

ASSAM POWER DISTRIBUTION COMPANY LTD.

BID DOCUMENT

FOR

Supply, installation, testing, configuration & commissioning of 4G supported Intelligent Modems at all 33 KV & 11 KV Feeders, Boundary Meters and selected HT Consumers under APDCL



Open Tender Notice

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OFFICE OF THE CHIEF GENERAL MANAGER (PP & D), APDCL,

6th FLOOR, BIJULEE BHAWAN,

PALTANBAZAR, GUWAHATI-781001

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Technical Specifications

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Abbreviations

AB Switch	Air Break Switch
ARMS	APDCL Revenue Management System
AC	Alternating Current
ACDB	Alternating Current Distribution Board
ACL	Access Control List
AES	Advanced Encryption Standard
ALG	Application Layer Gateway
AMC	Annual Maintenance Contract
AMR	Automatic Meter Reading
ANSI	American National Standards Institute
APDCL	Assam Power Distribution Company Limited
ARP	Address Resolution Protocol
ASIC	Application Specific Integrated Circuit
AT&C	Aggregate Technical & Commercial
BCS	Base Computer Software
BGP	Border Gateway Protocol
BIOS	Basic Input / Output System
BIS	Bureau of Indian Standards
BOQ	Bill of Quantities
CBIP	Central Board of Irrigation & Power
CCC	Customer Care Center
CEA	Central Electricity Authority
CERT-In	Indian Computer Emergency Response Team
CGRF	Consumer Grievance Redressal Forum
CIM	Customer Interaction Meeting
CIM	Common Information Model

CMC	Centralized Monitoring Console
COSEM	Companion Specification for Energy Metering
CPP	Critical Peak Pricing
CPRI	Central Power Research Institute
CPU	Central Processing Unit
CRM	Customer Relationship Manager
CT	Current Transformer
CUM	Cumulative
DAS	Distribution Automation Scheme
dBA	Decibel
DCU	Data Concentrator Unit
DDoS	Distributed Denial of Service
DC	Direct Current
DG	Diesel Generator
DES	Data Encryption Standard
DHCP	Dynamic Host Configuration Protocol
DLMS	Device Language Message Specification
DMC	Dough Moldings Compound
DMS	Distribution Management System
DMZ	Demilitarized Zone
DNP	Distributed Network Protocol
DNS	Domain Name System
DoD	Depth of Discharge
DoS	Denial of Service
DR	Demand Response
DSM	Demand Side Management
DT	Distribution Transformer
DTMU	Distribution Transformer Monitoring Unit

DTR	Distribution Transformer
DVD	Digital Video Disk
DXF	Drawing exchange Format
EAP	Extensible Authentication Protocol
ECS	Electronic Clearing Scheme
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ERP	Enterprise Resource Planning
ESB	Enterprise Service Bus
ESD	Electrostatic Discharge
FAT	Factory Acceptance Test
FIFO	First In First Out
FPR	Field, Problem, Report
FSR	Field Service Report
FTP	File Transfer Protocol
GB	Gigabyte
GIS	Geographic Information System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communications
GUI	Graphical User Interface
HD	High Definition
HDD	Hard Disk Drive
HES	Head End System
HF	High Frequency
HHU	Hand Held Unit
HIDS	Host based Intrusion Prevention system
HT	High Tension

HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
ICMP	Internet Control Message Protocol
ICs	Integrated Circuits
IEC	International Electro technical Commission
IKE	Internet Key Exchange
IP	Internet Protocol
IPCP	Internet Protocol Control Protocol
IrDA	Infrared Data Association
IS	Indian Standard
iSCSI	Internet Small Computer System Interface
ISO	International Organization for Standardization
ISP	Internet Service Provider
IST	Indian Standard Time
IT	Information Technology
IVR	Interactive Voice Response
KVM Switch	Keyboard, Video & Mouse Switch
LAN	Local Area Network
LCD	Liquid Crystal Display
LDAP	Lightweight Directory Access Protocol
LDC	Load Dispatch Center
LED	Light Emitting Diode
LT	Low Tension
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
MD5	Message-digest algorithm
MDAS	Meter Data Acquisition System
MDM	Meter Data Management

MFT	Multi-Function Transducer
MGCP	Media Gateway Control Protocol
MIP	Mapped Internet Protocol
MIS	Management Information System
MPLS	Multiprotocol Label Switching
MU	Million Unit
NABL	National Accreditation Board for Testing and Calibration Laboratories
NAN	Neighborhood Area Network
NAT	Network Address Translation
NCIIPC	National Critical Information Infrastructure Protection Center
NIPS	Network based Intrusion Prevention system
NMS	Network Management System
NPL	National Physical Laboratory
NTP	National Time Protocol
NVM	Non Volatile Memory
O & M	Operation & Maintenance
OEM	Original Equipment Manufacturer
OH	Over Head
OMS	Outage Management System
OS	Operating System

OSF	Open Software Foundation
OSPF	Open Shortest Path First
PAT	Port Address Translation
PC	Personal Computer
PCB	Printed Circuit Board
PERT	Program Evaluation and Review Technique
PF	Power Factor
PLM	Peak Load Management
POP3	Post Office Protocol 3
PPPoE	Point-to-Point Protocol over Ethernet
PSTN	Public Switch Telephone Network
PT	Potential Transformer
PTH	Plated Through Hole
PV	Photo Voltaic
PVC	Polyvinyl Chloride
QAP	Quality Assurance Plan
QR	Qualifying Requirement
RADIUS	Remote Authentication Dial-In User Service
RAID	Redundant Array of Inexpensive Disks
RAM	Read Access Memory
R-APDRP	Restructured Accelerated Power Development and Reforms Program
RF	Radio Frequency
RMU	Ring Main Unit
RoHS	Restriction of Hazardous Substance
RPC	Remote Procedure Call

RPO	Renewable Power Obligation
RSTP	Rapid Spanning Tree Protocol
RTC	Real Time Clock
RTP	Real Time Pricing
RTU	Remote Terminal Unit
SAE	Surface Vehicle Recommended Practice
SAN	Storage Area Network
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SCCP	Skinny Client Control Protocol
SGAs	Smart Grid Applications
SHA	Secure Hash Algorithm
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SMC	Sheet Moldings Compounds
SMPS	Switching Mode Power Supply
SMS	Short Message Services
SMT	Surface Mount Technology
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
SOA	Service Oriented Architecture
SRAM	Static Random Access Memory
Sun-RPC	Sun Remote Procedure Call
TB	Terabyte
TCP	Transmission Control Protocol

TDD	Total Demand Distortion
TFT	Thin-film Transistor
THD	Total Harmonic Distortion
THQ	Total Hour in Quarter
ToD	Time of Day
ToU	Time of Use
TS	Technical Specification
UDP	User Datagram Protocol
UG	Under Ground
UI	Unscheduled Interchange
UPS	Uninterruptible Power Supply
USB	Universal Serial Bus
UV	Ultra Violate
VDU	Visual Display Unit
VEE	Validation, Estimation & Editing
VIP	Virtual Internet Protocol
VoIP	Voice over Internet Protocol
VRLA	Valve Regulated Lead Acid
VSAT	Very Small Aperture Terminal
WAN	Wide Area Network
XML	Extensible Markup Language

Section 1

Introduction, Scope of Work and General Requirements

1. Introduction, Scope of Work and General Requirements

1.1 Detailed Scope of Work

APDCL intend to award the work for the duration of 5 years on SAAS (System as a Service) Basis which includes:

I. AMR of Feeders, boundary meters & Consumers: The objective is to implement an AMR system with 4G intelligent GPRS based modems including communication devices, data acquisition, analysis, and reporting system in respect of feeder meters, boundary meters and HT consumer meters. Category of meters (DLMS and non DLMS) wherein modems are to be installed are:

- (1) All 33 kV feeders
- (2) All 11 kV feeder
- (3) 33 kV & 11 kV boundary meters ¹
- (4) Selected HT consumers across APDCL

¹ Boundary meters are installed at the periphery of a defined project area, usually RAPDRP or IPDS towns, to measure the net input energy in the project area. (By subtracting the input energy recorded in the boundary meter from that of the original feeder in which the boundary meter is installed)

II. Annual Maintenance Contract of all the modems, network connectivity, peripheral devices as implemented on feeders, boundary meter and consumers meters as listed in the above point along with necessary software system hosted in cloud, post operational acceptance of the entire system by APDCL, shall be under the scope of the bidder. It shall be in the scope of the bidder to manage and perform all the necessary function/ activities required to meet the desired SLA.

