYBER SECURITY MONITORING

| 7.1 | Patch Updates | • | |
| 7.2 | Cyber Security Monitoring | • | |
| 7.3 | Annual Audits | • | |
| 7.4 | Implementation of Recommendations during Audit | • | |
| 7.5 | Maintenance of Spares | • | |

#### 2.32. Signing of SLA:
In witness, the parties who have caused this Service Level Agreement to be executed by their respective authorized representatives shall sign the agreement as mentioned in Annexure 26 of Volume 1 of this RfP.
VII. Section G: Project Management

APDCL will designate a Project Manager (PM) to coordinate all APDCL project activities. PM in association with partner organization (Project Management Consultant) will lead the Smart Grid effort. PM will be responsible for the direction and administration of contract. Regulatory changes will be issued by the concerned agency after successful implementation of the project. The Project Implementing Consortium shall assign a Project Manager with the authority to make commitments and decisions that are binding on the Project Implementing Consortium. All communications between APDCL and the Project Implementing Consortium shall be coordinated through the Project Managers.

The Project Managers shall also be responsible for all communications between other members of the project staffs including sub-Project Implementing Consortium, if any Project Implementing Consortium should follow the Project Managers direction and make all out efforts to complete the project in given time schedule. Project plan should be prepared by Project Implementing Consortium in tools such as MS Project and tracking should also be done using the same tool. Project Implementing Consortium is to provide the project management software license used for preparing project plan, as part of the project to facilitate APDCL in managing the project. Team size and skill set of personnel proposed to be deployed for the project should be submitted by the Project Implementing Consortium along with the proposal. Weekly progress reports should be made by the Project Implementing Consortium, highlighting the critical area and Report on Project management metrics as suggested below:

Metrics and measures

Following metrics is suggested to be included in progress reports wherever applicable:

- **Customer Level Metrics:**
  
  The number and percentage of customers and the amount of load served by the following will be measured:
  
  i. AMI
  
  ii. Dynamic Pricing (CPP and TOU)
  
  iii. Load Management and Control
  
  iv. Grid Connected Renewable Distribution

- **Distribution Level Metrics:**

  The number and percentage of installations and magnitude of total load served by Substations or feeder lines that use automation equipment. In addition to this, system losses and increased efficiency and reliability will be measured.

- **APDCL Operational Performance Metrics:**

  The Utilities plan to utilize the information provided by the Smart Grid project to further enhance and
to optimize system and APDCL operations:

i. Load Profile Data from individual customers will be aggregated to provide more accurate information on transformer and equipment loading for more efficient application and design optimization.

ii. Rate Structures – the hourly, possibly 15 minute, interval data provided by AMI will be used to optimize new dynamic rate structures.

iii. Peak Load Analysis – analysis of demand response program and peak load reduction.

iv. Outage Management.

v. Reduce system losses and outage times while optimizing the design process for equipment loading and operations based on system data.

vi. Discover effects of demand response, load control, and technological support of distributed generation dispatch, control and demand-side management

- **Project Schedule:**

The Project Implementing Consortium shall submit a preliminary project implementation schedule along with the bid. A detailed project schedule shall be submitted for approval by APDCL within one month of the signing of the Contract. The duration of project activities and scheduling of deliverables in the detailed schedule shall be the same as in the tentative schedule included in the proposal, except as otherwise agreed during Contract negotiations.

It shall include at least the following activities:

i. Site Survey

ii. Testing at Site for interface with existing systems

iii. Documents, Drawing submission and approval

iv. Database development

v. Type Testing Schedule

vi. Hardware purchases, development/manufacturing and integration

vii. Receipt, Storage, Installation & Field update schedule

viii. Execution of project

ix. Factory & Site Testing Schedule

x. Documentation

xi. Training schedule

xii. Run pilot

xiii. Evaluation of pilot

The project implementation schedule shall include the estimated period for completion and its linkage with other activities. The Project implementation schedule shall also contain APDCL activities required by the Project Implementing Consortium to complete the system.
• **Progress Report:**

A detailed progress report shall be prepared by the Project Implementing Consortium each month against the activities listed in the project schedule, in addition to weekly reports. The monthly report shall be made available to APDCL on a monthly basis, e.g., the 10th of each month and it should include project tracking in the soft copy as well. The progress report shall include all the completed, on-going and scheduled activities and issued and received for the month.

• **Project correspondence Procedures:**

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

• **Review Meetings**

Progress meetings shall be scheduled by the Project Manager and attended by the Project Implementing Consortium and APDCL each reporting period to review progress of the project. Progress meetings shall be used to review the progress report, written correspondence exchanged since the last meeting, and open action items.

The Project Implementing Consortium shall also attend technical meetings as required to discuss technical aspects of the project and to review APDCL comments on approval documents. When appropriate, these technical meetings shall be conducted as extensions to the progress meetings.

• **Quality Assurance & Testing:**

  i. **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 APDCL’s satisfaction, and the equipment has been approved for shipment by APDCL. If 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 Project Implementing Consortium 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.

  ii. **Inspection-**

Access to the Project Implementing Consortium’s facilities while manufacturing and testing are taking place, and to any facility where hardware/software is being produced for APDCL shall be
available to APDCL representatives. The Project Implementing Consortium shall provide to APDCL 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 Project Implementing Consortium's facilities and to Sub vendor facilities where equipment is being manufactured.

Inspections will be performed by APDCL, which will include visual examination of hardware, enclosure cable dressings, and equipment and cable labeling. Project Implementing Consortium documentation will also be examined to verify that it adequately identifies and describes all wiring, hardware and spare parts. Access to inspect the Project Implementing Consortium’s hardware quality assurance standards, procedures, and records that are applicable to the facilities shall be provided to APDCL. APDCL representatives shall be allowed access to the Project Implementing Consortium’s facilities during system manufacturing and testing and to any facility where hardware or software is being produced. Office facilities, equipment, and documentation necessary to complete all inspections and to verify that the Smart Grid system is being produced and maintained in accordance with the Specification shall be provided to APDCL’s representatives by the Project Implementing Consortium.

APDCL representatives shall be allowed to review and verify the functional implementation of the Smart Grid System informally in conjunction with scheduled project meetings at the Project Implementing Consortium's facilities. No test plans, procedures or reports are required to support these informal software demonstrations.

APDCL representatives shall be allowed to inspect the Project Implementing Consortium'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 Project Implementing Consortium 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 SMART GRID system and to sub-system suppliers. All materials and parts of the system/sub-system to be supplied under the project shall be of current manufacturer from a supplier regularly engaged in the production of such equipment.

iii. Quality Assurance and Quality Control Program-

The Project Implementing Consortium 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 Project Implementing Consortium’s plant, in the field, or at any Sub-Vendor source shall be controlled at all points necessary to assure conformance to contractual requirements.

The program shall provide for prevention and ready detection of discrepancies and for timely and positive corrective action. The Project Implementing Consortium shall make objective
evidence of quality conformance readily available to APDCL. Instructions and records for quality assurance shall be controlled and maintained at the system levels. The Project Implementing Consortium shall describe his QA/QC program in the Technical Proposal, (along with samples from his QA/QC manual) and shall submit his QA/QC Manual for review and acceptance by APDCL. Such QA/QC program shall be outlined by the Project Implementing Consortium and shall be finally accepted by APDCL after discussions before the award of Contract. A Quality Assurance Program of the Project Implementing Consortium 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-Vendor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases, etc.

e) System for shop manufacturing including process controls.

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

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

h) Inspection and test procedure for manufacture.

i) System for indication and appraisal of inspection status.

j) System for quality audits.

k) System for authorizing release of manufactured product.

l) System for maintenance of records.

m) System for handling, storage and delivery.

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

The Quality Plan shall be mutually discussed and approved by APDCL after incorporating necessary corrections by the Project Implementing Consortium as may be required.

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 Project Implementing Consortium 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 Project Implementing Consortium shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of APDCL's inspection of equipment/materials. APDCL or it’s duly authorized representative reserves the right to carry out Quality Audit and Quality Surveillance of the systems and procedures of the Project Implementing Consortium's/his vendor's Quality Management and Control Activities.

The scope of the duties of APDCL, pursuant to the Contract, will include but not be limited to the following:

a) Review of all the Project Implementing Consortium's drawings, engineering data etc.

b) Witness or authorize his 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.

f) Monitor the Quality Assurance program implementation at all stages of the works.

iv. Inspection Certificate-

The Project Implementing Consortium shall give APDCL 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 Project Implementing Consortium's account except for the expenses of the Inspector. APDCL, unless witnessing of the tests is waived, will attend such tests on the scheduled date for which APDCL has been so notified or on a mutually agreed alternative date. If APDCL fails to attend the testing on the mutually agreed date, Project Implementing Consortium may proceed with the test which shall be deemed to have been made in the Inspector's presence and Project Implementing Consortium shall forthwith forward to the Inspector, duly certified copies of the test results in triplicate. APDCL shall, within fourteen (14) days from the date of inspection as defined herein, give notice in writing to the Project Implementing Consortium of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Project Implementing Consortium 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 Project Implementing Consortium's or Sub-Vendor's works, APDCL shall issue a certificate to this effect within fourteen (14) days after completion of tests but if the tests are not witnessed by APDCL, the certificate shall be issued within fourteen (14) days of receipt of the Project Implementing Consortium's
Test Certificate by APDCL. The completion of these tests or the issue of the certificates shall not bind APDCL 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 Project Implementing Consortium or of any Sub-Vendor, the Project Implementing Consortium except where otherwise specified shall provide free of charge items such as labor, materials, electricity, fuel, water stores, apparatus and instruments, as may be reasonably demanded by APDCL or his authorized representative to carry out effectively such tests of the equipment in accordance with the Contract and shall provide facilities to APDCL or his authorized representative to accomplish testing. The inspection by APDCL and issue of Inspection Certificate thereon, shall in no way limit the liabilities and responsibilities of the Project Implementing Consortium in respect of the agreed Quality Assurance Program forming a part of the Contract. The Project Implementing Consortium shall keep APDCL 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 Project Implementing Consortium at his works for periodic inspection by APDCL's representative. Certificates of manufacturing tests shall be maintained by the Project Implementing Consortium and produced for verification as and when desired by APDCL. 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 APDCL in writing only. However, such inspection by APDCL's representative(s) shall not relieve the Project Implementing Consortium from the responsibility for furnishing material, software, and equipment to conform to the requirements of the Contract; nor invalidate any claim which APDCL may make because of defective or unsatisfactory material software or equipment.

v. Test Plans & Procedures

Test plans and test procedures shall be provided by the Project Implementing Consortium, for all tests to ensure that each factory and field test is comprehensive and verifies the proper performance of the smart grid elements under test for APDCL approval before the start of testing. The Project Implementing Consortium shall prepare detail testing procedure in line to specification and submit for APDCL’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 APDCL approval.
VIII. APPENDIX – I: DETAILED FUNCTIONALITIES OF SMART GRID PILOTS
(For Reference Use Only)

1. Introduction
The following are various functionalities being opted as part of the smart grid pilots in India.

- AMI for Residential, Commercial and Industrial
- Peak Load Management
- Outage Management
- Power Quality
- Renewable Integration
- Micro Grids
- Distributed Generation

Use Cases are the descriptions of smart grid functionalities that define the important actors, systems and technologies, and their requirements that are part of the smart grid applications. This document presents the key use cases of these functionalities, suggested for including in the Technical requirement documents for the smart grid pilots.

Fig:- Various functionalities of Smart Grid Pilots -Use Case Categories
The use cases and information exchange needs have been grouped based on functionality and the organization of the document is as shown in the figure below.
2. AMI for Residential, Commercial and Industrial
AMI is a flexible, general-purpose metering and communication system that can be used for many applications – including meter reading, distribution automation, connect/disconnect, and others. AMI systems promise to provide advanced energy monitoring and recording, sophisticated tariff/rate program data collection, and load management command and control capabilities. Additionally, these powerful mechanisms will enable consumers to better manage their energy usage, and allowing the grid to be run more efficiently from both a cost and energy delivery perspective. These advanced capabilities will also allow utilities to provision and configure the advanced meters in the field, offering new rate programs, and energy monitoring and control.

The key points under this section are Meter should record and store energy, load profile, metering and event data and send it to Control center thru appropriate communication technology that can be RF/GPRS… Data from various meters in a subsystem can be collated by DCU that polls meters reporting to it for data aggregation and then sending it to Control Center, Control Center will facilitate data repository with VEE, Synchronization and aggregation as per network hierarchy, Time clock of each node in the system i.e. meter/DCU/ Control center etc should be time synchronized

2.1 Meter Data Management
Data management system at Control center should support following functions:-

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Functionality</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Menu driven and web based</td>
<td>The software should have menu driven functions for automatic data capturing, periodic data uploading, etc. with user friendly web based front end. It should allow user to view energy usage for a specific customer, print or export the tables, view the last data collection timestamp, view the current status of diagnostics flags, perform usage analysis, and view any open Service Requests.</td>
</tr>
<tr>
<td>2</td>
<td>Data versioning and auditing</td>
<td>The software should be reliable, flexible, and scalable. The software should provide data management including data versioning and auditing i.e. all data is versioned and stored in the database, including the original values, error flags, estimated or edited data, and re-collected data etc.</td>
</tr>
<tr>
<td>3</td>
<td>Data Validation</td>
<td>The software should preferably ensure data validation at both ends e.g. at the meter/data logger end before transmission to eliminate possibility of garbage data and the system at the data centre should apply comprehensive data validation before accepting and using meter data like Meter Number, Connected DT, Scheduled Reading date and time, reading parameters (KWh, KVAh, KW, PF etc.), Period for which data needed</td>
</tr>
</tbody>
</table>
| 4 | Service Oriented Architecture | The software should support Service Oriented Architecture (SOA) compliant N-Tier multi-tier, distributed architecture design philosophy with following tiers:  
   a. Client Tier: The client tier will be the interface of the software with the utility’s operations/dashboard user. The client tier will provide all the user interfaces for the operational and supervisory activities involved in meter data acquisition, processing and analysis.  
   b. Business logic tier: It service the requests made by the client tier. These requests could be automated, based on user-defined schedules or on demand from the user.  
   c. Database tier: It comprise RDBMS designed to maintain the relationships between meter and network assets, network topology, user privileges, connection point details, customer accounts and other entities. The database tier should be optimally designed to exploit both normalized as well as multidimensional data models. The database should also maintain a time-series repository that stores the data collected and processed from meters, including meter readings, register reads, interval usage data, outage and restoration events and event logs as well as derived or computed data such as billing determinants, aggregations and asset performance indicators like load factor and load duration curves. |
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<tr>
<td>5</td>
<td>Core Reporting Functionalities</td>
<td>Software should also support core reporting functionality which includes data collection performance reporting (for example, actual vs. expected by day, by technology type) and exception reporting (for example, meter or communications equipment failures, diagnostic flags, etc.).</td>
</tr>
</tbody>
</table>
| 6 | Data Storage should facilitate storage for | a. Registered Read Data including register reads, daily billing cycle, as well as derived billing determinants (for example, TOU/RTP from interval data).  
   b. Interval Data channels with variable intervals (for example, 5 minutes to 60 minutes) and variable units of measure (kWh, kVARh, kW, kVAR, volts, amps, frequency etc.).  
   c. Calculated Data that is derived or computed such as billing determinants and aggregated loads. |
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<tr>
<th>S.No</th>
<th>Data Transfer to other systems</th>
<th>Details of requirement</th>
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<tr>
<td>7</td>
<td>Data Transfer to other systems</td>
<td>The software should support an interval data transfer service for transferring interval data to external systems on a scheduled frequency for non-billing purposes, including the transfer of the same interval data to multiple systems on different cycles. Data transfers can be scheduled to send data in real-time (as the interval data is received), or on a daily, weekly, or monthly cycle.</td>
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<tr>
<th>S.No</th>
<th>Data Synchronization</th>
<th>Details of requirement</th>
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<tr>
<td>8</td>
<td>Data Synchronization</td>
<td>The Data Synchronization Engine ensures that any changes in data elements or relationships such as meter changes, rate changes, move-in move-outs, and other changes to customer premise or Service Delivery Point (SDP) information are identified and reflected in MDM. The Synchronization process automatically generates and logs exceptions when attempts to synchronize data cause invalid or erroneous results.</td>
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This sub-section covers the requirement on remote meter reading.

