

ASSAM POWER DISTRIBUTION COMPANY LTD.

Contract for

**Appointment of Advanced Metering Infrastructure (AMI)
Service Provider for Smart Prepaid Metering in selected areas of APDCL on
DBFOOT basis (PHASE-II)**

Package-II

**(Circles: Tezpur, KANCH, Golaghat, Jorhat, Sivsagar, Dibrugarh, Tinsukia and
North Lakhimpur)**



Open Tender Notice

No. APDCL/CGM(PP&D)/SMART METERING (DBFOOT)/Ph-II/2021/1/PKG-2 dated 28.08.2021

August, 2021

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

Contract for

**Appointment of Advanced Metering Infrastructure (AMI)
Service Provider for Smart Prepaid Metering in selected areas of APDCL on DBFOOT basis
(PHASE-II)
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(Circles: Tezpur, KANCH, Golaghat, Jorhat, Sivsagar, Dibrugarh, Tinsukia and North Lakhimpur)**

Between

Assam Power Distribution Company Limited

AND

[AMISP]

AND

[SELECTED BIDDER]

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CONTRACT

THIS Contract (hereinafter referred to as “**Contract**”) executed on this [date] day of [month], [year] between:

BETWEEN:

Assam Power Distribution Company Limited (hereinafter referred to as “**Utility**” which expression shall unless repugnant to the context or meaning thereof include its successors, assigns and permitted substitutes), a company incorporated under the extant provisions of Indian Laws and having its registered office at **Bijulee Bhawan, Paltanbazar, Guwahati-1;**

AND

..... [A company incorporated by the Selected Bidder in terms of the Companies Act, 2013 having its registered office at..... [Registered address of the Company] (hereinafter referred to as the “**AMISP**” which expression shall unless repugnant to the context or meaning thereof include its successors, assigns and permitted substitutes).

AND

..... [The Selected Bidder identified pursuant to the RFP, in the event of the Consortium- Lead Member shall execute this Contract] having its registered office at..... [Registered address of the Company] (hereinafter referred to as the “**Selected Bidder**” which expression shall unless repugnant to the context or meaning thereof include its successors, assigns and permitted substitutes).¹

WHEREAS APDCL had invited Bids for Appointment of AMI Service Provider for Smart Prepaid Metering in APDCL on Design Build Finance Own Operate Transfer (DBFOOT) basis (the “**Project**”) through Tender No. [Tender Details]

WHEAREAS after evaluation of the Bids received from the Bidders, the Utility accepted the Bid of the [Bidder/ Consortium comprising [_____]] (collectively, the “**Selected Bidder**”), and issued its Letter of Award No. [_____] dated [_____] (“**LOA**”) to the Selected Bidder, requiring the Selected Bidder, inter alia, to execute this Contract within the time period prescribed in the RFP, through a special purpose vehicle.

WHEAREAS the Selected Bidder has since promoted and incorporated such a special purpose vehicle as the AMISP under the Companies Act, 2013 in accordance with the terms of the RFP, and has requested the Utility to accept the AMISP as the entity which shall undertake and perform the obligations and exercise the rights of the Selected Bidder under the LOA, including the obligation to enter into this Contract for Design Build Finance Own Operate Transfer (DBFOOT) AMI system in the Project area.

WHEAREAS the AMISP, by its letter dated [_____], while representing that it has been promoted by the Selected Bidder for the purposes hereof, joined in the request of the Selected Bidder to the Utility to accept the AMISP as the entity which shall undertake and perform the obligations and exercise the rights of the Selected Bidder including the obligation to enter into this Contract pursuant to the Letter of Award (LOA).

¹ In the event Selected Bidder is a consortium, the Lead Member in its individual capacity shall execute this Contract.