Summary of Scope of Works

- I. AMR for consumers include supply, installation and commissioning of Modems, periodic data acquisition through AMR and report generation for feeder meters, boundary meters and consumer meters. The Protocol of the Meters shall be provided to the selected bidder by the Designated Officer of T&C wing of the respective APDCL Circles.
- II. The communication technology used shall be 4G GPRS. However, the AMR system shall function with any future communicational technology upgrades e.g. 4G to 5G at no extra cost on the part of APDCL.
- III. Supply/replacement of meter/CT/PT for commissioning of AMR system shall be under the scope of APDCL. The selected bidder shall arrange for necessary equipment and peripheral devices for installation of modems in the concerned meters (both DLMS and non DLMS) and commission the AMR system.
- IV. Common AMR application shall collect the meter data from consumer meters in 15 minutes interval and feeder/boundary meters in one hour intervals. AMR solution should support strong user management, administrative area management (utility administrative hierarchy like Zone, Circle, Division, Subdivision etc.) and flexible tabular, graphical reporting module.
- V. The AMR system shall be integrated by the selected bidder with APDCL legacy IT systems.
- VI. Monthly submission of MIS reports shall be generated by the agency and submitted in the formats as decided by APDCL.
Project also includes maintenance of the AMR system along with communication system, hardware and software for a period of 5(five) years after operational

acceptance of the system by APDCL. During the maintenance period, the selected bidder shall be responsible for installation of new modems at new feeder, boundary meters /consumer meters along with establishment of end to end AMR system for the same. During the maintenance period the bidder has to maintain connectivity of all modems, generate necessary reports and adhere to the SLA parameters.

AMR implementation in Feeder, Boundary & Consumer Meters in APDCL

- APDCL has 33 kV feeders, 11 kV feeders, 33 kV & 11 kV feeder boundary meters and HT consumers across the state of Assam where AMR solution needs to be implemented.
- The selected bidder shall install modems on these meters along with all accessories and set up an AMR system. In case defective modems are replaced by new modems, the defective modems shall be handed over to APDCL by the selected bidder.
- The selected bidder shall arrange all the material required for installation including cable, lugs, housing of modems, fixing clamps etc.
- For effective project management, installation shall be done electrical circle wise. APDCL may define the priority regarding the circles wherein works shall be taken up by the selected bidder.
- Modems shall have three phase supply, so that the same can work in availability of any one or more phase. SIMs shall be installed by the selected bidder and connectivity with the central server hosted on cloud infrastructure shall be ensured by the contractor. Bidder shall select appropriate methodology (pull or push etc.) for data collection from meters.
- MDAS (Meter Data Acquisition System)& MDM (Meter Data Management) & Analytics: The bidder shall design, develop and implement the required web based software solution for data acquisition, data aggregation ,data storage in common format ,data dissemination, data display on responsive websites ,data analysis and depiction in form of dashboards, graphs and MIS reports , provision for automated SMS alerts and email. APDCL shall provide the SMS gateway for exchange of messages.
- Alert mechanism: Provision for automated SMS alerts and email shall be ensured by the bidder. The alerts shall be sent directly to respective area in-charge as specified by APDCL.
- Integration with APDCL's legacy IT systems shall be implemented by the selected bidder.

Special Cases/Condition

The selected bidder shall have to ensure cooperation with APDCL and cohesive efficiency to ensure smooth operation during implementation as well as maintenance period:

1. Feeder, Boundary & Consumer Meter/AMR: For feeders, boundary locations and consumers where modems are installed, in case of activities like meter replacement, meter burnt, release of new connection under the category specified in the scope, permanent disconnection, temporary disconnection etc. the selected bidder shall be responsible for reconnecting the modem and re-establishing the AMR system. For existing consumers the selected bidder shall be provided with meter seals for sealing the consumer meters at site and update the new seal numbers to APDCL in requisite format.

2. The following parameters (minimum but not limited to) shall have to be transmitted by

the modem to the cloud based HES/MDMS system:

kWh(I), kVArh_Ig, kVArh_Id, kVAh(I), PFA, kWh(E), kVAh(E), TOD1 kWh(I), TOD1 kVAh(I), TOD1 kWh(E), TOD1 kVAh(E), TOD2 kWh(I), TOD2 kVAh(I), TOD2 kWh(E), TOD2 kVAh(E), TOD3 kWh(I), TOD3 kVAh(I), TOD3 kWh(E), TOD3 kVAh(E), MD Occurrence Date, MD kW(I), MD Occurrence Date, MD kVA(I), MD Occurrence Date, kW(E), MD Occurrence Date, MD kVA(E), TOD1 MD Occurrence Date, TOD1 MD kW(I), TOD1 MD Occurrence Date, TOD1 MD kVA(I), TOD1 MD Occurrence Date, TOD1 MD kW(E), TOD1 MD Occurrence Date, TOD1 MD kVA(E), TOD2 MD Occurrence Date, TOD2 MD kW(I), TOD2 MD Occurrence Date, TOD2 MD kVA(I), TOD2 MD Occurrence Date, TOD2 MD kW(E), TOD2 MD Occurrence Date, TOD2 MD kVA(E), TOD3 MD Occurrence Date, TOD3 MD kW(I), TOD3 MD Occurrence Date, TOD3 MD kVA(I), TOD3 MD Occurrence Date, TOD3 MD kW(E), TOD3 MD Occurrence Date, TOD3 MD kVA(E)

1.2 Work Methodology

The minimum number of feeder meters, boundary meters and consumer meters have been mentioned in Appendix-C. However, this number may change at the time of award of the contract.

- 1) Initial Study: The selected bidder shall survey the existing system for better understanding of the present status of the meters. During the survey, if any meter is found to be non compliant with the modems to be installed, then the same shall be informed to APDCL by the selected bidder. The survey shall also be aimed at planning the required shutdowns.
 - a) All required parameters related to LT/HT consumer meters as well as feeder/boundary meters shall be captured by contractor during survey.
 - b) During survey, the bidder shall ascertain the GPRS signal strength in all areas in order to determine the appropriate service provider to be used in the said locations.
- 2) Implementation of the project: After completion of the above mentioned survey, the following activities shall be taken up by the selected bidder:
 - a) The selected bidder shall install and commission the Head End System, Meter Data Management System and the IT Help Desk in cloud environment. The above mentioned applications shall be integrated with APDCL's legacy IT systems by the selected bidder.
 - b) The bidder shall install modems at feeder, boundary and HT consumer meters. This activity shall also include any other consumables/ hardware (including cable, lugs, housing of modems, fixing clamps etc.) required for installation of the modems. The installed modems shall be integrated by the bidder with the cloud based HES, MDMS and Web applications and in turn to APDCL's legacy IT systems.
 - c) SIM cards & its monthly recurring charges as well as cloud hosting charges shall be the responsibility of the contractor during the implementation period. However, during the maintenance period, SIM card charges as well as cloud hosting charges shall be borne by APDCL in accordance with the amount quoted by the selected bidder.

1.3 Head End System

The main objective of Head End System (HES) is to acquire data from different end points and monitor them automatically from remote. The contractor shall provide the HES suitable to support the collection and storage interval data for **30000** end points with 100% future expansion in the project area. Scalability feature shall be there to cover more areas through procurement of additional licenses.

Head End System is the core application for interface to the end points. The HES shall perform following functions:

- Acquisition of end point data on demand & at user selectable periodicity
- AMR communication with nodes/end points
- Audit trail and Event & Alarm Logging
- Encryption of data for secure communication
- Store raw data for defined duration
- Handling of Control signals/event messages on priority.

Configuration

HES shall facilitate programming of following meter parameters:

- Load profile capture period
- Demand integration period
- Setting of parameters for time of day (TOD/TOU) billing
- Billing date
- Clock setting
- Lock out period for relay
- Remote firmware upgrade
- Password setting
- Push schedule
- Setting threshold limits for monitored parameters
- Provision for adding more programming features in future
- The retry attempts for meter data acquisition shall be configurable globally or individually for a meter.

Communication

- HES shall communicate with modems using GPRS technology
- HES shall automatically retry for missed data; the number of retry attempts shall be configurable.

- To receive confirmation on successful execution of a command.
- HES shall ensure data integrity checks, for example, checksum, time check, pulse, overflow, etc. on all metered data.

Monitoring and Reporting Capability

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

Critical Reporting

- HES shall have alarms and event log for node's (meter) events (tamper/power failures etc.)
- If data not received from nodes/end points

Non Critical Reporting

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

- Communication link failure with nodes/end points
- Network Failure
- Retry attempts
- Missed periodic reading

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

Integration

HES shall preferably interface with MDMS on standard interfaces and the data exchange models and interfaces shall comply with CIM / XML / IEC 61968. The solution shall be Service Oriented Architecture (SOA) enabled.

Others

- HES shall be developed on open platform based on distributed architecture for scalability without degradation of the performance.
- HES shall support storage of raw meter data, alarms and alerts for minimum 45 (Forty five) days.

1.4 Meter Data Management System (MDMS)

The Meter Data Management System should support storage, archiving, retrieval & analysis of meter data and various other MIS (Management Information system) along with validation & verification algorithms. It shall act as a central data repository. MDM shall have capability to import raw or validated data in defined formats and export the processed and validated data to

various other systems and services in the agreed format. It shall provide validated data for upstream systems such as billing, customer care etc. The vendor shall specify and deliver an initial system that supports the collection and storage of 15 minute interval data for 30000 nos. of meters with 100% future expansion. Scalability feature shall be there to cover more meters through procurement of additional licenses.