### 2.2 Perform Remote meter Reading

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<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
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<tbody>
<tr>
<td>1</td>
<td>Meter sending the consumption data</td>
<td>Meter at scheduled frequency sends the data to head-end (could be through the DCU if solution is defined so). Consumption details will be programmable time block basis, and data could be incremental to what was sent by meter in the preceding instance.</td>
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<tr>
<td>2</td>
<td>Acquiring meter data remotely</td>
<td>Multiple clients in data center will Read Demand and Energy Data Automatically from Customer Premises or will have access to the data if already available in the AMI system – e.g. for regular meter reading, load forecasting, load management etc. Ensure that clients like billing system and load forecasting, load management etc should not be required to initiate separate meter reading requests and meter reading data is validated, synchronized, unified and made available to other systems on request Head-end acquiring average/instantaneous data from the meters which then reaches Meter data management system The meter data received from DCU/Meter shall also give the data logging (till where data reached etc.)</td>
</tr>
<tr>
<td>3</td>
<td>Requesting meter data remotely</td>
<td>MDM requesting average/instantaneous interval and events data of the meters from the Head-end at scheduled intervals i.e. thru programmable data capture frequency; and creating billing profile, portal services to view energy data for various purposes, etc.</td>
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<tr>
<td></td>
<td>Set data capture frequency remotely</td>
<td>Control center to set data capture frequency remotely of AMI Meter/Device interval data for all consumers and DTs/feeders through MDM and Head-end</td>
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<tr>
<td></td>
<td></td>
<td>The daily capture (capture frequency shall be configurable) of AMI Meter/Device interval data for all consumers and DTs/feeder</td>
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<tr>
<td>5.</td>
<td>Utility can get on Demand Meter reading remotely</td>
<td>MDM capturing on Demand energy /Average/Instantaneous data (which means viewing the meter data at any instance on demand) that may include 3p voltages, currents, frequency, PFs, total kW, and kVA and register reads for cumulative kWh, kVARh, KVAh The system shall capture on Demand energy data (Three phases The call center/ consumer care center officials (having the required authorization e.g. district manager, customer care group head etc.) should have the ability to perform on Demand requests for residential and C&amp;I customers, including meter status, current month consumption, cumulative energy and voltage (power quality information) or shall have access to the voltages, currents, PFs, total kW, and kVA and register reads for cumulative kWh, kVARh, KVAh etc.) for all customers (residential, commercial, and industrial) and DTs/feeders data if already available in the AMI system. Call center/ consumer care center officials will have access to the data over a web based portal</td>
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<td></td>
<td>System shall have the ability to keep a log of the on Demand requests</td>
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<td>System shall have the ability to send energy data via e-mail (or another medium) if it exceeds maximum time allowed.</td>
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<td>If either no response was received in a given timeframe or a negative response was received, the requesting party will be notified, and an exception created. This will be recorded as an exception and resolved by the utility within approved TAT by regulation.</td>
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<tr>
<td>6</td>
<td>More than one make of meters communicating to multiple make of DCUs</td>
<td>More than one make of meters to communicate with multiple make of DCUs with synchronizing the various recorded meter interval data</td>
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<tr>
<td>7</td>
<td>Manual Collection of Meter Data</td>
<td>Field Representative collecting data manually from field and upload the same in MDM for meters where energy data was expected but not received, exceptions have to be created by the system and it should be possible to collect</td>
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<tr>
<td>Field Service Representative (Line man/ meter reader) retrieves data directly from AMI Meter (alternate retrieval of meter data) in a standard format that can be pushed into the main system</td>
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<tr>
<td><strong>8</strong> Validation, Estimation, and Editing (VEE) of data in MDMS function to perform validation, estimation, and editing (VEE) against energy data receiving from Head-end.</td>
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<tr>
<td>VEE system in MDM should have the capability as applicable on any type of data should be there (instantaneous/energy/load profile/event/meter general parameters like RTC etc.). Different estimation algorithm shall be used for missing data conditions (e.g. missing interval in a one hour gap, missing intervals of an entire billing span, etc.).</td>
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<tr>
<td>Meter Storage System</td>
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<tr>
<td>Meter stores interval data on 15/30 min basis for at least 15/30 days predefined periodicity along with the load survey, midnight survey, events (tampers) &amp; billing profile</td>
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<tr>
<td><strong>9</strong> Centralized data management</td>
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<tr>
<td>MDM ensures that clients like billing system and load forecasting, load management etc should not be required to initiate separate meter reading requests and meter reading data is validated, synchronized, unified and made available to other systems on request</td>
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<tr>
<td>Priority Message Generation</td>
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<tr>
<td>Head-end receives priority messages in less than 1 min for 95% of end points and non-critical messages can be pushed periodically (configurable) either at day end/ every 4 hours etc.). Utility configures which messages to be designated as priority through MDM.</td>
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<tr>
<td>AMI Network monitoring</td>
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<tr>
<td>Graphical interface enables utility to see the possible reasons, root cause analysis of the communication network if possible, logs captured in the devices etc. in case Meter(s) does not communicate remotely during default or non default schedule read. In such situation, events/alerts shall be raised to appropriate utility users e.g. Catastrophic failure scenario (&gt; 10% of meter population failing)</td>
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<tr>
<td>Meter communication denial</td>
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<tr>
<td>MDM gives the list of Meter that does not communicate remotely during default schedule read and for the meters that communicate intermittently (for xx consecutive days) from head-end.</td>
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<tr>
<td>Remote diagnosis of non-responding devices</td>
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<tr>
<td>Smart grid control center remotely diagnose non-responding devices remotely to reduce field visits and produces a report of non-performing field devices to quantify the system availability</td>
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<tr>
<td>Service Description</td>
<td>Description</td>
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<tr>
<td>Voluntary meter reading</td>
<td>Customer providing the meter reading which includes instantaneous meter read (status and data) in case of non availability of data thru remote reading</td>
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<tr>
<td>Remote maintenance</td>
<td>Firmware Upgrade, Remote programming, which includes user to maintain the AMI system by remotely programming the system parameters like critical events, interval period, etc., upgrading the system with new firmware</td>
<td></td>
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<tr>
<td>Interface to consumer portal</td>
<td>Meter data management should provide updated consumption data to the consumer portal which in turn allows consumers to download/VIEW the consumption history</td>
<td></td>
</tr>
<tr>
<td>Customer Interface to MDM for consumer engagement</td>
<td>System through MDM gives periodic updates to the customers and via media (website, SMS, e-mail, meter displays etc.) on various services floated by the utility for consumer engagement</td>
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</tbody>
</table>
| Billing System       | Register and Interval Billing:  
|                    | Register Billing  
|                    | Register Billing supports billing requirements for monthly billing based on register reads.  
|                    | It includes billing cycle data services that deliver billing determinants via an interface to CIS/Billing on the billing cycle date and on request when special reads are required. A Billing Determinant Calculator provides the flexibility to compute the billing determinant values based on utility defined formulas. Formulas are built around logical and arithmetic operators, and can contain other billing determinants, constants, and customer functions.  
|                    | Bi-directional: MDM should support bi-directional metering by processing the delivered and received channels for a given meter in two separate channels.  
|                    | Net Metering (using Virtual channel): MDM should support net metering by processing the delivered and received channels from the meter/recorder and calculating a net amount. The calculated net will be stored onto a virtual channel. MDM should provide full tracking, management, and storage of usage data related to each data channel. This allows summation of usage data separately for each data channel.  
|                    | Usage Calculated from Register Reads: MDM can create usage data from register reads received from AMR/AMI systems or gathered manually. MDM will calculate the difference between the current bill period register read and the previous bill period register read, applying the Current Transformer/Potential Transformer ratio (CT/PT) required converting to the correct kWh usage amount. Rollover conditions are also considered when computing usage. The calculated usage is stored in the billing table and accessible to all applications that require the data.  
|                    | Interval Billing: The Interval Billing should include all of the functionality offered in the Register Billing in addition to support Advanced Billing Determinants (ABD) calculated from interval reads.  
|                    | As interval data is retrieved by the AMR/AMI systems, the Advanced Billing Determinant (ABD) engine should process the interval reads into daily and billing cycle usage-based billing determinants (as compared to register-based billing). For example, if 15 min interval data is retrieved by the AMR/AMI system, MDM calculates the proper billing determinant which is based on RTP/Time-of-Use (TOU) tariff, then ABD engine will make this computation based on tariff configuration data in the database. Then it stores this daily data set (RTP/TOU values with usage details for each), along with the interval data in the Metered Usage Data Repository (MUDR). On each billing cycle, the ABD engine will summarize the RTP/TOU and demand data for each period over the requested billing span and deliver these billing determinants to the billing system. By performing the billing determinant summations on a daily basis, MDM support end-user presentation of "month-to-date" information as well as spread computational. |
2.3 Automatically Receive Events data /Non-Energy data like frequency voltage etc from Meter

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<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
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<tbody>
<tr>
<td>1.</td>
<td>Event Collection</td>
<td>MDM receives and stores the complete meter events daily from the head-end</td>
</tr>
<tr>
<td>2.</td>
<td>Critical Event Notification on near real time basis</td>
<td>Meter sends only critical events (priority set by utility) to the head-end as and when occurred.</td>
</tr>
<tr>
<td>3.</td>
<td>Event Management System</td>
<td>MDM thru workflow engine, manage the events instantaneously by routing of events to concerned dept / functions/other systems within utility. MDM further identify irregular alerts, consumption, alarms, and other abnormal activity and should proactively generate the necessary reports, service orders, or any user defined actions, resulting in operational efficiencies. For eg: Billing System will only receive events which are business process related.</td>
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<td></td>
<td></td>
<td>Utility shall have the option to manage the communication network, diagnose non-responding field devices remotely.</td>
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2.4 Tamper Detection

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<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
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<tr>
<td></td>
<td>Utility detects tampering or theft at customer site</td>
<td>The tamper events captured by meter are sent to head-end which in turn reaches meter data management for further action. Some examples include</td>
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<td>• Meter not communicating</td>
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<td>• Meter bypasses detection</td>
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<td></td>
<td></td>
<td>• Magnet is put on meter</td>
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<tr>
<td></td>
<td></td>
<td>• Physical tamper detection</td>
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<td></td>
<td></td>
<td>Meter is removed and not reinstalled (due to reasons like Meter damaged/stolen by unauthorized person)</td>
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<td></td>
<td>Notifying utility personnel for immediate site inspection: The meter data management system immediately sends high priority alerts to utility personnel for necessary action as per rules.</td>
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<td>If any discrepancy is found, a notification shall be created for a utility representative or process to analyze the tampering event and take appropriate action (for example, to create a</td>
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<td></td>
<td>Disconnecting connection: As soon a valid tamper event or malfunctioning is detected, connection is disconnected. Re-Connecting connection: Once the pre-programmed disconnecting tamper event is NORMAL meter shall automatically perform re-connection and send the notification to HES. Re-connecting connection at meter level: Head-end sends the re-connect command to the meter (could be through the DCU if the solution is defined so) Invoicing customer based on tamper: Once the tamper event is confirmed after some analysis, customer is invoiced for the tamper/theft. For tamper related details to be available in customer information system</td>
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<tr>
<td><strong>Analytics in Tamper Detection TDS</strong></td>
<td>TDS uses the data historian of MDM to derive various analytics for theft detection if the AMI Meter/Device is removed and re-installed, the usage pattern of the meter shall be compared with the historical usage pattern.</td>
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### 2.5 Customer has access to recent energy usage and cost at their site

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<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
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<tbody>
<tr>
<td>1.</td>
<td>Display Device at Consumer Premises</td>
<td>Customer views their energy and cost data on the display device at their site. The meter/in-home display is remotely configured according to the customer’s request</td>
</tr>
<tr>
<td>2.</td>
<td>Internet based Customer requests</td>
<td>Customer requests to view energy data and cost data (up to the current hour) for their site using the Internet</td>
</tr>
<tr>
<td>3.</td>
<td>Real-time messages and pricing signals</td>
<td>Customer receives real-time messages and pricing signals/details on the AMI meter and/or in home/business display device and/or through media like SMS, Email, Portal</td>
</tr>
<tr>
<td>4.</td>
<td>Energy Usage Notifications</td>
<td>Utility issues notifications on usage and usage restrictions to the consumer’s alternative device (via SMS)</td>
</tr>
<tr>
<td>5.</td>
<td>Outage Notifications</td>
<td>Utility notifies the consumers on planned outages in their area (correlating the feeder and consumer data available in GIS)</td>
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</tbody>
</table>
2.6 SI installs and configures AMI system

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<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
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<tbody>
<tr>
<td>1.</td>
<td>SI installs and configures AMI Meters/DCUs/Devices</td>
<td>SI shall install and configures AMI Meters/DCUs/ Devices and retrofit devices (includes all devices from the AMI Meter/Device and downstream)</td>
</tr>
<tr>
<td>2.</td>
<td>Automatically discover Meters</td>
<td>Program mesh network to automatically discover Meters in the network, associate the same with electrical network hierarchy (either at feeder voltage or geographical) at defined interval and update Meter ID information to the Central Server</td>
</tr>
<tr>
<td>3.</td>
<td>Cyber Security and Controls</td>
<td>Cyber data security interfaces with controls maintained from the meters to the system head end. All elements of the AMI system configure support for protection of data, confidentiality, data integrity and operational security. Further, AMI system enables creation and maintenance of accounts, passwords and functionality access levels, along with log details</td>
</tr>
<tr>
<td></td>
<td>Communication Network</td>
<td>SI shall install and configures communication network based on the device models and specifications, communication network can be either wireless or powerline.</td>
</tr>
</tbody>
</table>

2.7 Meter Asset Management

<table>
<thead>
<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Manage end-to-end life-cycle of the AMI System</td>
<td>SI shall manage end-to-end life-cycle of the AMI system including periodic and condition-based maintenance, Time Synchronisation of AMI Meters/Devices, maintaining internal AMI Meter/Device program ID to support rate changes and load limit threshold value</td>
</tr>
<tr>
<td>2.</td>
<td>Up gradation of AMI System</td>
<td>SI shall upgrade AMI to address future requirements such as Vendor upgrades field component firmware, Vendor upgrades field component software, and AMI System registers customer owned devices for communication on the HAN</td>
</tr>
<tr>
<td>3.</td>
<td>Asset Repository of Meters</td>
<td>SI shall maintain asset repository of meters such as Inventory of the meters, associated assets of meters (SIM cards, modems etc.), Maintenance history and Test results of the meter</td>
</tr>
</tbody>
</table>
### 2.8 Prepayment Facility

<table>
<thead>
<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
</tr>
</thead>
</table>
|      | Prepaid metering             | Utility through the system allows user to enroll for prepaid facility and switch from prepaid to post-paid and vice versa. Scope shall allow for the following scenarios:  
  - The customer’s prepayment balance approaches zero for their site and prepay for additional electricity  
  - The customer’s prepayment balance approaches zero for their site and they do not prepay for additional electricity  
  - The customer’s prepayment balance approaches zero at his or her site. The customer checks this over the portal or at the display devices. The customer does not prepay for additional electricity |
|      | Prepayment scheme            | Customer prepay electricity service at his or her site, or owned by the customer (for example, renting to organize an event) for a specific time frame                                                                 |
|      | Prepayment Alerting System   | Utility provides various messages alerting the customer that the prepayment balance on the AMI Meter/Device is low and time remaining before the prepaid account reaches zero. If equipped, this information is passed onto a display device at the event site |
|      | Facilitating Happy Hours     | System facilitates happy hours when balance exhausts during holiday, or late night                                                                                                                                      |
3 Peak Load Management

The objective of the peak load management iterated for the ongoing smart grid pilots is to optimal utilization of energy resources by uniform distribution of load across the day, to save additional investment in capacity addition within the utility, improved access of power to rural areas, reduction in technical losses, enhanced customer satisfaction by load curtailment in place of load shedding.