NOW, THEREFORE, in consideration of the foregoing and the respective covenants and agreements set forth in this Contract, the receipt and sufficiency of which is hereby acknowledged, and intending to be legally bound hereby, the Parties agree as follows:

ARTICLE 1: DEFINITIONS AND INTERPRETATION

1.1 DEFINITIONS

In this Contract, unless the context otherwise requires, the following words, expressions and abbreviations shall have the following meanings:

S No	Term	Definition
1.	“Advanced Metering Infrastructure” or “AMI”	An integrated system of Smart Meters, communication networks and meter data management systems that enables two-way communication between the utilities and consumer premises equipment. The functional blocks of AMI typically include HES — Head End System, WAN — Wide Area Network, NAN — Neighbourhood Area Network, DCU — Data Concentrator Unit / Gateway and HAN — Home Area Network;
2.	“Advanced Metering Infrastructure Service Provider” or “AMISP”	AMISP, [Provide Name] is the responsible implementation agency appointed by [Utility] for designing, building, financing, owning, operating and transferring the AMI Project in its area of operation upon execution of the Contract subsequent to the Letter of Award dated_____;
3.	“Affected Party”	An Affected Party means any of the AMISP or the Utility whose performance has been affected by an event of Force Majeure or Force Majeure Event;
4.	AMISP Monthly Fee	The total monthly payment to be made by APDCL to the AMISP in accordance with Article 6. This shall be computed as a product of AMISP Service Charge and Total meters installed and operationalized each month;
5.	AMISP Service Charge	The payment to be made by the Utility to the AMISP in INR per meter per month for each category of meter as quoted in the Bid;
6.	“Applicable Laws”	Shall mean the laws and any other instruments having the force of law in India as they may be issued and in force from time to time;
7.	“Bid”	The bid submitted by the Bidder(s) in response to the RFP;
8.	“Bidder(s)”	Individual entity or consortium of entities bidding in response to the RFP;
9.	“Change Order”	Shall have the meaning as ascribed thereto in Article 14 of this Contract;
10.	“Consortium Member”	Any member of the bidding consortium other than the Lead Consortium Member;
11.	“AMISP Contract” or “Contract”	The Contract to be entered into between the SPV incorporated by the Selected Bidder, Selected Bidder ² and the Utility for undertaking the AMI Project.;
12.	“Contract Period” or “Term of the Contract”	Shall have the meaning as ascribed thereto in Article 2.2.2 of this Contract;
13.	“Contract Value” or	Shall have the meaning as ascribed thereto in Article 6.1 of this

² Lead Bidder in the event the Selected Bidder is a consortium

SN	Term	Definition
	“Contract Price”	Contract;
14.	“Exit Management Period”	The transition period encompassing the time from the date of termination of the Contract or end of the Contract Period until the date upon which all transition activities/ services are completed by the AMISP;
15.	“Force Majeure” or “Force Majeure Event”	Shall have the meaning as ascribed thereto in Article 9 of this Contract;
16.	“Goods”	Any good(s) supplied or to be supplied as a part of the Solution by the AMISP;
17.	Independent Valuer	A qualified valuer duly registered under Companies (Registered Valuers and Valuation) Rules, 2017 for Plant and Machinery and jointly appointed by the Parties in the event of termination prior to Work Completion.
18.	“Operational Go Live”	Shall have the meaning as ascribed thereto in in Section 4 of Schedule F of this Contract;
19.	“Operational Period”	Total meter-months of operating the AMI system after Operational Go-Live;
20.	“Project or AMI Project”	APDCL’s AMI Project defined in recital clause;
21.	“Project Implementation Schedule”	Shall have the meaning as ascribed thereto in Schedule A of this Contract;
22.	“Request for Proposal” or “RFP”	This tender [Tender Name and Details] including all its Volumes for Appointment of AMISP (including all clarification/ addendum/ amendment/ corrigendum/ etc. issued from time to time);
23.	“Rupees” or “Rs.” Or “INR” or “₹”	Indian Rupees;
24.	“Service(s)” or “Related Service(s)”	Any service(s) performed or to be performed as a part of the Solution by the AMISP;
25.	SLA Default Notice	Notice to be issued by the Utility in the event AMISP fails meet any of the criteria specified in the SLA for cumulatively 3 (three) months in past 6 (six) months so as to entitling levy of maximum penalty for such criteria
26.	“Smart Meter”	Smart meter is an ac static watt-hour meter with time of use registers, internal connect and disconnect switches with two-way communication capability. It is designed to measure flow of forward (import) or both forward (import) and reverse (export), store and communicate the same along with other parameters defined in this standard. It shall be remotely accessed for collecting data/events, programming for select parameters (<i>as defined in IS 16444 including any amendments or modifications to the same from time to time</i>);
27.	“Solution”	The AMI system implemented in its entirety including but not limited to the designing, financing, supply of hardware, software,