The MDMS shall have the ability to selectively choose which data to be maintained and which to be purged or archived.

MDMS shall be developed on open platform based on distributed architecture for scalability without degradation of the performance.

Functional Requirements

Asset Management

- The MDM shall maintain information and relationships between the current installed meter location (apartment, shop, industry etc.), Consumer information (Name/ address etc.), Consumer account no, Meter ID, Type of Meter, with/without net-metering capability, Meter configuration etc.
- The software shall support tracking the status of meters and communication equipment after installation in the field. The history of the in-service asset location is maintained throughout the device life with start and end dates associated with each in-service location reference.
- Ability to report and log any damage / deterioration in the meter attributable to consumer/utility.

AMR Installation Support

- The MDM shall generate exceptions for meters not delivering the correct meter data after installation.
- The MDM shall provide a reconciliation report that identifies the meters that have been installed but not communicating for a designated (configurable) period. MDM shall generate reports on the number of meters installed in comparison to the number of meters successfully communicating.

Meter Data

The MDM shall be able for:

- Accept input data, process, store, and analyze meter data from HES and meter data collected through hand held meter reading instruments and manual meter reads. In case of manual reads, provision should be there to insert associated notes like assessed energy, etc.
- Provide storage of all collected meter data, events and alarm. It shall have capacity of storing 10 years data.
- Correctly track & resolve energy usage across meter changes with no loss of individual

meter data.

- Provide complete history and audit trail for all data collected from meters for 30 days (configurable period).
- Execute on-demand read processes.
- Handle special metering configurations like net metering/multiple meters at same premises.
- Ability to manage a minimum 15 minute interval data.
- Ensure data integrity checks on all metered data received from data collection systems.

Data Validation, Estimation, and Editing (VEE)

- The validation and estimation of metered data shall be based on standard estimation methods.
- MDM shall flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in the cumulative ("CUM") register reads
 - o CUM Decrements within a billing cycle(except net-metering)
 - o CUM reads increments more than configurable threshold
 - o Future or old read dates
 - o Number of digits exceeds number of meter dials
- MDM shall detect, flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in Time of Use (TOU) register reads
 - o Register decrements(except net-metering)
 - o Resets (to zero) (except net-metering)
 - o CUM reads increments more than configurable threshold
 - o Future or old read dates
 - o Erratic compared to CUM read (sum of TOU reads minus CUM read)
- MDM shall detect, flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in Demand register reads
 - o Do not reset on cycle
 - o Do not reset with customer move-out or move-in
 - o Reset off cycle inappropriately
 - o Too high
- All data shall be transferred to billing system after meter data validation and estimation including transformer / feeder station wise energy audit.

- The MDM shall maintain both the original received raw data in a non-manipulated state, in addition to VEE data.
- Notwithstanding the latency of data collection via the AMR system, once the MDM receives meter read data, the VEE process occurs in real-time and the post-VEE data is then immediately available to user or external systems.
- The MDM shall be able to automatically flag data changes from manual edits, VEE rules and data source corrections and electronically generate audit trail with timestamps and user-ids.

Billing Determinants Calculations

The MDM

- Shall allow configuring multiple TOU/TOD options (e.g. the number and duration of TOU rate periods) by customer type, tariffs and day type (weekend, weekdays, and holidays) and by season.
- Shall support the processing of interval data into billing determinants. Electric billing determinants to include the following at a minimum, but not limited to:
 - o Total Consumption
 - o Consumption in different time blocks for ToU billing
 - o Maximum Demand (in kW and kVA)
 - o On-Peak Demand
 - o Number of tamper count
 - o Average power factor
- Shall process interval data and frame it into the appropriate TOU periods for consumption and demand; for example, roll up 15 minute data intervals into hourly data.
- Shall have the ability to properly account for special metering situations such as check metering, sub metering, prepaid metering and net metering when calculating billing determinants and sending them to billing and other systems.
- Shall have the ability to properly account for special situations including, but not limited to, curtailment requests, demand response scenarios when calculating billing determinants and sending them to billing software.

Exception Management

- Ability to capture and log data exceptions, problems & failures and to generate management reports, provide trend analysis, automate generation of service requests and track corrective actions.
- Ability to group, prioritize, filter and send system generated alarms and events to

predetermined email addresses, cellular text messages to phone numbers.

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

Service Orders

The MDM shall generate service orders based on configurable rules for various events and alarms such as stop meter, tampers, problem in communication networks, AMR host server, etc. MDM shall send service orders via SMS, email, etc. with the email addresses / phone numbers which should be configurable. MDM shall receive feedback on action taken on the service order and track the status of service orders.

Customer Service Support

The solution shall provide customers with access to current and historical consumption and interval data, outage flags, voltage and power quality indications. The data shall be displayed in graphical and tabular form depending on user choice. The Customer may also access data through customer portal/mobile app. The solution shall integrate in the user friendly graphical interface.

Analysis

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

- Display consumption/load profiles by configurable period (15 min, hour, day, month, year etc.) day type (weekday, weekend, holiday, festival wise etc.) and by rate tariff, customer type, or any user specified group of meters.
- Generate peak & off-peak load patterns by aggregating all loads of DT/Feeder/consumer group.
- Perform DT/feeder wise energy audit.
- Perform load analysis for different groups and categories of consumers.
- Perform error management like: Missed reads and intermittent meter reads before taking into forecasting, load research or demand response
- Ability to configure the system to effectively visualize consumption trends, identify unusual patterns and visualize load analysis to understand which assets are being over utilized.

- Analyzing data to identify patterns of usage, setting fraud alert/transformer overload alerts/demand – supply gap alert etc.
- Ability to receive & store outage and restoration event data from meters and outage systems and to log all such events for analysis.

Reporting

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

- Usage exceptions
- VEE validation failures
- Missing read date and times
- Physical meter events (install, remove)
- Meter flags
- Meter inventory
- Defective meters
- AMR performance measurements
- Threshold Exception

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

- The MDM shall enable the Utility to deliver reports in standard digital format such as PDF, Excel, Word, txt, csv etc.
- Ability for GUI to set up or change report delivery to configurable email addresses, network file directories, ftp sites or printer systems without modifying source program code and without any proprietary language skills.
- All queries shall be generated through user driven drop down menu in GUI (Graphical User Interface). The Bidder shall provide example queries to support internal report generation needs.
- Ability to provide daily & weekly interface exception reports between MDM and other subsystems e.g. billing, outage etc.

Revenue Protection Support

- Ability to analyze meter tampering flags, power outages, usage trends and usage profiles to identify potential energy diversion situations and produce daily reports, monthly reports and service order requests for investigation.
- The business rules for revenue protection alerts shall be configurable via a user-friendly interface.

- The MDM shall filter out revenue protection alerts that may be caused by field activities if the field activity information is provided to the MDM.
- The MDM shall support the analytics/investigation (i.e. view current and historical usage patterns) to valid suspected revenue protection issues.

Additional Features for Net-Metering

Additional features for Net-Metering as given below:

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

- o CUM decrements of forward energy within a billing cycle
- o Register decrements for Time of Use (ToU) of forward energy
- o Power generated(exported) by any net-metering consumer more than the installed capacity of solar PV rooftop system
- o Energy exported(exported) in any given day by any net-metering consumer more than the programmable threshold value

User Interface

User interface for utility shall have ability for at least the following functionality:

- Enable the user to see how adjusting load or consumption levels or shifting them to different time periods influences costs.
- Display meter data at a user defined configurable cycle through a GUI that allows authorized users to view energy usage patterns and the data behind them for selected customers.
- Allow authorized users to view metered data, initiate and view reports, modify configurations, and initiate and update service requests via a GUI.
- Display via a GUI the energy usage profile for a single meter or group of meters. The load profile shall illustrate energy consumption and peak demand in user defined intervals for a user-specified time period.
- Display via a GUI the energy usage profile for a single meter or group of meters according to Time of Use (ToU) tariff.
- Access to a minimum of 5 years of historical energy usage and meter reads through the GUI.
- GUI to clearly and visually distinguish between metered, estimated data.
- GUI to provide role-based access based on user identity and user role. Shall have following types of users:

- o Administrator
- o Operator
- o Field staff
- o Viewer/Guest
- Configure the look, feel, and functionality of the MDM in accordance with business needs, business processes, and business conventions. (e.g. GUI, content, look and feel of screens, validation rules, exception handling, etc.).
- Ability for utility through user interface to set up alarm and event notifications that can be directed to a combination of configurable email addresses, cellular text messages or phone numbers.