3.1 Utility remotely limits usage and/or connects and disconnects customer

<table>
<thead>
<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Load Curtailment event in place of Load Shedding</td>
<td>System will determine based on day ahead schedule for available generation capacity, that a load curtailment is going to take place, advanced notice will be sent to a group of customers affected by this load curtailment. DR system will send the load curtailment command to the MDM. The MDM will forward this command to the appropriate AMI Head-End.</td>
</tr>
<tr>
<td></td>
<td>Sign-up customer</td>
<td>This use case deals with customers signing up for a load curtailment program. Curtailment details are sent to the customers via mail or e-mail. The customer calls the utility or logs on to the utility customer portal to sign up for the program. The customer service representative checks if the customer has the metering device needed for the program and, if not, performs necessary steps for the installation and configuration of these devices. The customer account will be updated to reflect the curtailment program.</td>
</tr>
<tr>
<td></td>
<td>DR Program Commencement</td>
<td>Once the customer is set up with all the devices necessary, the customer details will be sent to DR system. Premium charges for assured power supply with SLA and/or Rebates and incentives can be given to customers who participate in DR programs.</td>
</tr>
<tr>
<td></td>
<td>Load Pattern Forecast</td>
<td>System should be able to aggregate the consumption profiles of multiple customers to find out the total load pattern. System shall have a consolidated view of the grid frequency, demand schedule and actual drawal and also estimate the quantum of shortage on near real time basis as well as on day ahead basis. Utility should be able to further drill down to see the list of consumers violating sanctioned / threshold load (at that point in time, historically etc.). Utility shall be able to send a notification to respective load management systems to control the shortage</td>
</tr>
<tr>
<td>Description</td>
<td>Details</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Real Time Price Computation</td>
<td>Utility should be able to determine the Daily/weekly ToU Price signals on day ahead/week ahead basis, based on load pattern forecast and Business logics. This ToU price signal can be further redefined to get Real Time Price Signals for next/last interval usage data.</td>
<td></td>
</tr>
<tr>
<td>Real time Pricing</td>
<td>Utility shall be able to send real-time pricing signals to end consumers, using alarms (visual and audio), in home device, mobiles, emails etc.)</td>
<td></td>
</tr>
<tr>
<td>Remote Curtailment Process</td>
<td>The AMI Head-End may update the read frequency of the AMI Meter/Device if required. The curtailment schedule is stored in the HES as well as notified to consumers in advance preferably on day ahead basis, so once the curtailment date/time arrives, the HES will change the load limit of the area meters to say X KW. Once the curtailment end date/time is reached, the HES will again reset the load limit to contract load limit. DR system will forward the curtailment details to Billing System, and Billing System will update the customer account to reflect their curtailment activities.</td>
<td></td>
</tr>
<tr>
<td>Curtailment due to Contract Violation</td>
<td>Utility limits customer’s load due to reasons like exceeding contract load&lt;br&gt;Alarms (visual and audio) shall be provided in case of load violation (in home device, Email, SMS etc.). The billing system shall be notified of the load violation, and the corresponding charges shall be applied to customer (based on tariff rules).</td>
<td></td>
</tr>
<tr>
<td>Forced Curtailment</td>
<td>Utility shall be able to curtail the load during shortage situations (even when load curtailment event was not planned) with the intent to avoid load shedding and instead opt for load curtailment.</td>
<td></td>
</tr>
<tr>
<td>Special provision for Defaulters</td>
<td>System should provide details of the defaulters who are liable for disconnection due to credit or collection cause, disconnects (or limit load to 50W) customer for credit or collection cause, acknowledge the defaulters who made payment against disconnection due to credit or collection cause (can be an integration with existing system if already exists), as well as reconnects (or resumes load to normal contracted level) customer following credit and collection disconnect.(reconnection after</td>
<td></td>
</tr>
<tr>
<td>Demand side Management</td>
<td>In every 15 minute interval Meter data should be captured, Confirmation of action taken for demand response should be mentioned as well as monitoring of historical Customer Load Profile should be done.</td>
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<tr>
<td>------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Load Monitoring at Demand side</td>
<td>Daily Meter Reading, Status and associated details capturing for records of customer consumption data, TOU details, real time trends and Load profile Details. Along with this whenever there is a load violation event recorded in the meter, the information is sent to the control center</td>
<td></td>
</tr>
<tr>
<td>Provision of Re-checking for Automatically generated disconnection or Load</td>
<td>Automatic generated disconnection or load limiting commands go through the set of checks and approval (as per business rules), to ensure that no connection should be disconnected due to a mistakenly generated disconnection document.</td>
<td></td>
</tr>
<tr>
<td>On Demand Disconnection/ Reconnection</td>
<td>Customer requests routine disconnection / reconnection, by using SMS or AMI device or over Internet.</td>
<td></td>
</tr>
<tr>
<td>Initiate Direct Load Control Event</td>
<td>Utility calls a Direct Load Control Event using the Peak Load Management (PLM) Application and executes through head-end by sending a load control signal to Smart Appliances thru HAN/Smart meter or other means.</td>
<td></td>
</tr>
<tr>
<td>Provision of Re-checking for Automatically generated disconnection or Load</td>
<td>Automatic generated disconnection or load limiting commands go through the set of checks and approval (as per business rules), to ensure that no connection should be disconnected due to a mistakenly generated disconnection document.</td>
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<td></td>
</tr>
</tbody>
</table>
4. Outage Management

Outage management is extremely important for the Utilities and the customers they serve. The Utilities will leverage existing OMS (if exists) and utilize the capabilities of AMI and grid automation to improve grid reliability by self-healing and more quickly and accurately identifying the location and magnitude of an outage, resulting in faster restoration.

The objective of the outage management iterated for the ongoing smart grid pilots is to improve availability and reliability, customer satisfaction, proactive maintenance to avoid failures

4.1 Distribution operator locates outage and restores service

<table>
<thead>
<tr>
<th>S N</th>
<th>Requirement</th>
<th>Details of requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power Supply interruption</td>
<td>AMI Meter/Devices shall record outage event. (AMI Meter/Devices detect a power loss after processing preprogrammed checks for false indications.). AMI Meter shall notify the outage event to head-end as and when occurred/recorded (even when there is no power at the meter end) The head-end system shall record outage information on a meter-by-meter basis.</td>
</tr>
</tbody>
</table>
System shall receive outage events from the head-end, and generate alarms for genuine outages (system shall have the capability to define the genuineness of the outage – like momentary outages at consumer end will not be treated as outages etc.)

Metering System will send only that power on/off events to outage management system which is not momentary. Prediction engine shall use this data to identify a potential outage event.

The utility shall be able to get an option where in the outage events received from meters are correlated with the power availability status at transformer/feeder level to identify whether it is a system level outage or single light out.

The utility should be able to view the above over a spatial display which could be using the existing GIS system (or alternatively through options like Google maps, Bing, SLD etc. if GIS does not exist)

System shall request verification of outstanding orders scheduled for that day related to meter reporting loss of power. If there is a result, the message shall be logged but not sent to OMS.

MDM shall process a loss of power event with a configurable time interval delay to avoid alarming for momentary power drops or voltage sags.

The normal process for loss of power messages from the meters would be to check Enterprise Asset Management systems for orders under execution and to check OMS for planned outages at the service location. Any hits will be logged for later analysis. If there are no hits, the individual message shall be passed to OMS.

There will be a configurable counter and a timer so that upon receipt of a loss of power event, MDM will begin aggregating event messages into lists for upload to OMS if the configurable number of events (for example, 500) are recorded in a configurable time period (for example, 5 minutes).

Customer Care

OMS sharing information about Restoration time, type of Outage, customers affected with customer care system

Conventional channels of communication, like the call center shall receive calls notifying the utility of an outage.

The call center/ customer care executive(CSR) shall be able to receive calls regarding the outage and is able to query

The call center and other sources, such as IVR or a customer portal shall be able to begin to produce outage notifications as customers begin to communicate through

Outage

OMS shall calculate outage location (Utilizing the data from the AMI, GIS, DMS and other system and other sources,

Outage order is created and issued (OMS, through its existing interface with Enterprise Asset Management Systems/workforce systems, creates an order for field distribution personnel, and they are dispatched to the selected location.)
<table>
<thead>
<tr>
<th>Workforce Management</th>
<th>System shall provide the option to plan for crew management and dispatch (to be integrated with existing crew management if available)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>System to assign a service crew for restoration and equipment to crew for repair through Mobile workforce management.</td>
</tr>
<tr>
<td></td>
<td>Field crews restore service. Field crews determine the repairs required to restore service and complete work.</td>
</tr>
<tr>
<td>Outage Priority Mechanism</td>
<td>System shall be capable of aggregating power outage events or indications from individual meters into lists for processing, in order to avoid overloading communication with OMS. System shall be able to prioritize the notifications from feeder/DT/consumer meters, and suppress the events at lower level in the hierarchy (e.g. if outage at feeder, then events from DT/consumer will be suppressed).</td>
</tr>
<tr>
<td>Planned Outage of Electrical</td>
<td>System shall provide an option to maintain the list of planned outages with details like feeder code/name, date and time, duration (or integrate with the systems if already in place which maintain this data).</td>
</tr>
<tr>
<td></td>
<td>MDM shall request verification from OMS of planned outages in the service area relevant to the meter reporting loss of power. If there is a result, the message is logged, but not sent to OMS. If there is no result, the message should be sent to OMS.</td>
</tr>
<tr>
<td></td>
<td>SCADA receives requests for planned outage/restoration from Asset management system and sends this information to OMS for Outage Planning execution / maintenance and restoration of service</td>
</tr>
<tr>
<td></td>
<td>OMS sending the scheduled or unscheduled outage and restoration information to customer care for further dissemination of this information to the concerned customers through telephonic call/Email/SMS</td>
</tr>
<tr>
<td>Outage Restoration</td>
<td>Activities performed for restoring the outage are recorded and updated in the related systems. System shall have the capability of displaying historical activities of similar nature.</td>
</tr>
<tr>
<td></td>
<td>AMI Meters/Devices shall detect restoration of power and record the event and MDM shall be able to receive power restoration events from the meters. The aggregated event data is sent to OMS for processing.</td>
</tr>
<tr>
<td></td>
<td>The AMI system shall record the duration of outage for later statistical analysis and calculation of KPIs like SAIFI, SAIDI etc.</td>
</tr>
<tr>
<td></td>
<td>OMS shall request check for non responsive meters. (The outage completion data from the field and the restoration events from the AMI Meter/Devices shall be analyzed by outage management, and a request will be sent to through an interface with the AMI system to verify if a subset of meters are still without power.)</td>
</tr>
</tbody>
</table>
If outage management determines that outage is not completely over (based on the check for non-responsive meters), field crew will be notified for necessary action/restoration of power for the left out consumers.

MDM shall check the status of AMI Meters/Devices (MDM shall poll or ping meters to determine their status and reports response or lack of response to OMS. Based on the additional data from the AMI system, outage management may dispatch the field crews to alternate locations to perform additional work to restore power).

When outage management determines that the outage is over, OMS shall complete the outage order and closes any outstanding notifications related to the outage through its interface with Enterprise Asset Management Systems.

System shall track outage duration and customer minutes out. The system shall track and display the outage duration and customer minutes out for every outage. This information is shall be updated regularly as time passes and as partial restoration steps take place.

Operator or system shall be able to restore an outage. Operator shall be able to mark customer and secondary outage jobs as restored manually. The system shall automatically determine if all outaged customers part of a transformer, device or higher level outage have been restored. In these cases, the system shall transition the outage job to the ‘Restored’ state.

Safety
System shall provide a warning to the operator if a network operation affects a crew. If a Pre-Thermal Warning (PTW) has been issued on any segment of the network and field crew working on this segment, the operator should be warned and any remote network operation is blocked.

Reports
OMS calculates and send performance indices SAIDI, SAIFI, etc., to SCADA

OMS Database
OMS database for Distribution Network Model, Consumer data, interconnection system, and Equipment data either using GIS system and/or ERP system and/or direct entry

Real Time Network status Data for OMS
OMS acquiring real-time status of all Circuit breakers including date & time of tripping, cause of tripping, Expected duration of scheduled outage from SCADA

Outage Notifications
Utility notifies the consumers on planned outages in their area (correlating the feeder and consumer data available in GIS)

Switching Operations
SCADA sending network status update i.e, telemetered status change indications from switches, to OMS

Manual Switching
DMS sending manual switching operations for non-telemetered points as a part of network status update to OMS
<table>
<thead>
<tr>
<th><strong>Outage Prediction</strong></th>
<th>System reports assimilation of outages through MDM to OMS and OMS carry forward the prediction of the affected equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storm Management</strong></td>
<td>SCADA updates EHV outage to OMS for management of incoming outage requests</td>
</tr>
<tr>
<td><strong>Cyber-security</strong></td>
<td>Encryption layer to the data streams emerging IN/OUT from OMS</td>
</tr>
<tr>
<td><strong>Outage Verification</strong></td>
<td>Validating FPI signals received to OMS on outages for any momentary changes in system parameters</td>
</tr>
<tr>
<td><strong>Scheduled or Unscheduled Outages</strong></td>
<td>OMS sending the scheduled or unscheduled outage and restoration information to customer care for further dissemination of this information to the concerned customers through telephonic call/Email/SMS</td>
</tr>
<tr>
<td><strong>Fault detection, outage record</strong></td>
<td>SCADA receives requests for planned outage/restoration from Asset management system and sends this information to OMS for Outage Planning execution / maintenance and restoration of service</td>
</tr>
</tbody>
</table>
Figure: Processes and Infrastructure for OMS
5 Time of Use and Real Time Pricing

There are 2 ways of executing time of use and real time pricing:

- Billing System sends requests to MDM in order to execute the Time-of-Use formula remotely: Interval/ToU meter readings are stored in MDM.
- Billing System execute the Time-of-Use formula directly in the Billing System Energy Data Repository: Interval/ToU meter readings are stored in the Billing System energy data repository.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Execution of Time of use and Real time Pricing</td>
<td>• Billing System execute the Time-of-Use formula directly in the Billing System Energy Data Repository</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Formula interface and algorithm is implemented in Billing System</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Time of use blocks are defined in the Billing System</td>
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<td></td>
<td></td>
<td>• Each time block is assigned to an Time-of-Use formula</td>
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<tr>
<td></td>
<td></td>
<td>➢ Billing process in is executed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Time-of-Use formulas are executed directly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Values are assigned to Real Time Pricing values</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Billing System sends requests to MDM in order to execute the Time-of-Use formula remotely</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Formula algorithm is implemented in the MDM system and formula interface is represented in Billing System</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Time of use blocks are defined in the Billing System</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Each time block is assigned to an MDM formula</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ The Billing process in Billing System executes the billing run</td>
</tr>
</tbody>
</table>

6 Power Quality

Managing voltage, frequency etc within certain thresholds etc allows electrical systems to function in their intended manner without significant loss of performance or life. The objective of the Power Quality functionality iterated for the ongoing smart grid pilots is to improve Customer satisfaction, reduction in losses, and increase in Employer Revenue by charging a premium price for specific power quality requirements of the customer if mutually agreed.
<table>
<thead>
<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Power Quality Categories</td>
<td>IT system integrated with MDM stores various power quality records and calculates KPIs in the Utility, Consumer, and Distributed Generation categories/ perspectives considering parameters like Power factor, Total harmonic distortion, Spikes, Impulses, Flicker, Sag (momentary under voltage), Swell (momentary over voltage), Power on/off, Over voltage and under voltage</td>
</tr>
<tr>
<td>2.</td>
<td>Install Voltage / VAR Control (VVC)</td>
<td>System Integrator to install VVC-controllable devices (set to Transformers, capacitor banks, Inductors, etc) and monitor the set of telemetered voltage measurements associated with each. If System detects a limit violation, it advises the corrective control actions.</td>
</tr>
<tr>
<td>3.</td>
<td>Site selection and Installation</td>
<td>For the pilot area SI suggests sites for permanently installed power quality monitors and installs them</td>
</tr>
<tr>
<td>4.</td>
<td>Power Quality Event Capture and Transmittal</td>
<td>Power quality instruments capture and transmit the events and performance monitoring results based on defined baselines to IT system/MDM</td>
</tr>
<tr>
<td>5.</td>
<td>Data Storage, Characterization and Reporting</td>
<td>Based on events recorded in IT System, data is characterized and loaded into a database and reports are generated for the customers</td>
</tr>
<tr>
<td>6.</td>
<td>Real-time Alerts</td>
<td>IT system provides alerts on violation of parameters in real-time and identify the source of power quality disturbance</td>
</tr>
</tbody>
</table>

7 Distributed Generation/ Renewable Integration

Development and implementation of new and innovative technologies for distributed generation includes technology, products, and vendors and solutions evaluation and design of suitable solution for managing renewable integration. Examples are technologies and solutions related to EV/PHEV (Plug-in Hybrid and/or Electric Vehicles), wind, photovoltaic and other distributed generation technologies, systems and solutions supporting flexibility of interaction with customers, energy usage/exchange, demand and losses management, management of transactions, pricing and billing, etc.