SN	Term	Definition
		transportation, installation, integration, testing, commissioning, operation, maintenance, training and other services by the AMISP;
28.	“Termination Payment”	Shall have the meaning as ascribed thereto in Article 11 of this Contract;
29.	“Total meter-months of operating the AMI System after Operational Go-Live”	The product of total number of Smart Meters to be installed in the Project and 90 (ninety) months;
30.	“Work Completion”	Delivery, site installation, integration and operationalization of 100% (one hundred percent) of Smart Meters (as per Article 14 of this AMISP Contract) each with related hardware, software and equipment (as per provision of this AMISP Contract).

1.2 INTERPRETATION

In the interpretation of this Contract, unless the context otherwise requires:

- 1.2.1. APDCL, the Selected Bidder, and the AMISP/ Contractor shall individually be referred to as “Party” and collectively as “Parties.”
- 1.2.2. Unless otherwise specified a reference to an Article number is a reference to all of its sub-article;
- 1.2.3. Unless otherwise specified a reference to a clause, sub-clause or section is a reference to a clause, sub-clause or section of this Contract including any amendments or modifications to the same from time to time;
- 1.2.4. A word in the singular includes the plural and a word in the plural includes the singular;
- 1.2.5. A word importing a gender includes any other gender;
- 1.2.6. A reference to a person includes a partnership and a body corporate;
- 1.2.7. A reference to legislation includes legislation repealing, replacing or amending that legislation;
- 1.2.8. Where a word or phrase is given a particular meaning, it includes the appropriate grammatical forms of that word or phrase which has a corresponding meaning;
- 1.2.9. In the event of an inconsistency between the terms of the RFP, Bid submitted by the Selected Bidder and the subsequent Contract, the terms of the Contract hereof shall prevail;
- 1.2.10. Whenever a material or article is specified or described by the name of a particular brand, manufacturer or trademark, the specific item shall be understood as establishing type, function and quality desired. Products of other manufacturers may also be considered, provided sufficient information is furnished so as to enable APDCL to determine that the products are equivalent to those named.
- 1.2.11. No amendment or other variation of this Contract shall be valid unless it is in writing, is dated, expressly refers to this Contract, and is signed by a duly authorised representative of both APDCL and the AMISP thereto.

ARTICLE 2: THE CONTRACT

2.1. SCOPE OF WORK

2.1.1. The scope of work for AMISP shall include, in complete conformity with the specifications as mentioned in this Contract and Applicable Laws, site survey, planning, designing, financing, engineering, manufacturing, supply, transportation & insurance, delivery at site, unloading, handling, storage, installation, integration, testing, commissioning, demonstration for acceptance, training, maintenance, operation and documentation of:

- a) Single phase whole current Smart Meter [with/without net-metering] with suitable communication technology with pre-paid mode as default mode unless specified otherwise;
- b) Three phase whole current Smart Meter [with/without net-metering] with suitable communication technology with pre-paid mode as default mode unless specified otherwise;
- c) Communication Infrastructure (shall be provided based on Canopy based RF mesh Licensed frequency band as permitted by Wireless Planning & Coordination Wing (WPC)/ Statutory Bodies in India as applicable or in Unlicensed frequency band; Power Line Carrier Communication (PLCC) wired, Fiber Optic; Cellular communication technology (4G/Nb-IOT) or combination of these technologies to ensure the performance levels provided in this Contract;
- d) Integration of Network Interface Card (NIC)/ Communication Module with meters, to enable the respective meters to seamlessly integrate with proposed HES and/or MDM thus enabling interoperability of the system. In future, it would be AMISP's responsibility to integrate new meter or any other application as mutually decided by the AMISP and the APDCL. Plug and play type communication modules shall be deployed in the Smart Meters, for any given communication technology. These modules shall be field-deployable, with corresponding communication interface modules being used in the Gateway or Base Transceiver Station (BTS) of wide area network. General requirement for common pluggable communications module for Smart Meters has been provided under Annexure E to the Schedule F of this Contract;
- e) Out-bound interface of MDM to facilitate data transfer through API-based model/ service bus to a central platform as and when made available as mentioned in section 1.6 of the Schedule F to this Contract;
- f) Head End System (HES) and deployment on cloud as per the specifications defined in this Contract.
- g) Meter Data Management system (MDM) and deployment on cloud as per the specifications defined in this Contract;
- h) Consumer portal and mobile application covering all consumer categories and category specific features as applicable. Features in this app which relates to demand response (as per 1.6.5 of Schedule F to this Contract) should also be provided;
- i) Integration of different devices/ equipment/ software covered in the scope of this Project with each other as per functional requirements;
- j) Network Operation cum Monitoring Centre (NOMC) hardware such as workstation, storage, network & cyber security devices, printer, display system etc. as defined in this Contract. All cabling associated with NOMC hardware, communication systems and power supply source shall also be in the scope of AMISP;
- k) Suitable backend communication infrastructure for communication to operation cum monitoring centre;
- l) Generation of various reports as mentioned in the Schedule F of Contract;
- m) Integration with existing payment infrastructure (the same shall be facilitated by utility) including different payment channels for pre-paid recharges and post-paid bill payments.

- The channels to include mobile-based recharge/ payment options. The AMISP shall also create/ facilitate availability of infrastructure for recharge through feature phones/ channels.
- n) All other necessary software with valid licenses relevant to the Project to facilitate seamless operation of the AMI system;
 - o) Data privacy as per the specifications defined in the Schedule F of the Contract and/ or Applicable Laws.
- 2.1.2. All associated works/ items as required for efficient, viable and fully functional system is the responsibility of AMISP. The AMISP shall also be responsible to operate the system for the Operational Period during which the AMISP shall maintain system availability and service levels as mentioned in this document. The AMISP shall also bear the cost of recurring charges and to maintain including necessary upgrades for the complete AMI system as may be required and decided by the AMISP during the Contract Period.
- 2.1.3. Unless otherwise stipulated in the Contract, the scope of work shall include all such items not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for comprehensive, successful and satisfactory implementation of the Solution as if such items were expressly mentioned in the Contract. The same may be mutually enlisted and agreed upon by Utility and AMISP during the design phase as defined in the Contract;
- 2.1.4. The AMISP shall commence implementation of the Solution only after written approval of APDCL on the Project Implementation Plan as specified in Schedule A of this Contract. In case of any amendments suggested by APDCL, the AMISP shall document the amendments and re-submit for APDCL's approval.
- 2.1.5. As part of this Project, it is envisaged that AMI system with Smart Meters using plug and play type communication modules would be deployed. The Smart Meters are expected to be operated on both pre-paid and post-paid mode. The AMI system should be designed such that all the required hardware, software, and firmware with upgrades satisfy the requirements of this specification and are suitable for future scaling up.

2.2. EFFECTIVENESS AND TERM

- 2.2.1. This Contract shall come into force and effect on the date of execution of the Contract by the Parties;
- 2.2.2. Unless terminated earlier by either Party in accordance with the terms of this Contract, this Contract shall continue in full force and effect until the earlier of (a) 10 (ten) years from the date of execution of the Contract or (b) expiry of Total Meter-Months of operating the AMI System after Operational Go-Live” (“**Term of Contract**”).

ARTICLE 3: RESPONSIBILITIES AND DELIVERABLES

On and from the date of the execution of this Contract, utility grants to AMISP for the Term of Contract, the right to implement the Project in the Project area.

3.1. RESPONSIBILITIES AND DELIVERABLES

The Project can be broadly classified in four phases:

- a) Design phase;
- b) Installation phase;
- c) Pre-operation phase;
- d) Operational phase.

Accordingly, the responsibilities and deliverables are broadly divided in these four phases.

3.2. DESIGN PHASE

Under this phase, AMISP shall design and plan for the AMI Project within the Schedule A specified in this Contract. Subject to provisions of this Contract, the completion of implementation of the Solution by the AMISP shall be in accordance with the Project Implementation Schedule as specified in Schedule A.