Analytics

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

- Display consumption/load profiles of each meter by configurable period (15 min, hour, day, month, year etc.) day type (weekday, weekend, holiday, special day, festival etc.) and by rate tariff, customer type (hospitals, schools, movie theaters, commercial, residential, etc)/consumer category, or any user specified group of meters.
- Generate peak & off-peak load patterns by aggregating all loads of feeder/distribution transformer/consumer group for configurable period (15 min, hour, day, month, year etc.) day type (weekday, weekend, holiday, special day, festival etc.) and by rate tariff, customer type, or any user specified group of meters.
- Perform distribution transformer/feeder wise near real time energy audit.
- Perform load analysis for different groups and categories of consumers.
- Perform error management like: Missed reads and intermittent meter reads before taking into forecasting, load research or demand response
- Ability to configure the system to effectively visualize consumption trends, identify unusual patterns and visualize load analysis to understand which assets are being over utilized.
- Identify & visualize poor performing assets like feeder/distribution transformer on multiple criteria like energy losses, collection losses, billing losses, outage duration etc. and generates appropriate colour coding (lines with losses above threshold criteria with red colour, medium losses with light red colour and permissible losses with green colour)
- Analyzing data to identify patterns of usage, setting fraud alert / transformer overload alerts / demand – supply gap alert etc.
- Ability to receive & store outage and restoration event data from meters and to log all

such events for analysis.

- Analyzing data of net-metering consumers to identify patterns of export energy on hourly/weekly/monthly/yearly basis. Suggest list of mostly likely consumers who will back feed energy to grid.

Reporting

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

- Usage exceptions
- VEE validation failures
- Missing interval read date and times on hourly, daily, weekly and monthly basis for individual meter as well as collectively for all the meters
- Physical meter events (install, remove)
- Meter flags
- Meter inventory
- Defective meters
- AMR performance measurements
- Threshold Exception

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

- The MDM shall enable the Utility to deliver reports in standard digital format such as PDF, Excel, Word, txt, csv etc.
- Ability for GUI to set up or change report delivery to configurable email addresses, network file directories, ftp sites or printer systems without modifying source program code and without any proprietary language skills.
- All queries shall be generated through user driven drop down menu in GUI. The Bidder shall provide example queries to support internal report generation needs.
- Ability to provide daily & weekly interface exception reports between MDM and other subsystems e.g. billing, outage, etc.

1.5 Centralised IT Helpdesk

A standardized IT Helpdesk shall be developed & maintained by the Contractor containing full details of each issues, actions taken to correct the problem, applicable Severity level, time of reporting to the contractor support engineer/support, allowed Response time as per the Response times defined in above section, actual Resolution time etc. All tickets related to problems will be raised by APDCL in this IT Helpdesk.

1.6 General Requirement

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

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

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

Bidder may provide all applications in one suite or multiple modules to meet all the technical Specification requirements.

The bidder's proposal shall clearly identify all features described in the specifications.

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

The offered items shall be designed to operate in varying environments. Adequate measures shall be taken to provide protection against contaminants, pollutants, rain water & moisture, lightning & short circuit, vibration and electro-magnetic interference etc.

The Bidders shall demonstrate a specified level of performance of the offered items during well- structured factory and field tests.

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

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

Although all precautions have been taken to prepare this specification, the detailed specifications may have contradictory provisions or redundant provisions at different clauses. In such cases the specifications clause, which is beneficial to APDCL, shall be considered for the interpretation.

1.7. Reporting Requirements

MIS reports shall have to be generated by the AMR system on the following topics (minimum but not limited to), formats of the same shall be intimated to the selected bidder by APDCL

1. Feeder / Consumer meter analysis reports
2. No Load and Black Out Reports
3. Power factor profile
4. Load Utilization Report
5. Energy Comparison
6. Feeder / Consumer Wise Consumption Pattern
7. Consumption Comparison
8. Tamper Event

1.8 Contractor's Responsibilities and Obligations

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

- (1) Provide a working system (go-live) that meets the functional and performance requirements of this specification.
- (2) Engineering and design, specific to location including review and conformance with local environment especially with respect to communication.
- (3) Development of installation, commissioning and safety guidelines and procedures for the complete system.
- (4) Project management, project scheduling, including monthly project reports documenting progress during the contract period.
- (5) Coordination with APDCLs staff, consultant and other Contractors (R-APDRP/other scheme) for phased implementation and system integration, testing & commissioning of the overall project
- (6) Engineering and technical assistance during the contract period
- (7) Site visits and necessary studies to identify and provide all equipment needed to implement the project especially the need for measuring appropriate signal strength for communication network.
- (8) Supply, installation and termination of all wires/cables for fully functional system.
- (9) Factory and site acceptance testing of all items including hardware, software & firmware provided.
- (10) Conduct type tests or provide documented evidence of type testing APDCL as sought in specifications.
- (11) Provide a Quality Assurance Plan ensuring APDCL access to the manufacturing process.
- (12) Shipment of all equipment and documentation to APDCL designated locations and/or staging areas.
- (13) Storing, staging, maintenance and security of the staging area up to the operational

acceptance including the full responsibility for protection from fire, natural hazards, theft etc.

- (14) Installation, testing & commissioning of all equipment / software/ systems provided under the project.
- (15) Integration of the implemented system with legacy IT systems of APDCL, maintained either by APDCL or third party vendors.
- (16) Providing Mobile app (Android/IOS) for APDCL through google play store/Apple app store for APDCL users in order to access selected features of the MDMS system
- (17) All hardware, software and firmware required to satisfy the requirements of this Specification.
- (18) Submission of all documentation and drawings as specified.
- (19) All required maintenance aids.
- (20) Maintenance and support of the items during implementation and maintenance throughout the AMC period.
- (21) Hardware, software and firmware maintenance, debugging, and support of the equipment during final acceptance, and maintenance of all new equipment through the warranty period.
- (22) Due diligence in properly planning and executing the work so as to minimise inconvenience to consumer and ensuring there is no physical damage to end customer property.
- (23) The Contractor shall appoint key personnel for the project such as Project Manager, Design Engineer, Site Manager as well as installation, testing and commissioning engineer and informed the employer.
- (24) Availability of service and maintenance for the entire AMR system for a maintenance period of 5 (five) years from the date of operational acceptance
- (25) Operation of the system during first year of maintenance.
- (26) Notification services for field updates to the hardware, software and firmware.
- (27) Removal of existing modems and handing over to utility
- (28) Providing training to Employer's manpower
- (29) Attend progress review meeting
- (30) Facilitate employer visit for testing & training requirements
- (31) Evaluation of project
- (32) Installation of modems at new feeder/boundary/consumer HT meters to be installed in future and establishing the complete AMR system till maintenance period.

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

1.9 APDCL's Responsibilities and Obligations

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

- (1) Review and approval of the Contractor's designs, drawings, survey reports and recommendations.
- (2) Review and approval of test procedures.
- (3) Participation in and approval of "Type", factory and site acceptance tests.
- (4) Review and approval of training plans & reading material
- (5) Providing support and access to facilities at the sites.
- (6) Arranging necessary shutdowns and work permits.
- (7) Obtaining requisite statutory clearances and/or approvals as required to be taken by Employer for project work.
- (8) Overall project management
- (9) Organise project review meetings
- (10) Provide equipment storage space
- (11) All required documents for delivery of material at site

1.10 Applicable Standards

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

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

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

Section 2

Technical Specifications for Modems

2. MINIMUM TECHNICAL SPECIFICATION OF MODEM

2.1 Modem Specifications:

The modem shall be suitable for communication with electronic energy meter. The modem shall be used for remote meter reading of electronic energy meters via GPRS infrastructure.

Various features of intelligent GPRS modem are described as below:

- a) Power Supply Section: The modem shall have three phase AC input supply and should be capable of proper functioning within the power supply range of 90V to 440V AC, 50 Hz. Withstanding capacity against surges should be up to 6 KV.
- b) Communication Interface: The RS-232 output shall be provided on a 9-pin D type connector for connection to electronic energy meter's optical/ serial communication port through suitable communication cable. Communication to external world shall be via GPRS.
- c) GPRS Section:
 - i. The modem shall operate in Dual Band GSM 900/1800MHz.
 - ii. The modem shall be compliant with ETSI Phase 2 Standard. Class4 (2W) @ 900 MHz and Class 1 (1W) @1800 MHz.
 - iii. Circuit switch data transmission rate up to 14.4 Kbit/Sec.
 - iv. GPRS class B and Multi slot class 10 support
 - v. Packet Channel Support: PBCCH
 - vi. Coding Schemes: CS1 to CS4
- d) RF section: SMA (F) interface shall be provided on the enclosure for Antenna connection. Gain of Antenna should be of 5 dbi.
- e) SIM Card Section: The SIM Card shall support 4G communication and it shall be compatible with 5G communication also. For placing the SIM Card, a SIM card holder shall be provided on the modem and shall be accessible from outside without opening the modem enclosure. The SIM Card supported shall be of 3V Interface. SIM card holder shall be provided with suitable sealing provision on the device cover.
- f) Network Identification Section: The modem shall perform auto network registration at power up. Three different colored LEDs shall be provided on the modem which shall depict the current functioning status.
 - i. Power / Network Registration / Signal strength - RED colour
 - ii. Data transfer between Meter and Modem - Yellow colour
 - iii. Data transfer on GSM / GPRS - Green Colour
- g) IS/IEC Specifications: The modem shall meet the following IS/IEC specifications:

Impulse voltage test	IEC61000-4-5(95-03)
AC voltage test	IS13779:1999
Insulation resistance test	IS13779:1999
Electrostatic Discharge (ESD)	IEC61000-4-2(1995-02)
Electromagnetic radiated HF susceptibility	IEC61000-4-3(1995-02)
Fast transient Burst test	IEC61000-4-4(1995-02)
Radio Interface Measurement (CS)	IS6842
Surge Immunity test	IEC61000-4-6
Dry Heat Test	IS-13779:1999
Cold Test	IS-13779:1999
Damp Heat Cyclic Test	IS-13779:1999
Vibration test	IS-13779:1999
Shock test	IS-13779:1999
Spring Hammer test	IS-13779:1999

- h) Environmental specifications:
 - i. Operating temperature range: storage Temperature: -40 degrees to +85 degree Celsius, Operating Temperature: -25 degrees to +75 degree Celsius
 - ii. Humidity :- 95% RH (non –condensing)
- i) Mechanical Specifications:
 - i. Mounting Arrangement: A suitable wall mounting arrangement shall be provided.
 - ii. The modem shall comply with IP55 rating.
 - iii. Sealing Arrangement: The base and top cover shall have a suitable sealing arrangement
 - iv. The modem shall be housed in an enclosure of engineering plastic.
- j) Memory: The modem shall have minimum memory of 256 KB.

k) Functional specifications:

- i. The modem should be an intelligent device and capable of providing the all necessary functionalities on GSM/ GPRS network with suitable AMR Software.
- ii. The modem shall establish the communication channel between meter and Central station software for data transfer.
- iii. It shall be possible to configure the modem to work with any make of meter in transparent mode.
- iv. The modem shall support M2M SIM (13 digit numbers). M2M communication shall be established in compliance to Department of Telecommunication, Government of India's advisory/circular vide no 800-09/2010-VAS-III, dated 16.05.2018 or any amendment of the same published thereafter.
- v. It shall be possible to configure the modem for communication media (GPRS), Baud rate, and GPRS settings (i.e. APN number, user name and password)
- vi. Modem shall not use transparent data transmission but shall have built in intelligent software to poll the meter locally and send the same.
- vii. Modem shall send SMS on different conditions like Power ON, Power OFF, Tamperers etc. as configured by APDCL.

2.2 Type tests

The GPRS modem shall be fully type tested from any Govt. Approved NABL accredited test laboratories viz. ERTL, NPL etc. as per relevant standards. The Type test reports shall not be more than two years old from the date of publishing of this bid and a copy of the same shall have to be submitted by the bidder along with the technical bid.

2.3 Guaranteed Technical Particulars for GPRS modem

Sl. No.	Item	Compliance (YES/NO)
1	Operating Band – Dual Band EGSM 900/1800 MHz	
2	GPRS class B and Multislot class 10 support	
3	Interface with electronic energy meter – RS232 D type 9F connector	
4	Dual band external antenna of 5 dBi gain with SMA connector	
5	Three phase power supply input (90 V to 440 Volts AC, 50 Hz)	
6	Surge withstand capacity: 6 kV	
7	Enclosure material – Engineering plastic	
8	Sealing – The modem base and top cover shall have suitable arrangement for sealing.	
9	Modem should be provided with three different coloured LED's indicating its functioning status; LED's should be visible externally.	
10	SIM card holder – to be accessible from outside without opening the modem enclosure	
11	Internal Memory – 256 KB	
12	IP-55	
13	SMS on power off, power on and tamper conditions (configurable)	

The compliance of the above mentioned GTP shall have to be submitted by the bidder along with the technical bid.

2.4 Data Communication from modems

The Meter data communication to the cloud based HES/MDMS shall be GPRS based. Communication system shall meet following requirements:

- i) All communication between Intelligent Modem and cloud based HES/MDMS shall be through operator independent secured Virtual Private Network (VPN) tunnel which shall be managed centrally between each Intelligent Modem and the cloud based HES/MDMS.
- ii) Transfer of data from Intelligent Modem to cloud based HES/MDMS shall be on TCP/IP over GPRS.
- iii) For communication with cloud based HES/MDMS, each Intelligent Modem shall transfer the data to cloud based HES/MDMS using TCP socket communication/FTP. In both cases there shall be no mandatory requirement to assign static IPs to the GPRS Modems.
- iv) The GPRS Intelligent Modem shall be able to run the Meter protocol driver locally to read each type of meter and transfer the data over the secure VPN channel in readable format to the cloud based HES/MDMS.
- v) Intelligent Modem shall be of Dual Band capable of operating at 900 and 1800 MHz. Modem shall support both Data and SMS transmission. It shall have both GSM (Global System for Mobile Communication) and GPRS/EDGE (Enhanced Data Global Evolution) features.
- vi) The Intelligent Modem shall have internal power backup through battery or super-capacitor so that it can report power outage and restoration as an event.

Section 3

System Integration

3. System Integration

The AMR system established by the bidder shall be integrated with APDCL's IT systems mentioned in Appendix-A. 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, over Open XML Models defined by CIM/ XML.

Data exchange between IT system and AMR system 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.

The desired system integration points between AMR system and APDCL's IT system is given below-

- a) Exchange of billing determinants at predefined intervals with Metering/Billing/Collection module for implementation of billing.
- b) Synchronization of master data, new service connection as well as change request implementation by data exchange with CRM system.
- c) Exchanging consumer billing data, consumption pattern and any other required parameters for display in APDCL portal.
- d) Implementation of Single Sign-in via APDCL portal for unidirectional navigation to web based MDMS system to be developed under this project.
- e) Data exchange with centralized customer care of APDCL for enabling customer care agents to answer queries of concerned consumers.
- f) Integration with SAP ERP for synchronization of asset information, if necessary.
- g) Integration with GIS system for sharing of asset mapping and consumer location information, if necessary.

Section 4

Inspection Testing and Operational Acceptance

4. Inspection Testing and Operational Acceptance

4.1 General

All materials and parts of the system/sub-system to be supplied under the project shall be of current manufacturer and from a supplier regularly engaged in the production of such equipment.

4.2 Quality Assurance and Quality Control Program

The Contractor shall maintain a Quality Assurance/Quality Control (QA/QC) program that provides equipment, materials and services under this specification whether manufactured, designed or performed within the Contractor's plant 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 Contractor shall make objective evidence of quality conformance readily available to the Employer. Instructions and records for quality assurance shall be controlled and maintained at the system levels. The Contractor 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 the Employer.

Such QA/QC program shall be outlined by the Contractor and shall be finally accepted by Employer after discussions before the award of Contract. A Quality Assurance Program of the Contractor shall generally cover but not be limited to the following:

- a) The organization structure for the management and implementation of the proposed Quality Assurance Program.
- b) Documentation control system.
- c) Qualification data for key personnel.
- d) The procedure for purchase of materials, parts/components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases, etc.
- e) System for shop manufacturing including process controls.
- f) Control of non-conforming items and system for corrective action.
- g) Control of calibration and testing of measuring and testing equipment.
- H) Inspection and test procedure for manufacture.
- i) System for indication and appraisal of inspection status.
- J) System for quality audits.
- k) System for authorizing release of manufactured product to APDCL.
- 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 the Employer after incorporating necessary corrections by the Contractor 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 procedure shall be maintained by the Contractor for at least the duration of this Contract. The personnel performing QA/QC functions shall have well-defined responsibility, authority and organizational freedom to identify and evaluate quality problems and to initiate, recommend or provide solutions during all phases of the Contract. The Contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of Employer's inspection of equipment/materials.

4.3 Scope of Employer

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

The scope of the duties of the Employer, pursuant to the Contract, will include but not be limited to the following:

- a) Review of all the Contractor's drawings, engineering data etc.
- b) Witness or authorize his representative to witness process, 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
- 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.

4.4 Inspection Certificate

The Contractor shall give the Employer two weeks written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Employer, unless witnessing of the tests is waived, will attend such tests on the scheduled date for which Employer has been so notified or on a mutually agreed alternative date.

The Employer shall, within fourteen (14) days from the date of inspection as defined herein, give notice in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall make the modifications that may be necessary to meet said objections. When the factory tests have been completed

successfully at the Contractor's or Sub-contractor's works, the Employer shall issue a certificate to this effect within fourteen (14) days after completion of tests but if the tests are not witnessed by the Employer, the certificate shall be issued within fourteen (14) days of receipt of the Contractor's Test Certificate by the Employer. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection, be found not to comply with the Contract.

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

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

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

Record of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Employer's representative.