Integration of Renewable sources improves reliability of smart grid but poses a variety of issues like dynamic response and advanced protection to take into account the bidirectional flow of power. When Renewable energy sources are connected to the distribution system, the power flow gets altered and this would necessitate a change in the protection system settings. Also, sudden connection or disconnection of renewable energy sources due to faults etc. may result in unacceptable transients in
voltages in the distribution system which needs to be addressed. Forecasting of the renewable is another challenge. These and other issues if any shall become part of the solution designed for managing Renewable Integration through the ongoing smart grid pilots.

The objective of "Distributed Generation/ Renewable Integration" functionality iterated for the ongoing smart grid pilots is to ensure sustainable growth, improve power access in rural area, and encourage prosumer enablement.

<table>
<thead>
<tr>
<th>S.No</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Window Clearance for Connecting DGs to Grid</td>
<td>Setting up of DGs on a commercial basis i.e, increased grid- interactive energy will attract (directly/ indirectly) various permissions. Utility encourages Single window clearance for giving necessary approvals and clearances in time bound</td>
</tr>
<tr>
<td>DG Enrollment program</td>
<td>Customer applies for interconnection of distributed generation system (generation capacity, capacity available for grid, customer details etc.).</td>
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<tr>
<td></td>
<td>• The customer care system shall provide multiple interfaces to provide single or bulk enrollments to DG programs</td>
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<tr>
<td></td>
<td>• The website shall be the point of access to enroll in DG program for all enrollments.</td>
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<tr>
<td></td>
<td>• The customer care system shall validate customers for DG programs (service address, account number, name, generator interconnection data).</td>
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<tr>
<td></td>
<td>• Each DG will have its own AMI Meter/Device that will act as the gateway.</td>
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<tr>
<td></td>
<td>▪ The AMI system shall measure the following per-generator quantities (if present) on an interval or TOU basis:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Watt-hrs generated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- VAR-hrs generated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- VAR-hrs consumed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- All these quantities shall be independent (for example, the VAR-hrs are not “netted” by the AMI Meter/Device).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ The AMI system shall measure the following quantities at the point of common coupling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Watt-hrs consumed from utility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Watt-hrs generated by customer and sent to utility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Var-hrs generated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Var-hrs consumed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- All of these quantities shall be independent (for example, the Watt-hrs are not “netted” by the AMI Meter/Device).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ The AMI Meter/Device shall be able to be reprogrammed remotely to support directional metering.</td>
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</tbody>
</table>

<p>| Interconnection Approval | Utility assesses the application through that system that provides technical transformer capacity and loading, contractual (connected load), harmonics and other considerations. Utility then provides an NOC to the customer for distributed/ renewable generator integration. |</p>
<table>
<thead>
<tr>
<th>Preparatory Phase for final setup</th>
<th>Once the utility gives an NOC to the customer, the customer will construct the distributed generation system, and then request the utility for its commissioning by providing connectivity or installation/replacement of meters.) Utility will inspect the installation of the distributed generation system, certify it and commission it.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Connection/Disconnection</td>
<td>Utility shall be able to connect or disconnect the connectivity of the generation source remotely based on situations like system over load, unexpected back feed, maintenance related work etc.</td>
</tr>
<tr>
<td>Generation forecasting for DG system</td>
<td>System shall give information on generation forecasting of renewable generation/distributed generation sources (e.g. roof top solar) in the area, which can be day ahead/week ahead. This will help the utility assess/estimate the demand vs. generation availability (conventional plus renewable).</td>
</tr>
<tr>
<td>Net-metering model for DG integration</td>
<td>DG system is connected on the customer side of the meter, and the conventional meter is replaced by a bi-directional net-meter. Here costomer will be billed on net-consumption at the end of billing cycle. If customer is a net –generator at the end of the billing cycle then he will be provided credits towards next billing.</td>
</tr>
<tr>
<td>Gross – metering /feed-in tariff/two- meter model for DG integration</td>
<td>DG system is connected on the DisCom side of the meter. Here, the renewable energy fed into the grid is accounted directly through a dedicated meter, and the customer bills the DisCom based on the feed-in tariff. One meter will be installed at the interconnection point of the generation source. The second meter shall be installed at the consumption point.</td>
</tr>
<tr>
<td>Remote monitoring</td>
<td>Utility remotely monitors the net-meter or gross-meter at a pre-determined interval (15 mins to 24 hrs).</td>
</tr>
<tr>
<td>Billing In case of net-metering</td>
<td>If the consumer is a ‘net-consumer’ at the end of the billing cycle, then the utility will bill the consumer based on the meter reading itself. Not much changes in terms of meter reading. The appropriate policy/regulation shall be applicable.</td>
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<tr>
<td>Section</td>
<td>Description</td>
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<td>----------------------------------------------</td>
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<tr>
<td>Billing In case of gross-metering</td>
<td>The utility will reimburse the consumer based on a Pre-determined feed-in tariff based on the applicable scheme/ policy/ tariff. Further, if the gross-meter is linked to a consumer account, then the energy consumption and the energy generation bills of the consumer could also be merged into one. The appropriate policy/regulation shall be applicable.</td>
</tr>
<tr>
<td>Validation of DG system</td>
<td>Comparison of outputs of nearby distributed generation sources based on GIS proximity / nearby weather monitoring systems and check of irregularities</td>
</tr>
<tr>
<td>Synchronization requirements for Protection Relays</td>
<td>The connection of the DGs shall not cause a voltage fluctuation at the point of common coupling greater than ±5% of the prevailing voltage level of the area power system at that point.</td>
</tr>
<tr>
<td>Area energization requirements for Protection Relays</td>
<td>The DGs shall not energize the area power system if it is de-energized.</td>
</tr>
<tr>
<td>Fault in a circuit with DER connected to healthy section</td>
<td>DERMS/DMS receives the scan of SCADA data and historic load data to be checked for changes in topology and loading during the time of repair.</td>
</tr>
<tr>
<td></td>
<td>DERMS/DMS determines the sufficiency of the island during the time of repair and enables FLISR for location of the fault within the de-energized section.</td>
</tr>
<tr>
<td></td>
<td>DERMS/DMS determines the in sufficiency of the island during the portion of time of repair and enables FLISR for location of the fault within the de-energized section and solving restoration for the customers connected to the island.</td>
</tr>
<tr>
<td>Fault in a circuit with DER connected to healthy section cleared by fast circuit breaker trip and by reverse protection from DER fault injection, creating an insufficient island</td>
<td>DERMS/DMS receives the scan of SCADA data and historic load data to be checked for changes in topology and loading during time of repair.</td>
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<tr>
<td>Fault in a circuit with DER connected to faulty section cleared by Circuit breaker and by relay Protection of DER.</td>
<td>DERMS/DMS determines the insufficiency of the island during the time of repair and enables FLIR for location of the fault within the de-energized section and solving restoration for the de-energized customers connected to the island.</td>
</tr>
<tr>
<td>Fault in a circuit with DER connected to faulty section cleared by Circuit breaker and by relay Protection of DER.</td>
<td>DERMS receives the scan of SCADA data and historic load data to be checked for changes in topology and loading during time of repair.</td>
</tr>
<tr>
<td>Gross and Net metering of Generation - Demand and Energy Data Automatically from Prosumer Premises</td>
<td>Requesting instantaneous, interval and events data from the meters and create profile in Billing. Portal services to view energy data</td>
</tr>
<tr>
<td>Contract Management for DG installations (banking, carry over, smart tariffs)</td>
<td>Identifying implication of relevant policies and regulations. Mapping existing and new DG contracts on system</td>
</tr>
<tr>
<td>Generation Forecasting System</td>
<td>Generating reports based on transaction information as per defined periodicity Identification of banking, carry forward/lapse information and sending to billing system</td>
</tr>
<tr>
<td>Aggregate demand and net demand forecasting for pilot area</td>
<td>Identification of likely demand in pilot area for identified time periods based on past trends, Weather forecasting and based on immediately preceding periods (week, day, hour)</td>
</tr>
</tbody>
</table>
Transformer level flow monitoring to detect/predict back-flow. Prioritised remote disconnection for backflow

DG Outage and Restoration Notification

Power outage management – remote disconnection and reconnection

Power Outage and Restoration Notification (if OMS subscribed for events)

Visibility of gross and net generation/demand to prosumer

Instantaneous Meter Read (status and data) of gross and net meter

Figure: Processes and infrastructure for RE forecasting, scheduling and settlement

9 Visualization and Analytics

Visualization and analytics are integrated part of the ongoing smart grid pilots for effective realization of the proposed functionalities.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Requirement</th>
<th>Details of requirement</th>
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<tbody>
<tr>
<td></td>
<td>Hierarchical Visualization</td>
<td>Utility control center staff acquires the view/visualization of distribution network, AMI based on organizational hierarchy or electrical hierarchy or geographical, with respective</td>
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<tr>
<td>Feature</td>
<td>Description</td>
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<tr>
<td>Integrated real-time and historical views</td>
<td>IT system with MDM creates an integrated real-time and historical views into the incidents &amp; events, in context of functioning, for the purpose of optimizing command center operations (from the metering and grid management systems,</td>
<td></td>
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<tr>
<td>Operational Analytics System</td>
<td>Operational analytics system to analyze vast operational data (voltage, Current, power flow, temp etc) of asset collected over the period of time, to help in identifying the problem areas &amp; bring out actionable intelligence to make better decisions</td>
<td></td>
</tr>
<tr>
<td>Meter level event Routing for visualization and analysis</td>
<td>Utility acquires various events occurring at meter level from MDM to perform subsequent business process and analyze events like error in transferring meter results from the smart meter, malfunction during a smart meter self test, validation error, energy related events and non-energy events, Meter reading outside of the predefined range (overvoltage, under voltage, load violation etc.) and displays summary results in a</td>
<td></td>
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<tr>
<td>Centralized Message Notification Solution (CMNS)</td>
<td>Centralized message notification solution that allows authorized personal and/or business processes to send messages to target audience using multiple communication methods including SMS, Voice, Email for notifications, orders, exception</td>
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</tr>
<tr>
<td>Event Correlation Engine (ECE)</td>
<td>ECE correlate events coming from different sources e.g. outage event coming from a meter/MDM/ other equipment in the network and an outage event coming from the DT/feeder/other equipment s in the network to which the consumer is connected and makes smart decisions for effective</td>
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<tr>
<td>Real-time view of energy</td>
<td>SCADA and MDM provide the data to IT system to generate real-time view of energy losses across the network and display poor performing feeders/lines over a geo spatial map, where the operator can further drill down to see the consumers with tamper events, payment defaulters, load pattern on the transformers/feeders, phase imbalance etc. on the poor performing lines/DTs</td>
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<tr>
<td>Identifying and visualizing poor performing feeder</td>
<td>IT system integrated with MDM and SCADA identifies a feeder/DT as poor performing based on multiple criteria like energy losses, billing efficiency, payment efficiency, outage duration etc. and generates appropriate colour coding (lines with losses above a threshold to be shown in red, and lines with losses in medium range to b shown in light orange etc.) for visualization using SCADA and MDM data, wherever</td>
<td></td>
</tr>
<tr>
<td><strong>Customer profiling and segmentation</strong></td>
<td>IT system integrated with MDM analyse multiple customer consumption profiles &amp; generate the consumption pattern for a group of customers (grouped like hostels, hospitals, movie theaters, suspected, residential, commercial, load bucket etc.), used to understand their Consumption behavior</td>
<td></td>
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<tr>
<td><strong>Market Management System</strong></td>
<td>Market management system integrated with MDM and portfolio management provides consolidated view of the near real-time grid frequency, demand schedule and actual drawal from load dispatch center, and top consumers (considering open access agreements also) contributing to over drawal from AMI. Utility should be able to further drill down to see the list of consumers violating sanctioned load (at that point in time, historically etc.). Based on the information available, decisions regarding load management shall be taken by the</td>
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<tr>
<td><strong>Trend Analysis</strong></td>
<td>System shall compute/source from other systems have an integrated view of all key performance indicators, showing the target value and actual value. In addition to the latest KPI values, the system shall also give trend analysis (based on historical data)</td>
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</tr>
<tr>
<td></td>
<td>▪ Outage related KPIs</td>
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<tr>
<td></td>
<td>▪ SAIFI, SAIDI [as applicable]</td>
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</tr>
<tr>
<td></td>
<td>▪ CAIFI, CAIDI [as applicable]</td>
<td></td>
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<tr>
<td></td>
<td>▪ Total number of consumer level interruptions, consumers affected and duration, and corresponding estimated revenue loss</td>
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<td></td>
<td>▪ Interruptions reason wise view</td>
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<td></td>
<td>▪ MTTR/MTBF</td>
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<tr>
<td></td>
<td>Total contract load vs. total load at that point in time</td>
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<tr>
<td></td>
<td>Average load duration curve vs. actual load duration curve</td>
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<tr>
<td></td>
<td>Reading efficiency (%), Billing efficiency (%) and payment efficiency (%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Transformer failure rate</td>
<td></td>
</tr>
</tbody>
</table>
| | Top [five/ten] feeders/DT’s loss level wise or outage wise or

**Suggested Functional Specifications - Smart Grid Analytics Implementation**

**1. Analytics for Load Forecasting and Load Research**
Load forecasting is required for defining the requirements of the networks transmission capacity, approximating the transmission loss, estimating the existing networks capability to transfer increasing loads and create effective demand response programs.
As part of the Smart Grid initiative DISCOMs are expecting the following to be configured:

- Ability to forecast short term as well as Long term electricity demand is fundamental pre-requisite for the proposed tool.
- Granular level of forecasting must be performed as a hierarchy from system level, feeder level and capability upto meter level so that it help utilities understand which segments of customers are using more electricity versus which segments are using less - there by coming up with the pricing strategy, distribution-asset planning, capacity augmentation etc.
- Create the Decomposition of electricity load Demand into lower granularity of time dimension and geographical dimension.
- In order to facilitate decision making for surplus/shortage, the long term forecast then further need to be decomposed at lower level granularity.
- Annual into seasonal
  - Incorporates the shift effects across season
  - Seasonal into monthly
    - Incorporates the shift effect across month for any given season
  - Monthly to weekly
    - Incorporates the shift effect across weeks if any for any given month
  - Weekly to daily
    - Incorporate shift effect across the days for any given week: for example weekdays are different from the weekly.
    - Daily to hourly load shape.
      - Incorporate shift effect across different hours within a day to incorporate the shifts like peak and off peak hours.
- **Day Ahead Short Term Demand Forecasting:**
  - 1 hour Feeder Level Load Forecasting for the distribution company across 340 sub-stations.
  - Configuration of the load forecasting solution for day ahead 15 minute interval. It should include configuration of the diagnostic process for baseline forecasting and adding effects such as Recency Effect, Calendar (Weekend Effect), Holiday Effect.
  - Configuration of the 2 stage residual modeling with temporal and geographical hierarchy.
  - Configure the error analysis and outlier detection.
  - Configure the scenario planning for changes in events, explanatory variables.
  - Configure the recency effect, holiday effect, weekend effect, special event / festival effects.
- Configure or Build the medium term and long term load forecasting taking into consideration macro-economic data, weather data. SI to source, collect and build a repository of data from third party service provider if applicable.
- **Position mapping:** To understand the position GAP (i.e. demand and supply if any) so that a long term position mapping strategy can be devised to appropriately optimize on long term and short term power purchase agreement.
  - To understand the likely day ahead position GAP (i.e. Gap between demand and supply) on a granular basis (Load shape), to ensure that the gap is bridged optimally.
Create the baseline shape, the seasonal shape and the peak load profiles.
Long term demand forecasting should generate the total likely demand for the future years (Peak & off peak)

- **Power Scheduling:**
The solution should recommend power purchase schedule in an automated fashion. Long and medium term power scheduling form the generators as well as real time scheduling for the day-ahead and hourly/15 minute granularity scheduling is expected by the DISCOMs. While scheduling multiple factors like future demand, PPAs, spot prices from multiple sources as well as other regulatory constraints are to be considered.

- **Load research**
Load research produces simple models to be used in applications where only available data is monthly / bi-monthly energy consumption and customer class from the billing data. Using the load models the application can estimate the load for one year on hourly basis.
Sample and classification/segment customer using background data and annual energy for estimating load model parameters.
Create Load models based for models for each month, special days, temperature correlation, classification on initial meter data rollouts capturing 15 mts interval data and generalize the load models to the population it to the segmentation of the consumers.
Build load models for each customer class.
Linkage of load models data with the network / feeder total energy measurement with hourly /daily load curves. Create a repository of load models for customer class, day and time duration.

- **Medium Term and Long Term Forecasting**
Configure the load forecasting system to forecast for medium term load forecasting and long term load forecasting using explanatory variables including macro-economic factors
Configure the load forecasting system for scenario modeling for changes in explanatory variables and studying the impact.

2. **Analytics for Peak Load Estimation and Customer Segmentation**
Peak Load identification is very critical from Grid Stability and Demand Response and Time of Use Offers. Also significant upfront capital investment is required to meet the response of increasing demand at peak hours. However, an intelligent data driven peak-load management system can channelize the peak load demand and thereby significantly
1) Reduce peak demand deficit and forced load shedding
2) Reduce the requirement of capital intensive investment in distribution assets
3) Saves costly power purchase at peak time
The DISCOM expects analytics solution to provide a mechanism to manage the peak load demand. It should have the following functionalities:

- Build / Configure / Customize the analytics platform to anticipate which part of the day (hours) the future load may be high in the near future (may range from a few days ahead / week ahead to month ahead). The forecasting accuracy of the peak is expected to be very high and
should be based on advanced mathematical algorithm without the subjective bias. However, it should be flexible enough to incorporate the expert input as when required.

- Build the Clusters for the customer population into smaller meaningful sub-sets with data mining based clusters based on past consumption behavior and pattern.
- Create an analytical process for attractive incentivizing program for optimal TOU pricing.
  - Build customer contact program so that during the aforesaid identified peak hour’s customers could choose to lower their electricity consumption.
- Create an eligible and potential list of customers (likely to accept the program offer) that may adopt or accept to a ‘power reward’ program. The reward program intends to gives customers or a set of customers (say large housing society or commercial users and industrial users) monetary credits when they reduce their electric usages during critical peak events as notified by the program.
- Draw a baseline of each customer’s hourly electric usage needed to be constructed and rewards were calculated based on the differences between customer’s actual usage and the projected usage.
- Recommend the variable pricing for each cluster of customers and calculate the credit amount to be rewarded for the participating customers within a stipulated time after the peak load event.
- Publish the reward program result in the company’s website for customers to view their actual usage, baseline usage and calculated reward amount online.
- Identify the additional revenue potential and alert the stakeholders

3. Analytics for Demand Response & Time of Use:

Managing the energy deficit by controlling the demand and matching it to the available supply at the instant of peak is important. The DISCOM wants to adopt analytical methods of attaining this objective and optimize the tariffing mechanism.

- Build demand response program that would allow the residential and industrial consumers to curtail the load when utility demands and to pay on a per- kWh basis. There can be voluntary curtailment of up to certain hours in a year. Alternatively, the load curtailment can be triggered a) when the DISCOM is incurring high cost toward power purchase or b) when the distribution network is congested. This anticipated shift in load presents a beneficial situation for both utility and customer, as the utility will also be saving on account of reduction in purchasing costly power to serve peak loads.
- Leveraging the smart meter level data suggest input in designing an innovative dynamic tariff structures that might in the long term benefit all the stakeholders involved: right from consumer, distribution companies, state governments etc.
- Recommend multiple pricing options based on frequency based tariff component as well as usage based pre-announced Time of Day tariff.
- Build processes to Compare load profiles of different consumers within or across the same industry segment. It should be able to bring out pattern out of variations in the load profiles that is
not visible in a spreadsheet environment. The analysis should be capable of executing in multiple levels of distribution chains: like Distribution Transformer, Feeder etc.

- Configure / Customize the solution to detect the change in behavior of a consumer. Based on the changed behavior, it should identify potential consumers for targeting the demand Demand Response Program.
- Identify consumers having individual consumption pattern similar to aggregate Consumption pattern. Prepare the load profiles in a visual and easy to understand manner and should provide good insight of consumption patterns of consumers. Configure the analytics engine to identify consumers with -
  - Similar load patterns to the Aggregate load curve
  - Non-similar load pattern to Aggregate load curve.
Also provide flexibility to set tolerance limits for deviation between consumer load pattern and Aggregate load curve.
- Build the solution on the consumer level meter data, to address business problems like: “Who are the customers with the possession of equipment like Central A/C, Multiple Air-conditioners, Water pumps, Room heaters that consume more energy levels. The system should be able to identify the penetration level of such customers by substation/feeder.
- It would be ideal to create a predictive model to score all customers with a probability of having these type of equipments based on sample surveys of households/consumers. To deliver the above analysis the system is expected to seamlessly access applications / data bases from customer information, billing system, GIS management and weather data.

4. Analytics for Outage & Asset Management
- Create Visualization of changes in outage information available real-time, alarms and events by integrating AMI data, GIS data, Asset Management Data and Historian Data.
- Create Visualization of asset reliability metrics across the network
  Create and configure the system to give the following additional visualization
  - Time of day segmentation analysis of events & alarms
  - Event Frequency Trend analysis
  - Multi-variate correlation analysis of events/trends with weather, network, feeder
  - Statistical Process Control charts on events/alarms/outages

Create classification, segmentation and predictive models for the following:-
- Network / Feeder / Distribution Transformer Mix of Alarms/Events
- Data Driven Event Correlation Analysis of alarms for alarm suppression and fault development early warnings and root cause analysis with decision trees.
- Predictive models for accurate prediction of outages with variables having significant impact on the outages.
- GIS integrated output to understand the impact of outages.
- Distribution analysis of fault restoration.
- Integrate operational data such as Workforce data, maintenance planning data, real time fault
event/alarms prioritization data, asset location data, spares data, route data for optimization of the workforce allocation. Build a workforce optimization model using linear programming, mixed integer linear programming or non-linear programming.

- Proactively real time monitoring of the distribution network to assess the load and voltage condition to identify problem areas and recommend corrective action.
- Combine geospatial visualization with predictive analytics, the predictive enterprise utility can shorten outages from weather events and identify weak points in the electrical distribution system thus preventing future outages in transformers / cable.
- Create transformer segments/clusters across the network based on transformer attributes such as type, rating, age, failure history, failure type, consumption history, meter’s -growth history, inspection history.
- Create transformer overload models for early warnings using transformer voltage, current, power factors, number of meters connected, consumption data, transformer attributes, surges at the primary and secondary sides of a single-phase / 3-phase distribution transformer.
  - The transformer overload early warning models should be built on integrated analytics approach using statistical process controls, statistical analysis, data mining techniques and advanced visualization techniques.
  - The data driven predictive models should be applicable to diagnostics of cable failures
    Number of failures in the past Size of cable (cross section), Nature of size: Yes and NO , Type of the insulation – XLPE, PILC,XLPE+PILC, Nature of section: UG, composite, Joint of cable: XLPE, PILC, Transition, Differential size etc, Loading: Max, Max-min difference, average, Duration of the over load, Voltage surges: voltage violation from the operation, External factors : Damage by agencies (Y or N), Weather: It contributes to loading (temperature, humidity etc), Fault in the run: insulation wear-off (Y and N), Vulnerability to water ingress: High, medium, low, None Termination failure: Y & N, Vulnerability to chemical reaction: High, medium, low, None, Age of cable, Make / manufacturer of the cable
  - Create dashboards for assessment of risks of each individual asset, feeders and the overall system providing a top to bottom understanding of the power system and the revenue required to optimally manage risk coupled with the transformer survival models.

5. Analytics for Energy Accounting and Leakage.
Energy Accounting is highly data-intensive exercise .Hence mapping of each consumer has to be clearly identified for energy accounting purpose. The solution should be able to calculate Energy Loss at feeder-level or distribution-transformer level or at both. It involves preparation of accounts of the energy flow to various segments and its consumption. To calculate energy loss at a particular network element, say for e.g. At Feeder level, the difference between the sent-out units (inflow units) and sold-out units (outflow units) is to be calculated. Example of calculation is given below:-

Net energy Calculation (E): e (t) =M_ (n-1) (t)-M_n (t)-Σ1_k [m_k (t)]-L_n (t)
Where e (t) =Net Energy
L_n (t) = Line losses and unmetered loads

M_ n (t) = (Integrated) energy from the downstream feeder meter

m_k (t) = Energy usage from (or supplied through) meter k, can be + or –

M_1 (n-1) (t) = (Integrated) energy from the upstream feeder meter

- **Visualization capability:** For proactive or early intervention to reduce technical and commercial losses, the utilities need have capability of generating different kinds of reports like:
  - Loss analysis for different groups and categories of consumers
  - Accounting and auditing at Feeder level, Distribution Transformer level and DCU level.
  - Given the voltage and energy information for already deployed or planned deployment of smart meters, the software solution should be able to identify the meters with stolen energy
  - Given the GIS map of a secondary distribution network, the solution should be overlay the identified meter ids of the accounts (stealing power). It should also be able to estimate many indicative figures like : average hourly power stolen etc.
  - Perform error management like : Missed reads and Intermittent meter reads
  - Measure off-peak, mid-peak, min-max and average voltage and also use the advance statistical process control like Shewhart analysis etc to identify mechanical diversion.

- Configure the system to effectively visualize consumption trends, identify unusual patterns, and visualize load analysis to understand which assets are being over utilized.

- Implement a proper energy accounting framework. It should enable quantification of losses in different segments of the system and would provide the means to identify the areas of leakage, wastage or inefficient use.

- Build a troubleshoot energy problems and billing errors process by consistently tracking energy use. It should identify an unexplained increase in consumption, triggering for an investigation for the cause. For example, a correlation plot should be revealing the strength of relationship between consumption and other factors like area, weather, income etc.

- Configure smart meter data combined with enhanced line sensors enable tighter tracking of power delivery – from the point of distribution all the way to the home or business. To detect fraud or collusion, utilities must have a comprehensive understanding of a customer’s behavior and associated drivers (weather, special events, seasonal use of property, etc.).

- Enable and empower the business users to act and make data-driven decisions quickly by creating self service reports.

- Configure the visualization layer to create own data visualizations through a wizard driven interface.

- **Alert potential fraudulent energy use:** Build Alerts to identify occurrence of diverting, bypassing, or tampering with power connections or meters results in higher rates and potentially unsafe conditions. Such mal-practices are wide spread that costs an average utility companies and valid customers millions annually. The need is to access the customer level usage and demographic data by leveraging data mining to stay one step ahead of the perpetrators by:-
  - analyze data to identify new patterns of transmission versus usage
- set fraud alert engines
- manage potential fraud cases efficiently, from detection through notification of the authorities

6. Analytics for Capacitor Bank Planning and Volt Var Optimization

The Volt VAR optimization helps improve the technical loss, reduce electricity demand and promote a self-healing grid and enables widespread deployment Optimal control of the switching of capacitors, voltage regulators and transformer load tap changers in order to minimize the power drawn from source while maintaining acceptable voltage levels. Implementation of Conservation Voltage Reduction as many electrical devices operates more efficiently (use less power) at reduced voltage.

The volt var optimization and capacity bank planning system should involve the following analytics work:-

1. Build optimal models using linear and non-linear programming and advanced solvers for multiple objective models for minimizing losses; minimize power drawn while maintaining acceptable voltage levels, conservative voltage reduction.
2. Model should recommend actions such as optimal tap position; optimally identify capacitor banks for switching.
3. Create scenario planning which would aid decision support system for optimal switching plan such as where to locate the capacitor banks for the desired reduction in power loss or desired level of reduced voltage or power factor needs.
4. The modeling should take into consideration the following constraints such as real power in bus, reactive power in bus, capacity of the reactive power, bus voltage, and angles between bus voltages.
5. Integrate the transformer and regulator taps, capacitor banks, voltage and status, bus voltage, bus admittance matrix, voltage data and accurate load forecasts.

7. Visual in-memory Analytics

Real Time analytics can help facilitate through in-memory computing to analysis massive quantities of data in local memory so that the results of complex analysis and transactions are available at and business decisions can be executed without any delay. The same analysis built in the system should provide mobility by enabling access through mobile devices such as ipad’s.

The following visualization dashboards and performance metrics are envisaged in the analytics component:-

1. **Program Outcome - Meter Rollout out**
   a. Outcome considering pre and post smart meter consumption comparison, customer complaints etc.
   b. Rollout progress status planned versus actuals, costs per engineer, logistics cost, service cost etc.
   c. Service complaints related to pre and post unit consumption increase, service related
issues, meter related issues across various categories of customers, meter types.

2. **Load Forecasting and Load Research**
   a. Load forecasting accuracy measurement across the network hierarchy considering the system level, feeder level, DT level and meter level.
   b. Various Monthly/Hourly Load profiles across various customer class depicting forecasted load models
   c. Time of day patterns of load consumptions across customer segments and load characteristics on transformers with ability to filter data dynamically.