3.2.1. RESPONSIBILITIES OF AMISP

- a) The AMISP shall be required to visit Project area for detailed site surveys for performing the design and implementation of AMI system;
- b) Perform equipment engineering and design specific to each location including review of, and conformance with local environmental and earthing considerations;
- c) Define source power requirements for each cabinet/ rack of equipment provided and the total power requirements to operationalize the system;
- d) Develop a consumer engagement plan for smooth implementation of AMI system. The plan should include educating consumers about the benefits of smart meters, pre-paid recharge mechanism, benefits of pre-paid meters, potential usage of Smart Meters data for consumers, etc;
- e) Develop Exit Management Plan in accordance with provisions of this Contract;
- f) Develop a detailed Project Implementation Plan in accordance with the provisions of this Contract and Applicable Laws;
- g) AMISP shall ensure that all equipment/ components/ parts used for the Project, which is/ are not manufactured in India, shall indicate the "Country of Origin" of all such equipment / components/ parts. AMISP undertakes to use imported equipment only after the same are permitted by appropriate government instrumentality in accordance with applicable laws including the guidelines issued vide Order No. No.9/16/2016-Trans-Part(2) issued by Ministry of Power dated 18 November 2020 as amended and/ or modified from time to time.

3.2.2. RESPONSIBILITY OF UTILITY

- a) Whenever implementation of any component of the Solution requires that the AMISP obtain permits, approvals, and import and other licenses from local public authorities, APDCL shall, if so required by the AMISP, make its best effort to assist the AMISP in complying with such requirements in a timely and expeditious manner;
- b) The Chief General Manager (PP&D) of APDCL shall act as the nodal point for the implementation of the Contract and for issuing necessary instructions, approvals, commissioning, acceptance certificates, payments etc. to the AMISP;
- c) The Chief General Manager (PP&D) shall approve all such documents within 15 (fifteen) working days from the date of execution of the Contract;

- d) APDCL may provide on AMISP's request, particulars/ information / or documentation that may be required by the AMISP for proper planning and execution of scope of work under this Contract;
- e) APDCL shall provide database of consumer indexing and existing physical & IT infrastructure as well as periodic updates of such information. Utility shall provide all required data to the AMISP to the extent possible to identify all the consumers connected on the identified sub-stations, feeder lines and transformers of the AMISP Project area;
- f) Review and approval of AMISP's Project Implementation Plan;
- g) Provide drawings for NOMC building where AMI system installations are planned;
- h) Provide necessary inputs for developing a comprehensive consumer engagement plan;
- i) Provide indexed data and other requisite information within 30 (thirty) days from date of execution of the Contract to enable preparation of the Project Implementation plan by the AMISP.

3.2.3. DELIVERABLES EXPECTED

- a) Submit a checklist of all documents on which approvals from utility or other agencies may be required;
- b) Consumer engagement plan;
- c) Detailed Project Implementation Plan including verification of all integrations with external systems as mentioned in this Contract and delineated in the approach paper created for the purpose
- d) Exit Management Plan
- e) The AMISP shall prepare document/ drawings to indicate the following:
 - i. Tentative location of devices/equipment for setting up communication network with power plan;
 - ii. Confirmation of adequacy of space and AC power supply requirements;
 - iii. Identify all additional items required for interconnection with the existing/owner provided equipment/facilities;
 - iv. Requirement of modification to existing earthing arrangement of net NOMC and locations where communication equipment / devices etc. are to be installed, if any.

3.3. INSTALLATION PHASE

After the Utility's approval on design phase, AMISP shall initiate installation of AMI Systems.