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

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

4.5 Inspection and Testing

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 Employer's satisfaction, and the equipment has been approved for shipment by Employer.

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

The test shall be considered complete when (a) all variances have been resolved and all variance report submitted (b) all the test records have been submitted (c) Employer acknowledges in writing the successful completion of the test.

4.5.1 Inspection

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

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

4.5.2 Test Plans & Procedures

Test plans for both factory and field tests shall be provided by the Contractor to ensure that each test is comprehensive and verifies all the features of the equipment are tested. The test plans for factory and field tests shall be submitted for Employer approval before the start of testing.

The contractor shall prepare detail testing procedure in line to specification and submit for Employer's approval. The procedure shall be modular to the extent possible, which shall facilitate the completion of the testing in the least possible time.

4.5.3 Test Records

The complete record of all factory and field acceptance tests results shall be maintained by the Contractor. The records shall be maintained in a logical form and shall contain all the relevant information. The test reports shall be signed by the testing engineer and the engineer witnessing the tests.

4.5.4 Reporting of variances

A variance report shall be prepared by either Employer or Contractor personnel each time a deviation from specification requirements is detected during inspection or testing. All such variances shall be resolved in mutually agreed manner including retesting.

However, at any stage if Employer 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.

4.5.5 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:

- a) Verification of all functional characteristics and requirements specified
- b) Inspection and verification of all construction, wiring, labelling, documentation and completeness of the hardware

Before the start of factory testing, the Contractor shall verify that all changes applicable to the equipment have been implemented. As a part of the factory tests, exploratory/contra testing shall be performed to allow Employer representatives to verify proper operation of the equipment under conditions not specifically tested in the above structured performance test. The Contractor's test representative shall be present and the Contractor's technical staff members shall be available for consultation with Employer personnel during exploratory/contra test periods. All special test facilities used during the structured performance test shall be made available for Employer's use during exploratory/contra testing.

4.5.5.1 Factory Test Requirements

The data base, web based user interface displays and the report formats developed by the contractor shall be demonstrated and verified by the employer before factory testing.

All equipment / system shall be tested and demonstrated for performance & compliance to the standards as per the approved factory test plan. The Employer will participate in and witness these tests.

The contractor shall also carry out testing of their standard protocol and interfaces for successful integration with existing system of employer before FAT starts. The database and the report formats developed by the contractor shall be verified by the employer before factory testing.

The control center redundant hardware and software architecture shall be staged and completely tested with simulated data at the Contractor's facility. The inspection clearance certificate for all hardware shall be issued only after successful completion of FAT as per specification. FAT shall be carried out at a subsystem or module level and shall consist of all the components of the system being supplied to the extent possible.

The employer shall witness all tests and will not accept un-witnessed test results. 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.

4.5.5.2 Functional Performance Test

The functional performance test shall verify all features specified in respective technical specifications of equipment/ systems along with hardware and software. As a minimum, the following items shall be included in the functional performance test:

- a. Simulation of field devices, communication link and their failures including incorrect check codes and random channel noise bursts
- c. Verifications communication errors, interface errors at AMR control center.
- d. Simulation of hardware and software failure to verify the redundancy requirements.

- e. Demonstration of all features of software functionalities as per Technical Specification.
- f. Verification of User Interface displays and reports

4.5.5.4 Integrated System Test

Integrated system test shall be performed after successful completion of functional performance test. During the integrated system test, all functions shall run concurrently and all Contractor supplied equipment shall operate for a continuous 100-hour period. This minimum level of activity during this period shall be as per the discretion of employer. 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 employer that the AMR system is free of improper interactions between software and hardware while the system is operating as an integrated unit.

4.5.5.5 Downtime

Downtime occurs whenever the criteria for successful operation defined in Section “Criteria for successful operation” 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.

4.5.8.3 Hold-Time

Certain contingencies may occur that are beyond the control of either employer or the Contractor. These contingencies may prevent successful operation of the system, but are not necessarily valid for the purpose of measuring system availability. Such periods of unsuccessful operation may be declared “hold-time” by mutual agreement of employer and the Contractor. Specific instances of hold-time contingencies are:

- a) Scheduled Shutdown: During scheduled shutdowns, or if an equipment failure occurs while its backup device is scheduled out-of-service, the resulting system outage shall be hold-time, provided that service can be restored according to Contractor specified procedures within 30 minutes.
- b) Power Interruption and Environmental Excursion: Loss of power or manual shutdown in the event of loss of environmental control shall be considered hold-time. If the system is operated during periods of power or environmental conditions beyond those specified, any resultant downtime shall also be considered hold-time.
- c) Intermittent Failure: Periods during which an intermittent, recurring software or hardware failure is experienced will be considered hold-time, provided that the Contractor is engaged in remedial action and normal functions can be restored by Contractor-defined procedures whenever the failure occurs. Instead of accounting for the actual intermittent downtime, one hour of downtime shall be counted for each 120 hours of otherwise successful operation while the problem persists.

- d) Failure of Employer's Software: Time during which the system is down due to failure of software written and independently produced by employer shall be considered hold-time. If a failure in such software cannot be overcome by Contractor- defined procedures, execution of the failed program will be suspended. Programs developed by employer personnel under Contractor supervision are specifically excluded from this provision.
- e) Service Response Time: A maximum four (4) hours of hold time will be allowed for the Contractor to respond to each call for maintenance support. The time between detection of a failure and the start of diagnostic procedures shall also be considered hold-time when performed by employer's personnel.
- f) Corrected Design Defect: Hold-time may be declared by mutual agreement to ensure against similar future occurrences if a failure occurs due to a defect in system design for which the Contractor defines and implements corrective measures. In such a case, hold-time shall be allowed in increments of 120 hours to allow verification of the corrective action.

4.6 Criteria for Successful Operation

The system shall be designed to meet the total system availability of 99%. That is, the ratio of total operational time minus downtime to total operational time shall be equal to or greater than 0.99. Total operational time shall not include the hold time. The system shall be considered available as long as all functions defined in earlier sections are available. Further each server and other control room device meets a minimum availability of 99% individually.

4.7 Contractor's Maintenance Responsibility till Operational Acceptance

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

Section 5

Project Management and Implementation Plan

5. Project Management and Implementation Plan

This section describes the project management and implementation plan for the project.

5.1 Project Management

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

5.2 Project Schedule

The bidder shall submit a preliminary project implementation schedule along with the bid. The detail project implementation schedule shall be submitted by the Contractor after award for Employer's approval, which shall include at least the following activities:

- (a) Site Survey
- (b) Documents, Data Requirement Sheet, Drawing submission and approval
- (d) Hardware purchases, development/manufacturing and integration
- (e) Dispatch Schedule
- (f) Receipt, Storage, Installation & Field update schedule
- (g) Factory & Site Testing Schedule
- (h) Training schedule
- (i) Field trial run schedule

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

5.3 Progress Report

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

5.4 Transmittals

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

5.5 Review Meeting

Progress meetings shall be scheduled by the employer and attended by the Contractor each reporting period to review progress of the project. Progress meetings shall be used to review the progress report, written correspondence exchanged since the last meeting, and open action items.

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

5.6 Document Review and Approval Rights

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

The Employer will respond with written comments to the Contractor within thirty (30) calendar days after receipt of the documents. Documents requiring correction must be resubmitted by the Contractor to the Employer within thirty (30) calendar days. The Employer will respond to resubmitted documents within fifteen (15) calendar days after receipt of the document. No implementation schedule relief is to be implied for documents requiring correction and resubmission to the Employer.

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

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

To help the Employer manage the review and approval of documents during any given period, the Contractor shall stagger the release of documents over the time allocated in the project schedule. The number and size of documents shall be factored into the document release schedule. At any time, no more than five (5) documents shall be submitted to the Employer for review and approval.

5.7 Project Schedule

5.7.1 Implementation Schedule

The implementation schedule for the project shall be **twelve (12) months** from the date of commencement, which shall be one month after the date of award.

The Contractor shall produce and maintain the implementation schedule. The overall project plan shall consist of a Milestone Plan and a detailed Schedule Plan.

The Contractor shall provide a critical path analysis report and a manpower resource analysis report. Other standard reports will be defined during the Work statement.

Within four (4) weeks of contract signing, the Contractor shall submit detailed project schedule, as described below. The project schedule shall include all activities to track overall direction and integration of the project from inception through completion.

The Schedule Plan shall be developed utilizing the concept of Work Breakdown Structures. No task shall be greater than three (3) weeks in duration.

The implementation schedule shall include the project milestones, the Contractor activities and the Employer activities. The project schedule shall be an accurate representation of the progress and planned activities of the project.