3. **Peak Load Estimation and Customer Segmentation**
   a. Customer Segments and Peak Load along with linked trend charts.
   b. Additional Revenue collection by peak load analysis and savings to the Utilities and Consumers.
   c. Customer class and load estimations
   d. Mean Absolute Errors in Daily Peak, Monthly Peak, Annual Peak e. Peak Load Savings for Utilities and Customer.

4. **Outage and Asset Management**
   a. Reliability indicators in electric distribution utilities such as SAIFI, CAIDI, CAIFI, MAIFI, ASAI, ALII, ACCI, ASCI, Feeder outage number, feeder outage duration etc.
   b. Asset (Distribution Transformer) reliability figures such as MTBF, MTTR(Restoration), Frequency of failures, trends with geo-mapping of DT network
   c. Additional Revenue collection by peak load analysis and savings to the Utilities and Consumers.
   d. Alarm & Events Occurrence and Patterns across time segment such as time of day, geo segment, season including linkage with load patterns and weather events.
   e. Transformer Load and Consumption analysis indicating linked drilldown facility of overload across network/feeder/distribution transformer

5. **Complete Energy Accounting and loss/leakage metrics system to the meter level**
   a. Near Real time Energy accounting system across the network to the DT level. b. Risk Maps with tile charts on the feeder/DTD having higher losses

6. **Data Management**
   The system should be able to integrate data from SAP, Oracle, GIS, Excel / Flat Files, MS SQL and Historian preferably with native connectors. The data management system should be able to exchange data in XML format with XML Mapper.
Suggestive Use cases and integration interfaces for Smart Grid Pilot Projects
The smart grid pilot projects planned to be taken up in India are targeted to address various challenges ranging from AT&C loss reduction to peak load management and improved outage management. With the intent to give a strong support to this initiative, member organizations of India Smart Grid Forum from all domains of a smart grid – metering, grid management, load management, renewables etc. drafted an exhaustive set of use cases and integration interfaces. These use cases and integration interfaces were developed by leveraging the global experience member organizations carry and also by referring to the globally available resources like

- NIST Framework and Roadmap for Smart Grid Interoperability Standards
  - [http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/IKBUseCases](http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/IKBUseCases)
- Use cases from Southern California Edison
- Gridwise Architecture Council
  - [http://www.gridwiseac.org/pdfs/interopframework_v1_1.pdf](http://www.gridwiseac.org/pdfs/interopframework_v1_1.pdf)

The approach followed in these global resources, for example NIST, is to define the functional use cases along with the requisite information exchange needs. These resources cover the aspects like use case, primary actor, use case description, information source, information receiver, information exchanged and the industry standards which can be referred to.

By adopting the similar approach, ISGF has developed some of the integration interfaces for use cases and the same is at Appendix-II for reference of utilities and vendors. However, Bidder/ system Integrator has to apply their own due diligence for development of these functionalities.
### IX. APPENDIX – II: USE CASES DEVELOPED BY INDIA SMART GRID FORUM

*(For Reference Use Only)*

<table>
<thead>
<tr>
<th>Use case</th>
<th>Primary Actor</th>
<th>Name of Process Activity</th>
<th>Description of process/activity</th>
<th>Source Application</th>
<th>Destination Application</th>
<th>Relevant Interoperability Standards</th>
<th>Information Exchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Clients Read Demand and Energy Data Automatically from Customer Premises</td>
<td>Meter Data Management</td>
<td>Requesting meter data</td>
<td>Requesting instantaneous, interval and events data from the meters and create profile in Billing. Portal services to view energy data</td>
<td>Meter Data Management</td>
<td>Head-end, CIS/CRM</td>
<td>IEC 61968 Part 9, 11</td>
<td>Meter Number, Scheduled Reading date and time, Period for which data needed</td>
</tr>
<tr>
<td>Multiple Clients Read Demand and Energy Data Automatically from Customer Premises</td>
<td>Meter Data Management</td>
<td>Acquiring meter data</td>
<td>Acquiring instantaneous, interval and events data from the meters by head-end which then reaches Meter Data Management system.</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968 Part 4, 9,11</td>
<td>Meter number, Reading date and time, reading parameters KWh, KVAh, KW etc.)</td>
</tr>
<tr>
<td>Load forecasting</td>
<td>Meter data for load forecasting</td>
<td>Load forecasting system needs meter data for finer load forecasting</td>
<td>Meter Data Management</td>
<td>Load Forecasting/Analytics</td>
<td>IEC 61968</td>
<td>Connected DT, meter reading date and time, reading parameter (KW, KVA)</td>
<td></td>
</tr>
<tr>
<td>Meter</td>
<td>Meter sending the consumption data</td>
<td>Meter at scheduled frequency sends the data to head-end (could be through the DCU if solution is defined so). Consumption details will be 15 minute block data, and data could be incremental to what was sent by meter in the preceding instance</td>
<td>Meter</td>
<td>Head-end</td>
<td>Meter number, reading date and time, KW, KVA, KWH, KVAH, PF</td>
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</tr>
<tr>
<td>Meter</td>
<td>Meter sending the billing data</td>
<td>Meter at scheduled frequency sends the billing data to head-end (could be through DCU if solution defined so)</td>
<td>Meter</td>
<td>Head-end</td>
<td>Meter number, reading date and time, KW, KVA, KWH, KVAH, PF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility detects Tampering or theft at customer site</td>
<td>Head-end</td>
<td>Capturing tamper events</td>
<td>The tamper events captured by meter are sent to head-end which in turn reaches meter data management for further action.</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>meter number, tamper code/description, tamper occurrence date and time</td>
</tr>
<tr>
<td></td>
<td>notifying utility personnel for immediate site inspection</td>
<td>The meter data management system immediately sends high priority alerts to utility personnel for necessary action as per rules</td>
<td>Meter Data Management</td>
<td>CIS, Enterprise Asset Management System, Email/SMS,</td>
<td>IEC 61968</td>
<td>Customer number, meter number, tamper code, address (in case of interface with Email/SMS gateway), event date and time</td>
<td></td>
</tr>
<tr>
<td>Meter sending the events data</td>
<td>Meter is sending the high priority events to head-end as and when occurred</td>
<td>Meter</td>
<td>Head-end</td>
<td>Meter number, event date and time, event code/description</td>
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<tr>
<td>Meter sending the non-critical events data</td>
<td>Meter is sending the non-critical events data to head-end as per scheduled frequency.</td>
<td>Meter</td>
<td>Head-end</td>
<td>Meter number, event date and time, event code/description</td>
<td></td>
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</tr>
<tr>
<td>Disconnecting connection</td>
<td>As soon a valid tamper event or malfunctioning is detected, connection is disconnected.</td>
<td>Meter Data Management</td>
<td>Head-end, CIS</td>
<td>IEC 61968 Customer number, meter number, action to be triggered (disconnect), action date and time</td>
<td></td>
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</tr>
<tr>
<td>Disconnecting connection at meter level</td>
<td>Head-end sends the disconnect command to the meter (could be through the DCU if the solution is defined so)</td>
<td>Head-end</td>
<td>Meter</td>
<td>Meter number, action (disconnect)</td>
<td></td>
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</tr>
<tr>
<td>Re- Connecting connection</td>
<td>Once the pre-programmed Disconnecting tamper event is NORMAL meter shall automatically perform re-connection and send the notification to HES.</td>
<td>Meter</td>
<td>Head-end</td>
<td>Meter number, action (connect)</td>
<td></td>
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</tr>
<tr>
<td>Re-connecting connection at meter level</td>
<td>Head-end sends the re-connect command to the meter (could be through the DCU if the solution is defined so)</td>
<td>Head-end</td>
<td>Meter</td>
<td>Meter number, action (re-connect)</td>
<td></td>
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<tr>
<td>Missed interval readings</td>
<td>Head-end</td>
<td>Head-end</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>Customer Information system</td>
<td>IEC 61968</td>
<td>Customer number, meter number, tamper code/description, tamper occurrence date and time</td>
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<tr>
<td></td>
<td></td>
<td>Missed reading /Gap reconciliation scenario</td>
<td>Missed Interval and Reads Data (Gap Reconciliation)</td>
<td>Head-end</td>
<td>Meter Data Management ,CIS</td>
<td>IEC 61968</td>
<td>Meter number, readings with date and time</td>
</tr>
<tr>
<td></td>
<td>Head-end</td>
<td>Missed interval readings acquisition</td>
<td>On identifying the missed interval, head-end will re acquire the data for the missing period from meter</td>
<td>Head-end</td>
<td>Meter</td>
<td></td>
<td>Meter number, from date and time, to date and time (for which data is missing)</td>
</tr>
<tr>
<td></td>
<td>Meter</td>
<td>Missed interval readings sent by meter</td>
<td>On receiving the data request command from meter, meter will send the data to head-end</td>
<td>Meter</td>
<td>Head-end</td>
<td></td>
<td>Meter number, reading date and time, KW, KVA, KWH, KV AH</td>
</tr>
<tr>
<td>Power outage events</td>
<td>Head-end</td>
<td>Power Outage /restoration events to Outage management if OMS subscribed From HES for these events.</td>
<td>Power Outage and Restoration Notification (if OMS subscribed for events)</td>
<td>Head-end</td>
<td>OMS</td>
<td>IEC 61968</td>
<td>Meter number, Outage/ Restoration Date and Time, Power On Off count</td>
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<tr>
<td>Meter Data Management</td>
<td>Meter Data Management</td>
<td>Power Outage and Restoration Notification</td>
<td>Meter Data Management</td>
<td>CIS/CRM</td>
<td>IEC 61968</td>
<td>Meter number, Outage/ Restoration Date and Time, Power On Off count</td>
<td></td>
</tr>
<tr>
<td>Voluntary meter reading</td>
<td>CIS/CRM</td>
<td>Customer providing the meter reading</td>
<td>Instantaneous Meter Read (status and data)</td>
<td>CIS/CRM</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Meter Number, Readings details, Read Date and time</td>
</tr>
<tr>
<td>Remote maintenance</td>
<td>Firmware Upgrade, Remote programming</td>
<td>User shall be able to maintain the AMI system by remotely programming the system parameters, upgrading the system with new firmware</td>
<td>Meter Data Management, Head-end</td>
<td>Meter</td>
<td></td>
<td>Meter and network equipment firmware, programs etc.</td>
<td></td>
</tr>
<tr>
<td>Utility remotely limits usage and/or connects and disconnects customer</td>
<td>Peak Load Management</td>
<td>Remote load setting</td>
<td>Utility identifies shortage in load, and hence invokes remote load limiting or disconnects customer based on some analysis done by a peak load management system</td>
<td>Peak Load management system</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Customer number, meter number, action to be triggered(load restriction, disconnection etc.), action date and time, audit information</td>
</tr>
<tr>
<td>Demand side management</td>
<td>Meter Data Management</td>
<td>Remote load setting</td>
<td>The request received from peak load management system is recorded and passed on to the head-end system for further action</td>
<td>Meter Data Management</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td>Customer number, meter number, action to be triggered(load restriction, disconnection etc.), action date and time</td>
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<tr>
<td>Demand response</td>
<td>Meter Data Management</td>
<td>Schedule meter reading data to Demand response program</td>
<td>15 minute interval Meter data</td>
<td>Meter Data Management</td>
<td>Demand Response</td>
<td>IEC 61968</td>
<td>Meter number, date and time of intervals, register data</td>
</tr>
<tr>
<td>Load monitoring at demand side</td>
<td>Meter Data Management</td>
<td>Midnight read scenarios</td>
<td>Daily Meter Reading, Status and associated details</td>
<td>Meter Data Management</td>
<td>CIS/CRM</td>
<td>IEC 61968</td>
<td>Meter number, date and time of daily reads, register data</td>
</tr>
<tr>
<td></td>
<td>Meter Data Management</td>
<td>Customer consumption information to CIS/CRM</td>
<td>Customer consumption data, TOU details, real time trends</td>
<td>Meter Data Management</td>
<td>CIS/CRM / analytics</td>
<td>IEC 61968</td>
<td>Meter number, date and time of daily reads, register data</td>
</tr>
<tr>
<td>Meter Data Management</td>
<td>Load profile data to CIS / CRM / Analytic application</td>
<td>Load profile Details</td>
<td>Meter Data Management</td>
<td>CIS/CRM / Analytics</td>
<td>IEC 61968</td>
<td>Meter number, date and time of intervals, register data</td>
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<tr>
<td>Meter</td>
<td>Load violation event information to control center</td>
<td>When there is a load violation event recorded in the meter, the information is sent to the control center</td>
<td>Meter</td>
<td>Head-end</td>
<td></td>
<td>Meter number, max demand, date and time of load violation</td>
<td></td>
</tr>
<tr>
<td>Meter disconnection/reconnection</td>
<td>Meter Data Management</td>
<td>Reconnecting meter Connect/disconnect switch for supply restoration.</td>
<td>Meter Connect operation</td>
<td>Meter Data Management</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td>Meter number, group of meters, instruction to close switch</td>
</tr>
<tr>
<td>Meter Data Management</td>
<td>Disconnecting meter connect/disconnect switch to break electric supply to customer.</td>
<td>Meter Disconnect operation</td>
<td>Meter Data Management</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td>Meter number, group of meters, instruction to open switch</td>
<td></td>
</tr>
<tr>
<td>Meter Data Management</td>
<td>Get Current Status of Meter Connect/Disconnect switch/relay.</td>
<td>Connection Status Update Request</td>
<td>Meter Data Management</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td>Meter number, group of meters, switch status.</td>
<td></td>
</tr>
<tr>
<td>Reconnect customer</td>
<td>CIS</td>
<td>Reconnect the meter after making payment against default</td>
<td>Customer is to be reconnected after he makes the payment</td>
<td>CIS</td>
<td>Meter Data Management</td>
<td>Customer number, meter number</td>
<td></td>
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<tr>
<td>After making defaulted payment</td>
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<td></td>
<td>CIS</td>
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<tr>
<td></td>
<td>CIS</td>
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</tr>
<tr>
<td>[New meter installed at site]</td>
<td>Meter management</td>
<td>Meter installation scenarios</td>
<td>Energization (The trigger showing the meter has energy flowing through)</td>
<td>Meter Management</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td>Meter number, Energization date and time.</td>
</tr>
<tr>
<td></td>
<td>Head-end</td>
<td>Meter reading scenarios</td>
<td>Meter Read/commissioning/sync Failures</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Meter number, date of last successful readings received, last logged date and time.</td>
</tr>
</tbody>
</table>
## Integration Interfaces for Tampering (also covered in section on Acquiring Meter Data)

<table>
<thead>
<tr>
<th>Use case</th>
<th>Primary Actor</th>
<th>Name of Process Activity</th>
<th>Description of process/activity</th>
<th>Source Application</th>
<th>Destination Application</th>
<th>Relevant Interoperability Standards</th>
<th>Information Exchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI System detects alerts, events or tampering at customer site</td>
<td>Head-end</td>
<td>Capturing tamper events</td>
<td>The tamper events captured by meter are sent to head-end which in turn reaches meter data management for further action.</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Customer number, meter number, tamper code/description, tamper occurrence date and time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Notifying utility personnel for immediate site inspection</td>
<td>The meter data management system immediately sends high priority alerts to utility personnel for necessary action</td>
<td>Meter Data Management</td>
<td>Email/SMS/CRM</td>
<td>IEC 61968</td>
<td>Customer number, tamper code, address, event date and time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disconnecting connection</td>
<td>As soon a valid tamper event is detected, connection is disconnected.</td>
<td>Meter Data Management</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td>Customer number, meter number, action to be triggered (disconnect), action date and time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Invoicing customer based on tamper</td>
<td>Once the tamper event is confirmed after some analysis, customer is invoiced for the tamper/theft. For tamper related details to be available in customer information system</td>
<td>Meter Data Management</td>
<td>Customer Information system</td>
<td>IEC 61968</td>
<td>Customer number, meter number, tamper code/description, tamper occurrence date and time</td>
</tr>
</tbody>
</table>
## Integration Interfaces for Consumer Portal