3.3.1. RESPONSIBILITIES OF AMISP

- a) Installation and integration of new Smart Meters;
- b) Handover replaced old meters to Utility in terms of the direction of the Utility;
- c) Installation of field devices, hardware, software and communication system;
- d) Implement consumer engagement plan with support of Utility;
- e) Project management, Project scheduling, including periodic Project reports (weekly/monthly basis) documenting progress during the Contract Period;
- f) Keeping the consumer indexing updated in the AMI system during the Contract Period;
- g) To implement all minor civil works necessary for installation of proposed equipment and provide the details of such work to the Utility;
- h) Conduct type tests or provide documented evidence of type testing and BIS certification to the Utility;
- i) Assistance in integrating with existing payment infrastructure including different payment channels for pre-paid recharges. The channels to include mobile-based recharge options. The AMISP shall also create/ facilitate availability of infrastructure for recharge through feature phones/ offline channels;
- j) Implement the governance framework, in consultation with the utility, and submit monthly

- progress reports on AMI Project implementation;
- k) Type tests and inspecting except for operational go-live as described in Section 4 of Schedule F of this Contract.

3.3.2. RESPONSIBILITIES OF UTILITY

- a) Provide necessary approvals and shutdowns required for implementing the AMI System;
- b) Storage and disposal of replaced old meters;
- c) Coordinate with AMISP to execute a successful consumer engagement plan and provide implementation support for project execution;
- d) Obtaining requisite statutory clearances and/or approvals as required to be taken for Project work;
- e) Providing accurate details of consumer indexing, validating/accepting the Consumer Indexing updated by AMISP within 30 days and informing AMISP of any changes in the area network during the project installation and maintenance period;
- f) Provide A.C. power supply inputs;
- g) Provide all required documents for delivery of material at site;
- h) Provide at its expense, the electrical energy required for performance of the Project activities, installation, testing, and operation of the AMI Systems;
- i) Providing support and access to facilities at the sites, including consumer premises;
- j) Arranging for necessary shutdowns and work permits;
- k) Implement major civil works such as expansions or construction of rooms, trenches etc. as required for the AMI equipment;
- l) Utility to ensure that sites for installation for Smart Meters are ready along with service cable including electrical neutral connectivity to the transformer, wherever applicable for AMISP;
- m) Provide the required integration interface details of the existing billing enterprise and related information required for Operational Go-Live of the AMI system, within 6 (six) months from date of execution of the Contract;
- n) Provide necessary clearance/ approval/ permits that are to be issued by it for initial 20% of contiguous area for Smart Meter deployment along with related documentation within 6 (six) months from date of execution of this Contract;
- o) Provide necessary clearance/ approval/ permits to be issued by it, including (e) above, for remaining contiguous area for Smart Meter deployment along with related documentation on quarterly basis. Utility shall endeavour to provide 20% of contiguous area cleared each quarter and complete area within 18 (eighteen) months from date of execution of the Contract.
- p) Review the specifications of the Goods proposed to be used to ensure compliance with the provisions of this Contract.

3.3.3. DELIVERABLES EXPECTED

- a) Ensure the implementation of new AMI system as per the agreed Project Implementation Plan;
- b) Type test reports and associated document as per Section 4 of the Schedule F to this Contract;
- c) Updated consumer indexing as per the implemented AMI system;
- d) Monthly progress report briefing the status of installation of meters and key challenges faced if any.

3.4. PRE-OPERATION PHASE

The Pre-Operation Phase shall mean the period for Test and inspection of the AMI system for Operational Go- Live of the AMI system as defined in Section 4 of the Schedule F to this Contract.

3.4.1. RESPONSIBILITIES OF AMISP

- a) Test and inspection of the AMI system for Operational Go-Live as described in section 4 of the

Schedule F to this Contract.

- b) Complete the training obligations for Utility personnel along with training documentation

3.4.2. RESPONSIBILITIES OF UTILITY

- a) Provide reasonable support to the AMISP for the Operational Go-Live in terms of the provisions of this Contract;

3.4.3. DELIVERABLES EXPECTED

- a) Trainings of utility personnel and training documentation.

3.5. OPERATIONAL PHASE

Operational Phase shall mean the time period after the Operational Go-Live of the AMI system till the end of Contract Period. Detailed Scope and responsibilities of the AMISP under this Phase is provided in Schedule F to this Contract.