The actual progress made to date and the scheduled delivery date for the completed systems shall be closely monitored by both the Contractor and the Employer. The following information shall be reported to the Employer in a clear and concise manner using the tabular and graphic capabilities of the project management software:

- (a) An overview and general assessment of all the Employer and Contractor activities and any progress or delays in these activities since the last reporting period
- (b) Identification of tasks in the critical path together with an analysis indicating any required remedial action
- (c) The amount of contingency time (float) remaining in the schedule
- (d) Information on each task, including:
 - (1) Estimated start and finish dates
 - (2) Any change in the estimated dates since the last reporting period
 - (3) Estimated total number of calendar-days to complete the task
 - (4) Per cent of task completed
 - (5) An indication of whether the start date was manually entered or computed.
- (e) Total project resources
- (f) The tasks to begin in the next two reporting periods

- (g) The tasks to be completed in the next two reporting periods
- (h) The tasks completed in the last two reporting periods

The content and format of the project schedule shall be subject to the Employer approval. The Contractor shall update and submit the project schedule to the Employer at least one week prior to each progress review meeting.

5.7.2 Contractor Activities

The implementation schedule shall be compiled by the Contractor summarizing all activities, and shall include but not be limited to the following:

- (a) Survey, Design & Engineering
- (b) Hardware purchases, development, and integration
- © Hardware production schedules
- (d) Documentation preparation and release
- © Documentation revision and release following the Employer review
- (f) Software design, coding, unit testing, and integration
- (g) System integration
- (h) Type Tests and Factory testing
- (i) Shipment
- (j) Receipt, forwarding and staging
- (k) Installation & Commissioning
- (l) Site Acceptance testing
- (m) Field Trial runs

Each scheduled task shall have an estimated duration for completion and predefined relationships with other tasks. Relationships shall be used to enforce the logical progression of work in as much as certain tasks cannot start until others have been completed.

5.7.3 The Employer Activities

The implementation schedule shall contain all the Employer activities required in order for the Contractor to complete their systems and integration tasks, including the following:

- (a) Document reviews and approvals
- (b) Participation in all levels of testing and training
- (c) Any site preparations, if required.
- (d) Assistance in database, display and report definition
- (e) Participation in Installation & Commissioning

5.7.4 Documentation Schedule

The documentation schedule shall include an entry for each document and drawing to be delivered throughout the project. Each documentation schedule entry shall include the document or drawing title, number, revision level, actual or future submittal date for the Employer review or approval, date of completion of review or approval by the Employer, and outcome of review or approval by the Employer. When the Employer requires correction to any document, the documentation schedule shall be updated with a new entry for the next revision of the document. The content and format of the documentation schedule shall be subject to the Employer approval.

The documentation schedule shall allow for at least two submissions of each document requiring review or approval. The time schedule for document review or approval by the Employer shall be as specified in this section.

5.7.5 Training Schedule

The training schedule shall identify the dates & duration of all of the training courses. The Contractor shall work with the Employer to determine the training schedule. The training schedule shall be subject to the Employer approval. The training schedule shall accommodate the Constituent's availability of personnel in so much as it is possible.

5.7.6 Progress Reporting

With the intent to assure quality management and project progress as per the implementation schedule, progress reports submitted for each reporting period and Progress Review Meetings shall focus on the following:

5.7.6.1 Monthly Progress Reports

A Monthly Progress Report shall be prepared by the Project Manager to the contractor that includes inputs from all its subsystem. The report shall be made available to the Employer as hard copy and soft copy, by the 10th working day of each month and shall include but not be limited to:

- (a) Updated project schedule highlighting any deviations from the previous issue of the project schedule
- (b) Explanation and anticipated effect of each schedule deviation and its implication to the Employer.
- (c) Schedule recovery plan for any deviation incurring a delay in delivery date. (All delays shall be factored into the project schedule as soon as they are known to the Contractor.)
- (d) A summary of activities performed by the Contractor and the Employer during the previous reporting period
- (e) An updated list of all correspondence transmitted and received by the Contractor
- (f) Updated documentation schedule
- (g) Updated training schedule
- (h) List of all Contractor personnel and the Employer personnel resident at the Contractor facility, identifying all activities performed by each person and the

activities scheduled for the next two reporting periods

- (i) Updated list of Contractor and the Employer action items with status, description of required information, and required resolution dates
- (j) Summary of pending and upcoming Contractor and the Employer activities during the next two reporting periods along with required completion dates
- (k) Status of unresolved contract questions and change requests
- (l) Summary of variances
- (m) Log of invoice status
- (n) Description of current and anticipated project problems and steps to be taken to

Though not detailed, the above steps are intended to encompass all relevant work required to provide the Employer a fully working system supporting all Project commitments.

Section 6

Documentation and Deliverables

6. Documentation and Deliverable

6.1 General

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

6.2 Instructions

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

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

6.3 Hardware Documentation Requirements

The following document shall be submitted as applicable for the subsystem.

1. System description documents (Overview)
2. Data requirement sheets for all items
3. Functional description document
4. Database documents
5. Drawings/Documents for manufacturing/assembly of the equipment/system
6. Drawings/Documents for installation of the equipment/system at site
7. Software description/design documents for each module
8. Factory test procedure and report
9. Manuals for each equipment
10. System configuration parameter
11. Site testing procedure and report
12. Training documents

13. System administrator documents
14. User guide
15. Software licenses
16. Type test reports
17. Cable sizing calculations
18. Inventory of the hardware
19. General and internal arrangement drawing of panels indicating modules, components location etc.
20. Installation drawing
21. Schematic drawing

6.4 Software Documentation Requirements

The documents to be submitted shall include the following information:

6.4.1 Software Inventory

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

6.4.2 Functional Description

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

- a) Introduction describing the purpose of the function with references to other documentation to aid the reader's understanding of the functions performed.
- b) Performance requirements that describe the execution periodicity and the tuning parameters that control or limit the capabilities of the software.
- c) Complete description of the operation, data and logic interfaces with other functions.
- D) Sample displays where applicable.

6.4.3 Software Design

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

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

- b) Mathematical algorithms and formulae.
- c) Complete description of the algorithms, operation and the data and logic interfaces with other functions.
- d) Data dictionary in which the following (as applicable) information for each data item in tables, file, and array is provided: (1) Name (2) Purpose, (3) Location, (4) Length of data item, and (5) Initialization.
- e) Databases internal and external to the software, along with a description of all inputs required and the output produced by the software modules.
- f) Interfaces with other software modules.
- g) Design limitations such as field length and the maximum quantity of data items that can be processed.

6.4.4 Database Documentation

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

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

- a) The overall organization of input records
- b) The format of each data record
- c) Each data field and the valid entries pertaining to the fields.

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

6.4.5 User Documentation

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

- a) All user guidance and error messages, along with the steps necessary to recover from errors
- b) The user interface including displays and keyboard operations used to control, review the input and output produced by the function. All displays relevant to the function shall be included along with a description of each dynamic display field.
- c) Alarms and messages issued by the function and the conditions under which they are generated
- d) Procedures to be followed for computer system restarts, failures, and failovers.

6.5 Test Documentation

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

6.6 Training Documentation

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

Section 7

Maintenance and Support Services

7. Maintenance and Support Services

7.1 General

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

7.2 Maintenance Support

The period of maintenance support shall be for 5(five) years from the date of operational acceptance of the entire AMR system by APDCL. The period of maintenance support shall include replacement of all defective modems along with necessary hardware accessories. During first one year, commencing from Operational Acceptance of the entire AMR system by APDCL, operation of the entire system shall be under the scope of the contractor.

System availability requirements during the maintenance period shall be as described in the Table below:

Table 7-1: Maintenance support and availability requirements

S. No.	System	System Availability Requirements
1	Cloud Services in respect of HES/MDMS	99%
2	Data Availability at Individual modem level	95%

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

The maintenance of the System shall be comprehensive and shall comprise of the following category of works which is further elaborated for each of the different subsystems:

- a) Preventive Maintenance Activity (performance monitoring, system backup, hardware & software maintenance and update, emergency response and troubleshooting etc.)

- c) Integration of new meters and modems with the AMR system
- d) Maintaining HES/MDMS and any other applications hosted in cloud.
- e) GPRS SIM cards and liaising with concerned service providers.
- f) In case there is meter replacement/addition of meters, it shall be the contractor's responsibility to reinstall the modem in the new meter along with all necessary accessories like cable etc. The arrangement of all accessories like cables, lugs etc. shall be the contractor's responsibility.
- g) Maintaining adequate spares for maintenance.

7.3 Preventative Maintenance Activity

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

- Repair / replacement of defective equipment: The Contractor shall be responsible for repair/replacement of all the hardware. Defective modems shall be replaced within 3(three) days from the date of detection of defect.
- 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,
- Monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components.
- Providing all necessary assistance to Employer for addition and modification of database and user interface and Database sizing activities.
- Take Backup of the system at regular interval
- Restoration of the systems upon its failure and to restore the functioning of the various systems at the AMR Control Center hosted at cloud.

7.3.1 Hours of Cover

The Contractor shall provide sufficient numbers of engineers with experience and skill to maintain the system to the desired level of availability. The contractor's on site support for hardware/software shall be 24X7 throughout a year.