<table>
<thead>
<tr>
<th>Use case</th>
<th>Primary Actor</th>
<th>Name of Process Activity</th>
<th>Description of process/activity</th>
<th>Source Application</th>
<th>Destination Application</th>
<th>Relevant Interoperability Standards</th>
<th>Information Exchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customers having access to consumption details</td>
<td>CIS/CRM</td>
<td>Provide Customer information to MDM for portal purpose</td>
<td>Customer Data (Person &amp; Account, Premises and Service Points)</td>
<td>CIS/CRM</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Person &amp; Account, address and K Number</td>
</tr>
<tr>
<td></td>
<td>CIS/CRM</td>
<td>Customer load information for exception/ theft / Revenue loss scenarios identification</td>
<td>Customer Approved Load Information</td>
<td>CIS/CRM</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>K Number, Meter Number and Load details</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customer request for temporary disconnection/ re-connection</td>
<td>Operational Command: Connect &amp; Disconnect</td>
<td>CIS/CRM</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>K Number, Meter Number and Connect/ Disconnect command</td>
</tr>
</tbody>
</table>
## Integration Interfaces for Smart Metering System Maintenance

<table>
<thead>
<tr>
<th>Use case</th>
<th>Primary Actor</th>
<th>Name of Process Activity</th>
<th>Description of process/activity</th>
<th>Source Application</th>
<th>Destination Application</th>
<th>Relevant Interoperability Standards</th>
<th>Information Exchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time synchronization</td>
<td>Head-end</td>
<td>Sync up network device time and other information</td>
<td>Sync up of meters /data concentrators/ master data and Network Hierarchy in case of installation of new meters/data concentrators</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Network identification information including data concentrator</td>
</tr>
<tr>
<td>Metering network changes</td>
<td>Head-end</td>
<td>Network updation/meter-concentrator mapping change scenarios</td>
<td>Change in Meter / Concentrator Network Hierarchy</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Network identification information including data concentrator</td>
</tr>
<tr>
<td>Meter maintenance</td>
<td>Meter Data Management</td>
<td>Field service request</td>
<td>Create Field Service Order (FSO) Request for Meter trouble or exception</td>
<td>Meter Data Management</td>
<td>CIS/CRM</td>
<td>IEC 61968</td>
<td>Meter Number, Problem description</td>
</tr>
<tr>
<td></td>
<td>Meter Data Management</td>
<td>Device events</td>
<td>Device Events</td>
<td>Meter Data Management</td>
<td>CIS/CRM</td>
<td>IEC 61968</td>
<td>Meter number, Date and Time, event type &amp; name, priority</td>
</tr>
<tr>
<td></td>
<td>Meter Data Management</td>
<td>On-demand read scenarios</td>
<td>Instantaneous Meter Reading Request</td>
<td>Meter Data Management</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td>Meter Numbers, Reading duration</td>
</tr>
<tr>
<td>RFP FOR APPOINTMENT OF SMART GRID IMPLEMENTING AGENCY FOR IMPLEMENTATION OF SMART GRID PILOT PROJECT, APDCL</td>
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</tr>
<tr>
<td>Remote firmware upgrades/ meter configuration changes</td>
<td>Meter Data Management</td>
<td>Remote configuration scenarios</td>
<td>Configuration Commands: Change tariff parameters, Synchronize clock, Registers reset (status, maximum, tampering)</td>
<td>Meter Data Management</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td></td>
</tr>
<tr>
<td>Meter Data Management</td>
<td>Power Outage/restoration events to Outage management if OMS subscribed From MDM for these events.</td>
<td>Power Outage and Restoration Notification</td>
<td>Meter Data Management</td>
<td>OMS</td>
<td>IEC 61968</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

meter number, tariff parameters, registers status, event type and priority

Meter number, Outage/ Restoration Date and Time, Power On Off count
## Integration Interfaces for Outage Management

<table>
<thead>
<tr>
<th>Use case</th>
<th>Primary Actor</th>
<th>Name of Process Activity</th>
<th>Description of process/activity</th>
<th>Source Application</th>
<th>Destination Application</th>
<th>Relevant Interoperability Standards</th>
<th>Information Exchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer connection has an outage</td>
<td>Meter</td>
<td>Meter notifies the outage/restore event</td>
<td>The outage/restore event recorded by meter is sent to head-end as and when event occurs</td>
<td>Meter</td>
<td>Head-end</td>
<td></td>
<td>Meter number, event date and time, event (outage/ restoration)</td>
</tr>
<tr>
<td>Customer connection restores from outage</td>
<td>Head-end</td>
<td>Meter outage scenarios</td>
<td>Power Outage Notification (PON)</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Meter number, Outage Date and Time, Power On Off count</td>
</tr>
<tr>
<td></td>
<td>Head-end</td>
<td>Power restoration scenario</td>
<td>Power Restoration Notification (PRN)</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Meter number, Restoration Date and Time, Power On Off count</td>
</tr>
<tr>
<td></td>
<td>OMS</td>
<td>Reading request from OMS system to identify service restoration</td>
<td>Receive Operational Command from OMS like Instantaneous Meter Read etc.</td>
<td>OMS</td>
<td>Meter Data Management</td>
<td>IEC 61968</td>
<td>Meter Number, Readings details, Read Date and time</td>
</tr>
<tr>
<td></td>
<td>Meter</td>
<td>Meter notifies the outage/restore event</td>
<td>The outage/restore event recorded by meter is sent to head-end as and when event occurs</td>
<td>Meter</td>
<td>Head-end</td>
<td></td>
<td>Meter number, event date and time, event (outage/ restoration)</td>
</tr>
<tr>
<td>Distribution Grid Control and Monitoring</td>
<td>Distribution SCADA</td>
<td>Control and Monitoring</td>
<td>Telemetry of analog/digital field signals and control of field equipment</td>
<td>Distribution SCADA</td>
<td>Standard protocols like IEC-61850, IEC-104, IEC-103, DNP3, Modbus</td>
<td>Voltage, Current, Equipment Status, frequency, protection signals</td>
<td></td>
</tr>
<tr>
<td>Distribution Control Center has a view of the transmission system and other interconnected systems</td>
<td>Distribution SCADA</td>
<td>Grid Monitoring</td>
<td>Exchange of Data with other SCADA systems</td>
<td>Transmission SCADA</td>
<td>Distribution SCADA</td>
<td>ICCP</td>
<td>Equipment status, analog values, grid frequency, MU’s sent, MU’s received</td>
</tr>
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</tr>
<tr>
<td>Utility plans to estimate the load flow in areas where analog data is unavailable (by utilizing the available data)</td>
<td>Distribution SCADA, DMS</td>
<td>State Estimation</td>
<td>Run the state estimation algorithm and identify the possible load flow in certain areas of the distribution grid</td>
<td>SCADA (Analog values and Equipment status)</td>
<td>DMS–State Estimation Application</td>
<td>Feeder code, equipment status, voltage, current</td>
<td></td>
</tr>
<tr>
<td>Volt Var Monitoring and Management</td>
<td></td>
<td>Volt Var Management</td>
<td>SCADA (Cap Bank control, OLTC control etc.)</td>
<td>DMS – Volt VAR Control application</td>
<td>CIM or other acceptable standard</td>
<td></td>
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</tr>
<tr>
<td>Effective Load Management and Distribution</td>
<td>Distribution Management System</td>
<td>Feeder Reconfiguration</td>
<td>Reconfigure the feeders and Normal Open Points based on system loading pattern</td>
<td>SCADA (RMU/Isolator status and control)</td>
<td>DMS – Feeder Reconfiguration on application</td>
<td>CIM or other acceptable standard</td>
<td>Analog values – Load, Voltage, Current</td>
</tr>
<tr>
<td>Restoring network To normal configuration through switch operation</td>
<td>Distribution Management System</td>
<td>Switch order management</td>
<td>Create switch order Sequence based on the configuration to be incorporated, and do the necessary action in the field manually.</td>
<td>DMS/OMS</td>
<td>Work Force Management / EAM</td>
<td>CIM or other acceptable standard</td>
<td>Feeder code, switch status, date and time of action</td>
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</tr>
<tr>
<td>Network topology is synchronized in all systems</td>
<td>Geographical Information System</td>
<td>Network topology synchronization</td>
<td>GIS is considered to be the primary source of network topology. This topology data is needed by other systems for proper functioning.</td>
<td>GIS</td>
<td>DMS, OMS, WFM</td>
<td>CIM or other Acceptable standard</td>
<td>Network connectivity data – feeder to DT, DT to customer</td>
</tr>
<tr>
<td>Utility monitors the reliability indices on daily basis</td>
<td>Performance Management System</td>
<td>Performance Management</td>
<td>System reliability data is Acquired from multiple utility systems like customer management, SCADA/DMS etc. to calculate the reliability indices.</td>
<td>SCADA, DMS, OMS, Customer Management</td>
<td>Performance Management System</td>
<td>CIM or other acceptable standard</td>
<td>Outage details, billing and collection details, equipment failure details</td>
</tr>
<tr>
<td>Network reconfiguration changes to be updated into relevant systems</td>
<td>SCADA/DMS</td>
<td>Network reconfiguration changes</td>
<td>Network configuration changes to flow from SCADA/DMS to GIS</td>
<td>SCADA/DMS</td>
<td>GIS</td>
<td>CIM or other acceptable standard</td>
<td>Feeder number/code, reconfiguration date and time, change in input feeder, DT number/code, reconfiguration date and time, change in input feeder</td>
</tr>
<tr>
<td>Utility identifies single light out customers</td>
<td>Outage Management System</td>
<td>Identify single light out consumers</td>
<td>Based on outage events captured by AMI, and relating it to transformer and feeder status, utility tries to identify single light out customers</td>
<td>AMI</td>
<td>OMS</td>
<td>CIM or other acceptable standard</td>
<td>Meter number, connected DT, connected feeder, consumer number, outage time and duration</td>
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<tr>
<td>Outage Management System</td>
<td>Identify single light out consumers</td>
<td>DMS</td>
<td>OMS</td>
<td>CIM or other Acceptable standard IEC 61968</td>
<td>Feeder number, feeder status</td>
<td></td>
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</tr>
<tr>
<td>Database for Distribution SCADA</td>
<td>Distribution SCADA</td>
<td>Network Model</td>
<td>Distribution Network Model and Land Base data</td>
<td>GIS</td>
<td>Distribution SCADA</td>
<td>IEC 61968-1 or any native format of GIS</td>
<td>SLD, Network Model, Interconnection system</td>
</tr>
<tr>
<td>CIS</td>
<td>Distribution SCADA</td>
<td>Circuit Breaker Status table</td>
<td>Real-time status of all Circuit breakers, date &amp; time of tripping, cause of tripping, Expected duration of outage.</td>
<td>ISR</td>
<td>Customer Care</td>
<td>CIM/XML or any other standard</td>
<td>Circuit breaker status table</td>
</tr>
<tr>
<td>Billing System</td>
<td>Distribution SCADA</td>
<td>Daily Energy Values</td>
<td>Daily energy values for 15 Minute blocks / one hour blocks of a day &amp; shall be stored for each feeder on daily basis along with quality codes.</td>
<td>ISR</td>
<td>Billing</td>
<td>CIM/XML or any other standard</td>
<td>Daily energy values for each feeder for 15 mins block.</td>
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</tr>
<tr>
<td>Digital Data Polling from Substation/ RMUs</td>
<td>Distribution SCADA</td>
<td>Digital Status update</td>
<td>Digital Status from RTU should be updated within 4 secs and 6 secs from FRTU.</td>
<td>Substation Automation, FEEDER Automation</td>
<td>Distribution SCADA</td>
<td>IEC 60870-5-104</td>
<td>Digital Status</td>
</tr>
<tr>
<td>Analog Data Polling from Substation / FRMU</td>
<td>Distribution SCADA</td>
<td>Analog status update</td>
<td>Analog Status from RTU should be updated within 5 secs and 10 secs from FRTU</td>
<td>Substation Automation, FEEDER Automation</td>
<td>Distribution SCADA</td>
<td>IEC 60870-5-104</td>
<td>Analog Status</td>
</tr>
<tr>
<td>Distribution Grid Control and Monitoring</td>
<td>Distribution SCADA</td>
<td>Control and Monitoring</td>
<td>Telemetry of analog/digital field Signals and control of field equipment</td>
<td>Station Gateway, FRTUs, FPIS, Energy Meters, Numerical Relays etc.</td>
<td>Distribution SCADA</td>
<td>Standard protocols like:IEC-104 for Communication between RTU/FRTU to SCADA/DMS Control Centre; and IEC-61850,IEC-103 for Communication between Numerical Relays and RTU; Modbus for MFT communicating with RTU/FRTU</td>
<td>Voltage, Current, Equipment Status, frequency, protection signals.</td>
</tr>
<tr>
<td>Distribution Control Center has a view of the transmission system and other interconnected systems Data Recovery</td>
<td>Distribution SCADA</td>
<td>Grid Monitoring State Estimation</td>
<td>Exchange of Data with other SCADA systems</td>
<td>Transmission SCADA</td>
<td>Distribution SCADA</td>
<td>ICCP / FTP (for DR)</td>
<td>Equipment status, analog values, grid frequency, MU’s sent, MU’s received</td>
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<td>Feeder code, equipment status, voltage, current</td>
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</tr>
<tr>
<td>Fault Isolation and Service Restoration</td>
<td>SCADA (FPI &amp; equipment status and Control, analog values) WFM remote updation by field crew</td>
<td>DMS – FISR application, OMS</td>
<td>CIM or other acceptable standard</td>
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<td>SCADA/DMS</td>
<td>GIS</td>
<td>CIM or other acceptable standard</td>
<td>Feeder number/code, reconfiguration date and time, change in input feeder DT number/code, Reconfiguration date and time, change in input</td>
</tr>
<tr>
<td>OMS Database</td>
<td>OMS</td>
<td>Network Model</td>
<td>Network configuration changes needed to calculate energy accounting</td>
<td>GIS</td>
<td>Energy Accounting</td>
<td>CIM or other acceptable standard</td>
<td>Feeder number/code, reconfiguration date and time, change in input feeder DT number/code, reconfiguration date and time,</td>
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</tr>
<tr>
<td>OMS Database</td>
<td>OMS</td>
<td>Network Model</td>
<td>Distribution Network Model, Consumer data and Equipment data</td>
<td>GIS</td>
<td>OMS</td>
<td>IEC 61968-1 or any native format of GIS</td>
<td>Distribution Network Model, Equipment data, Consumer data Interconnection system</td>
</tr>
<tr>
<td>Real Time Data for OMS</td>
<td>OMS</td>
<td>Real Time Analog Information and Digital Status</td>
<td>real-time status of all Circuit breakers, date &amp; time of tripping, cause of tripping, Expected duration of outage, Analog Values from MFTs</td>
<td>SCADA</td>
<td>OMS</td>
<td>CIM/XML or ICCP</td>
<td>Real-time Analog information and Digital Status.</td>
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<tr>
<td>Customer Care System</td>
<td>OMS</td>
<td>Restoration time and customers affected</td>
<td>Restoration time, type of Outage, customers affected</td>
<td>OMS</td>
<td>Customer Care</td>
<td>CIM/XML or ODBC or any other standard</td>
<td>Restoration time, type of Outage, customers affected.</td>
</tr>
<tr>
<td>Mobile Workforce Management</td>
<td>OMS</td>
<td>Assignment of Crews</td>
<td>assign a service crew for restoration and equipment to crew for repair</td>
<td>OMS</td>
<td>MWFM</td>
<td>CIM/XML or ODBC or any other standard</td>
<td>Crew assignment and equipments available with</td>
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</table>
### Summary of currently outaged equipment and customers