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

7.3.2 Service Response Requirements

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

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

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

7.4 Monitoring

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

7.4.1 Log Monitoring

- System logs for a selected day
- System history log

- Aggregate data collection

- Field Device failure

- Events collection

- Availability of communication link

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

7.4.2 Resource Monitoring

Resource Monitoring services comprise checking the system's major resources, gather log data, analyze results, and advise Employer on the appropriate actions to be taken and undertake any agreed upon actions. The contractor shall continuously study the following system generated 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 reports
- System error log

7.4.3 Cyber Security System Monitoring

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

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

7.5 Physical Maintenance

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

Equipment shutdown during preventive maintenance shall be deemed as available.

7.6 Problem/Defect Reporting

The bidder shall submit an appropriate problem/defect reporting procedure to meet the requirement of all severity levels to get the approval of the same from Employer. The problems will be categorized as defined in Table 7-2.

Table 7-2: Severity Levels

Category	Definition
Severity 1 – Urgent	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability

Severity 2 – Serious	Degradation of services or critical functions such as to negatively impact system operation. Failure of any redundant system component such that the normal redundancy is lost
Severity 3 – Minor	Any other system defect, failure, or unexpected operation
Severity 4 – General/Technical Help	Request for information, technical configuration assistance, “how to” guidance, and enhancement requests.

7.9Severity Levels

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

7.9.1 Severity-1(Urgent Support)

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

- Loss of data due to any problem in software /hardware.
- Loss of data due to any problem in communication network
- Outages of any application software.
- Cyber Security issues.
- Loss of data exchange with other computer systems of utility.

The failure of field devices shall be considered as Severity-1 level, however a maximum time of Organization and travelling time of 24 hrs shall be provided to rectify field defects.

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

7.9.2 Severity-2

The support services not defined under Severity-1 are included under this category. Coverage under this severity would be outages that do not immediately cause on line data loss but subsequently could result into Severity-1 category outage, loss of an important subsystem that may affect the day-to-day works and loss of archived data.

- Failure of Storage System, stoppage of data collections for archiving and outage of other applications not covered under severity-1 are included in this category.
- Failure of any redundant system component affecting the critical redundancy.
- Non-availability of designated contractor's Man-power at site as well as required inventory of spares specified here.

7.9.3 Severity-3 (Standard Support)

The support services included under this category are when the outage or loss of functionality is neither of an emergency nor priority functionalities as indicated in severity level 1 or 2 above..

7.9.4 Severity-4 (General Technical Help)

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

7.10 Response & Resolution Time

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

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

Table 7-3: Emergency Support Response/Resolution Time

Severity	Initial Response Time (Working Hours)	Initial Response Time (Non-Working Hours)	Action Resolution Time	Action
1	5 minutes	30 minutes	4 hours	An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored – may be by workaround.

2	5 minutes	2 Hours	24 Hours	Attempt to find a solution acceptable to Employer (dependent on reproducibility), as quickly as practical.
3	2 hours	1 day	2 days	Evaluation and action plan. Resolution time is dependent on reproducibility, ability to gather data, and Owner/ Employer's prioritization. Resolution may be by workaround.
4	2 hours	1 day	5 days	Report on the problem/query is to be furnished.

7.11 Availability and Maintenance Charges

The contractor shall provide guaranteed availability for various types of Systems as specified in **Table 7-1**. Availability calculation methodology for MDMS/HES application and data availability of field devices at control center shall be as below:

7.11.1 Availability of Centralised MDAS Software (Cloud)

The non-availability hours for availability calculation shall be counted from the end of the allowed Action Resolution time. A standardized IT Helpdesk shall be developed & maintained by the Contractor containing full details of each outages, actions taken to correct the problem, applicable Severity level, time of reporting to the contractor support engineer/support, allowed Response time as per the Response times defined in above section, actual Resolution time etc. All tickets related to problems will be raised by APDCL in this IT Helpdesk.

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

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

$$\text{Availability per quarter yearly} = (\text{THQ} - (\text{S1} \times 1 + \text{S2} \times 0.8 + \text{S3} \times 0.5) \times 100\%) / \text{THQ}$$

Where THQ is total hours in the quarter

S1 is the total non-available hours in Severity Level-1

S2 is the total non-available hours in Severity Level-2

S3 is the total non-available hours in Severity Level -3

7.11.2 Data Availability for field devices

Data availability of the field devices shall be taken from the MDM, where missing interval data

read report is prepared on hourly, daily, weekly and monthly basis. Each segment of missing interval data reads i.e hourly, daily, weekly and monthly, shall have equal weightage. Availability shall be calculated as below:

Availability per quarter yearly $= (D1 + D2 + D3 + D4) / 4$

Where

D1 is the total % data availability on hourly basis in a quarter

D2 is the total % data availability on daily basis in a quarter

D3 is the total % data availability on weekly basis in a quarter

D4 is the total % data availability on monthly basis in a quarter.

7.11.3 Payment of Maintenance Charges

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

For Centralised MDAS Software (Cloud):

Availability of MDMS/HES per quarter	Deduction as % of AMC / FMS (quarterly price)
> = 99%	NIL
Less than 99%	Deduction of 2% of the quarterly AMC / FMS charges for every 0.5% or part there of decrease in availability under 99%. The maximum deduction shall be limited to the 50% of the AMC/FMS charges to be paid for that quarter.

For Data Availability for field devices:

Availability of data for field devices	Deduction as % of the AMC/FMS (quarterly price)
Greater than or equal to average of data availability (95%)	NIL
Less than 95%	Deduction of 2% of the quarterly AMC / FMS charges for every 1% or part there of decrease in availability under 5%. The maximum deduction shall be limited to the 50% of the AMC/FMS charges to be paid for that quarter.

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

7.12 Contractor's Obligations and Responsibility

The contractor shall guarantee continuous availability of the system as indicated in this bid document.

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

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

7.13 Responsibilities of Employer

The responsibilities of the Employer during the maintenance period are as follows:

- (a) Employer shall ensure that proper environmental conditions are maintained for the system.
- (b) 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.
- (c) Employer shall provide access to the sites of installation for purposes of providing Support Services.

Appendix A

General Information

A. Existing Systems for Integration

A.1 Introduction

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 AMR 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 are available in APDCL, which shall be required to be integrated:

1. R-APDRP-IT System.
2. APDCL Revenue Management System (ARMS)

A.1 R-APDRP IT System under implementation

Under Government of India's R-APDRP, Part-A scheme, the following modules were implemented in 71 (Seventy One) towns across APDCL

- Meter data acquisition
- Energy audit
- New connection
- Disconnection and dismantling
- GIS-based customer indexing and asset mapping
- 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 consumers
- Billing
- Collection
- Metering

A.2. ARMS (APDCL Revenue Management System) under implementation

For the non-RAPDRP areas, the following modules are being implemented with the help of ARMS system:

- Energy audit
- New connection
- Disconnection and dismantling
- Management Information System (MIS)
- Web self service
- Development of commercial database of consumers
- Billing
- Collection
- Metering

Appendix B

Bill of Quantity

APPENDIX-B

SI No	Item	Unit	Qty.
A	Field Hardware		
A.1	Supply, Installation, Testing, Configuration & Commissioning of 4G supported Intelligent AMR Modems along with cables and all accessories	Nos	10,000
B	Web based software solution (Shall be hosted on Cloud) inclusive of Head End System (database included), Meter Data Management software (MDM), web application, data archiving , system integration and any other item required to deploy the application	Lot	1
C	Facility Management Services (FMS) for 5 years – Maintenance and operational support of the whole system for 5 years after operational acceptance of the project	Lot	1
D	GPRS Charges for 5 years	Lot	1
E	Cloud hosting charges for 5 years	Lot	1

APPENDIX-C

Sl. No	Name of Circle	No. of feeders to be covered (33 kV & 11 kV)	No. of boundary meters	Number of HT Consumers to be covered	Total nos. of modems
1	Barpeta	104	37	100	241
2	Bongaigaon	128	20	200	348
3	Dibrugarh	114	11	200	325
4	Guwahati EC-I	227	3	3000	3230
5	Guwahati EC-II	129	12	1000	1141
6	Cachar	97	12	200	309
7	Badarpur	74	14	159	247
8	Jorhat	117	28	500	645
9	Golaghat	95	16	150	261
10	Kokrajhar	120	32	200	352
11	Mangaldoi	100	16	200	316
12	Nagaon	139	19	300	458
13	Marigaon	55	6	100	161
14	North Lakhimpur	99	13	100	212
15	Rangia	105	13	200	318
16	Sivasagar	127	25	200	352
17	Tezpur	150	25	200	375
18	Tinsukia	139	28	200	367
19	KANCH	106	34	200	340
Total:		2227	364	7409	10000

**The end of Volume-II against NIT No. APDCL/CGM(PP&D)/UDAY/
T-51(MDAS)/AMR/2020/ 1 ; Dtd: 26.05.2020**