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<th>System</th>
<th>Description</th>
<th>Additional Information</th>
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<tbody>
<tr>
<td>OMS</td>
<td>Affected equipment summary</td>
<td>Summary of affected equipment and and customers</td>
<td>OMS, SCADA, CIM/XML or ICCP</td>
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<tr>
<td><strong>Calculation of Performance indices</strong></td>
<td>OMS</td>
<td>SAIDI, SAIFI Calculation</td>
<td>OMS, SCADA, CIM/XML or ICCP</td>
</tr>
<tr>
<td><strong>Power Supply interruption</strong></td>
<td>AMI</td>
<td>Power Supply interruption from Smart Meters</td>
<td>AMI, OMS, CIM/XML or ODBC or any other standard</td>
</tr>
<tr>
<td><strong>Switching Operations</strong></td>
<td>SCADA</td>
<td>Network Status update</td>
<td>SCADA, OMS, CIM/XML or ICCP</td>
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<tr>
<td><strong>Manual Switching operations</strong></td>
<td>DMS</td>
<td>Network Status update</td>
<td>DMS, OMS, CIM/XML or ICCP</td>
</tr>
<tr>
<td><strong>Fault detection, outage record creation and SERVICE Restoration</strong></td>
<td>DMS</td>
<td>Fault Isolation and Service &amp; Restoration</td>
<td>SCADA, OMS, CIM/XML or ICCP</td>
</tr>
<tr>
<td><strong>Planned Outage of electrical equipment</strong></td>
<td>OMS</td>
<td>Planned Outage</td>
<td>Asset Management /Field intimation, OMS, CIM/XML or ODBC or any other standard</td>
</tr>
<tr>
<td><strong>Outage Prediction</strong></td>
<td>OMS</td>
<td>Prediction of affected equipment</td>
<td>AMI, OMS, CIM/XML or ODBC or any other standard</td>
</tr>
<tr>
<td>Storm Management</td>
<td>OMS</td>
<td>Management of incoming outage requests during EHV outage / force majeure.</td>
<td>Management of incoming outage requests during EHV outage / force majeure</td>
</tr>
</tbody>
</table>
### Integration Interfaces for Distributed Generation

<table>
<thead>
<tr>
<th>Use case</th>
<th>Primary Actor</th>
<th>Name of the Process/Activity</th>
<th>Description of Process/Activity</th>
<th>Source Application</th>
<th>Destination Application</th>
<th>Relevant Industry Standards</th>
<th>Information Exchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault in a circuit with DER connected to healthy section cleared by fast circuit breaker trip and by reverse protection from DER fault injection creating a self-sustainable island</td>
<td>SCADA database, Relay Protection Schemes, Historical Data Base</td>
<td>Self-sustainable island is created</td>
<td>DERMS/DMS receives the scan of SCADA data and historic load data to be checked for changes in topology and loading during the time of repair.</td>
<td>SCADA</td>
<td>DERMS/DMS</td>
<td></td>
<td>Real-time analog, status data</td>
</tr>
<tr>
<td>DERMS/DMS</td>
<td>Checking the sufficiency of the island during the time of repair</td>
<td>DERMS/DMS determines The sufficiency of the island during the time of repair and enables FLISR for location of the fault within the de-energized section.</td>
<td>DERMS/DMS</td>
<td>FLISR</td>
<td></td>
<td>Instructions to FLISR</td>
<td></td>
</tr>
<tr>
<td>DERMS/DMS</td>
<td>Checking the sufficiency of the island during the time of repair</td>
<td>DERMS/DMS determines the insufficiency of the island during the portion of time of repair and enables FLISR for location of the fault within the de-energized section and solving restoration for the customers connected to the island.</td>
<td>DERMS/DMS</td>
<td>FLISR</td>
<td></td>
<td>Instructions to FLISR</td>
<td></td>
</tr>
<tr>
<td>Fault in a circuit with DER connected to healthy section cleared by fast circuit breaker trip and by reverse protection from DER fault injection, creating an insufficient island.</td>
<td>SCADA database, relay protection schemes, historic database</td>
<td>Unintentional insufficient island is created, DER is separated with or without balanced load</td>
<td>DERMS/DMS receives the scan of SCADA data and historic load data to be checked for changes in topology and loading during time of repair.</td>
<td>SCADA database</td>
<td>DERMS/DMS</td>
<td>SCADA real-time analog, status data</td>
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</tr>
<tr>
<td>DERMS/DMS</td>
<td>Checking the sufficiency of the island during the time of repair</td>
<td>DERMS/DMS determines the insufficiency of the island during the time of repair and enables FLIR for location of the fault within the de-energized section and solving restoration for the de-energized customers connected to the island.</td>
<td>DERMS/DMS FLISR</td>
<td>Instruction to FLISR</td>
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</tr>
<tr>
<td>Fault in a circuit with DER connected to faulty section cleared by circuit breaker and by relay Protection of DER.</td>
<td>SCADA database, relay protection schemes, historic database</td>
<td>The feeder is de-energized, DER is separated with or without balanced load</td>
<td>DERMS receives the scan of SCADA data and historic load data to be checked for changes in topology and loading during time of repair.</td>
<td>SCADA database</td>
<td>DERMS/DMS</td>
<td>DMS real-time Analog, status data.</td>
<td></td>
</tr>
<tr>
<td>Gross and Net metering of Generation - Demand and Energy Data Automatically from Prosumer Premises</td>
<td>Meter Data Management</td>
<td>Requesting meter data</td>
<td>Requesting instantaneous, interval and events data from the meters and create profile in Billing. Portal services to view energy data</td>
<td>Meter Data Management</td>
<td>Head-end, CIS/CRM</td>
<td>IEC 61968 Part 9, 11</td>
<td>Instructions to FLISR</td>
</tr>
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</tr>
<tr>
<td>Meter Data Management</td>
<td>Acquiring meter data</td>
<td>Acquiring instantaneous, interval and events data from the meters by head-end which then reaches Meter Data Management</td>
<td>Head-end</td>
<td>Meter Data Management</td>
<td>IEC 61968 Part 4, 9,11</td>
<td>Meter number, Reading date and time, reading parameters (KWh, KVAh, KW etc.)</td>
<td></td>
</tr>
<tr>
<td>Load forecasting</td>
<td>Meter data for load forecasting</td>
<td>Load forecasting system needs meter data for finer load forecasting</td>
<td>Meter Data Management</td>
<td>Load Forecasting/ Analytics</td>
<td>IEC 61968</td>
<td>Connected DT, meter reading date and time, reading parameter (KW, KVA, KVAR, KVARH, PF)</td>
<td></td>
</tr>
<tr>
<td>Meter</td>
<td>Meter sending the consumption data</td>
<td>Meter at scheduled Frequency sends the data to head-end (could be through the DCU if solution is defined so). Consumption details will be 15 minute block data, and data could be incremental to what was sent by meter in the preceding instance.</td>
<td>Meter</td>
<td>Head-end</td>
<td>IEC 61968</td>
<td>Meter number, reading date and time, KW, KVA, KWH, KVAR, KVARH, PF</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>System/Tool</td>
<td>Function Description</td>
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<tr>
<td>Meter</td>
<td>Meter sending the billing data</td>
<td>Meter at scheduled frequency sends the billing data to head-end (could be through DCU if solution defined so)</td>
<td>Meter</td>
<td>Head-end</td>
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<tr>
<td>MDM</td>
<td>Net flow measurements</td>
<td>Measurement of actual Generation data (gross/net) data with the regulations</td>
<td>MDM</td>
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<tr>
<td>DG Contract Management System/Tool</td>
<td>Reconciliation of DG generation</td>
<td>Generating reports based on transaction information as per defined periodicity Identification of banking, carry forward/lapse information and sending to billing system</td>
<td>Billing System</td>
<td>Contract Management System/Data base, MIS</td>
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<tr>
<td>Aggregated distributed generation forecasting for pilot area</td>
<td>Generation Forecasting System/Tool</td>
<td>Identifying available DG systems based on meter data</td>
<td>MDM</td>
<td>Generation Forecasting System</td>
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<tr>
<td>Weather forecasting tools/system</td>
<td>Weather influence on generation</td>
<td>Determination of weather patterns and other influencers of demand</td>
<td>Weather forecasting tools/system</td>
<td>Generation Forecasting tools/system</td>
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<tr>
<td>Generation Forecasting System</td>
<td>DG generation forecasting for pilot area</td>
<td>Forecasting of generation based on DG system availability and weather inputs</td>
<td>Generation Forecasting System</td>
<td>ALDC Systems (Load Management, Scheduling)</td>
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<td></td>
<td></td>
<td>Forecast of generation for identified time blocks</td>
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<tr>
<td><strong>Aggregate demand and net demand forecasting for pilot area</strong></td>
<td><strong>Analytics</strong></td>
<td><strong>Trending of historical demand in area (gross and net)</strong></td>
<td><strong>Identification of likely demand in pilot area for identified time periods based on past trends</strong></td>
<td><strong>Analytics</strong></td>
<td><strong>Demand Forecasting System</strong></td>
<td><strong>Historical consumption trends (varying periodicity) as per forecasting system</strong></td>
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<tr>
<td><strong>MDM</strong></td>
<td><strong>Identification of recent demand data</strong></td>
<td><strong>Identification of likely demand in pilot area for identified time periods based on immediately preceding periods (week, month, year)</strong></td>
<td><strong>MDM</strong></td>
<td><strong>Demand Forecasting System</strong></td>
<td><strong>Gross and net demand data (MW) in pilot area as per identified periodicity</strong></td>
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<tr>
<td><strong>Weather forecasting tools/system</strong></td>
<td><strong>Determination of weather influence on demand</strong></td>
<td><strong>Weather patterns and other influencers of demand</strong></td>
<td><strong>Weather forecasting tools/system</strong></td>
<td><strong>Demand Forecasting tools/systems</strong></td>
<td><strong>Weather data (temperature, humidity, sunshine, precipitation)</strong></td>
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<tr>
<td><strong>Demand Forecasting System</strong></td>
<td><strong>Gross and Net Demand Forecasting for pilot area</strong></td>
<td><strong>Determination of gross demand in the pilot area based on</strong></td>
<td><strong>Demand Forecasting tools/systems, Generation Forecasting System</strong></td>
<td><strong>ALDC Systems (Load Management, Scheduling)</strong></td>
<td><strong>Gross and Net demand forecasts</strong></td>
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<tr>
<td><strong>Transformer level Flow monitoring to detect/predict backflow. Prioritized remote disconnection for backflow</strong></td>
<td><strong>Head-end</strong></td>
<td><strong>Power Outage/ Restoration for gross (input from DG) meters in accordance with priority/roster.</strong></td>
<td><strong>DG Outage and Restoration Notification</strong></td>
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<td><strong>IEC 61968</strong></td>
<td><strong>Meter number, Outage/ Restoration Date and Time, Power On Off count</strong></td>
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<tr>
<td>Scenario</td>
<td>Role</td>
<td>Data Provided</td>
<td>System</td>
<td>Additional Info</td>
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<tr>
<td>Power outage management - remote disconnection and reconnection</td>
<td>Head-end</td>
<td>Power Outage/Restoration events to Outage management if OMS Subscribed from HES or these events.</td>
<td>Power Outage and Restoration Notification (if OMS subscribed for events)</td>
<td>Head-end OMS IEC 61968 Meter number, Outage/Restoration Date and Time, Power On Off count</td>
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<tr>
<td>Visibility of gross and net generation/ demand to prosumer</td>
<td>Meter Data Management</td>
<td>Meter Data Management</td>
<td>Power Outage and Restoration Notification</td>
<td>Meter Data Management CIS/CRM IEC 61968 Meter number, Outage/Restoration Date and Time, Power On Off count</td>
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<tr>
<td>Customer providing the meter particulars</td>
<td>CIS/CRM</td>
<td>Customer providing the meter particulars</td>
<td>Instantaneous Meter Read (status and data) of gross and net meter</td>
<td>CIS/CRM Meter Data Management IEC 61968 Meter Number, Readings details, Read Date and time</td>
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## Integration Interfaces for Power Quality

<table>
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<tr>
<th>Use case</th>
<th>Primary Actor</th>
<th>Name of the Process/Activity</th>
<th>Description of Process/Activity</th>
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<th>Destination Application</th>
<th>Relevant Industry Standards</th>
<th>Information Exchanged</th>
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<tr>
<td>Measuring voltage variations at Distribution Transformer LT side for DTs supplying Domestic/Small Commercial Consumers</td>
<td>Meter Data Management</td>
<td>Meters (for measuring voltage variations) sending data</td>
<td>Voltage variations to be monitored for compliance with standards set by the regulatory authorities. This information could be utilized by OMS for predictive maintenance or installation of fast power factor correction equipment by the utility</td>
<td>Meter Data Management</td>
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<td>/</td>
<td>DMS</td>
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<tr>
<td>Measuring Voltage variations at Distribution Transformer LT side for Large Industrial / Commercial Consumers</td>
<td>Meter Data Management</td>
<td>Meters (for measuring voltage variations) sending data</td>
<td>Voltage variations to be Monitored for compliance with standards set by the regulatory authorities. This information could be utilized by OMS for predictive maintenance, by metering systems for penalization if the voltage variations have happened due to specific identified customers.</td>
<td>Meter Data Management</td>
<td>OMS</td>
<td>/</td>
<td>DMS</td>
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<tr>
<td>Measuring Flicker at consumer premises and at Distribution Transformers</td>
<td>Meter Data Management (Flicker meters)</td>
<td>Meters for measuring flicker</td>
<td>Flicker meter measures the degree the annoyance flicker causes. Pst, is the measure of annoyance. It may be noted that the annoyance. Threshold corresponds to Pst=1. When Pst&gt;1, the observer is understood to suffer annoyance% when Pst&lt;1, the light fluctuations may be perceivable but not annoying The outputs of these meters could be transferred to the OMG / work force responsible for monitoring power quality, for both corrective and regulatory measures.</td>
<td>Meter Data Management (Flicker meters)</td>
<td>OMS</td>
<td>/</td>
<td>DMS</td>
</tr>
<tr>
<td>Measuring and transferring Voltage Sag/Surge at consumer premises and Distribution Transformers</td>
<td>Meter Data Management (Meters for capturing voltage sags and surges, along with voltage angles)</td>
<td>Voltage Sag/Surge Measurement</td>
<td>Events when voltage sags / Surges that have been observed can be transferred to MDMS and/or OMS as may be required. This could again be utilized for both corrective and regulatory purposes.</td>
<td>Instrumentation for capturing voltage surges/sags</td>
<td>OMS / DMS</td>
<td>Voltage (sinusoids) curves, angles, rms values with angles</td>
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<tr>
<td>Measuring Harmonics</td>
<td>Meters with a capability to compute Total Harmonic Distortion (THD) and Total Demand Distortion (TDD)</td>
<td>Harmonic Distortion Measurement</td>
<td>The impact of harmonics is measured in terms of Total Demand Distortion (TDD). These meters can be placed at various load centers where the nature of load is non-linear. The communication devices could be utilized to transfer this information to both OMS and for regulatory purposes. Harmonics can cause transformer burn outs even in instances when the load at fundamental frequency voltage and current may not be high.</td>
<td>Instrumentation for capturing Harmonic Distortions</td>
<td>OMS</td>
<td>Total Demand Distortion, Total Harmonic Distortion</td>
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</tbody>
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