3.5.1. RESPONSIBILITIES OF AMISP

- a) Operate and maintain the AMI System for the entire period of the Contract;
- b) Remain responsible for the professional and technical accuracy of all Services performed, whether by AMISP or others on its behalf, throughout the term of this Contract;
- c) Develop guidelines for operation and maintenance of the AMI system during the Term of the Contract and after taking over by the Utility;
- d) Update the Exit Management Plan as required;
- e) Overall integration of equipment/ subsystem in terms of this Contract;
- f) Training of the [Utility's] personnel;
- g) Ensure availability of Services and spare parts including for expansion;
- h) Hardware, software, and firmware maintenance, debugging, and support of the software applications, and maintenance of all supplied equipment;
- i) Maintain required spare parts, maintenance aids, and test equipment, software maintenance and testing tools;
- j) Periodically (at least annually) test restoration of the system from the backup;
- k) All fault and maintenance tickets shall be system driven and generated automatically. The same shall be transparently available to both utility and AMISP;
- l) Keep a record of the repairs/replacements to the AMI system and provide such information to Utility on a quarterly basis;
- m) A monthly progress report against the activities listed in the Project schedule. The report shall be made available to APDCL on a monthly basis, e.g., the 10th (tenth) day of each month. The progress report shall include all the completed, ongoing and scheduled activities and correspondence and received for the month;
- n) Take *suo-moto* action regarding rectification of faults in the AMI system without any requirement of request from Utility so as to maintain AMI system integrity.

3.5.2. RESPONSIBILITIES OF UTILITY

- a) Work with the AMISP to ensure that AMISP's staff gets all required assistance in carrying out the operational activities for the Project;
- b) Provide at its expense, the electrical energy required for operation and maintenance of the AMI system;
- c) Maintain consumer expectations basis the consumer engagement plan;
- d) Review all products used by AMISP for the Solution and certify Work Completion in accordance with the provisions of this Contract.

3.5.3. DELIVERABLES EXPECTED

- a) Generate reports as mentioned in this Contract which includes but not limited to the following:
 - i. Service Level Agreement (SLA) performance report;
 - ii. Monthly progress report;
 - iii. Reports mentioned in Section 1.8 of the Schedule F to this Contract;
 - iv. Data Privacy Audit report at least once every year;
 - v. Provide status reports to utility on the AMI Project, problems that arise with the installed AMI system (if any) including any cyber security related issues and corrective action taken by AMISP for the same.
- b) Operation and maintenance guidelines;
- c) Updated Exit Management Plan.

3.6. GENERAL RESPONSIBILITIES

3.6.1. RESPONSIBILITIES OF AMISP

- a) Maintain full backup of all installed software applications and data;
- b) Assist the Utility in obtaining required regulatory interventions for implementation of AMI schemes;
- c) Identify, buy and maintain spares along with main items to assure the system availability during the Contract Period;
- d) Provide storing, maintenance of storing area and security including full responsibility for protection from theft and fire for all the items to be installed. The warehouse may be a temporary storage area to be constructed by AMISP or the same may be taken on rent in APDCL's premises;
- e) To conduct Factory Acceptance Test (FAT) and Site Acceptance Test (SAT) of all hardware, software and firmware provided;
- f) Appoint and notify to APDCL of the names and contact details of the AMISP representative and its dedicated staff for the Project;
- g) Prepare and submit all documentation and drawings in hard copy as well as soft copy;
- h) The AMISP's personnel shall comply with all applicable rules, regulations and requirements relating to visitors on the premises of APDCL;
- i) AMISP is responsible to conduct 3rd (third) party data privacy audit at least once every year. The audit report should be made available to APDCL. AMISP to take necessary actions on audit observations in consultation with the APDCL.
- j) Detailed descriptions of the AMISP's obligations, in relation to individual items and Services offered, are delineated in other sections specified in the Schedule F of the Contract.
- k) In the event any imports are required for the purposes of this AMISP Contract, such imports shall be in accordance with all applicable laws including those in relation to testing issued by Ministry of Power (Order No No.9/16/2016-Trans-Part(2) dated 18 November 2020; as amended and/ or modified from time to time) and conditions for import from prior reference countries.
- l) AMISP undertakes to comply with all applicable laws, regulations and standards including the guidelines issued by the central government including the guidelines issued in Order No. F/No.6/18/2019-PPD by Ministry of Finance, Department of Expenditure, Public Procurement Division dated 23 July 2020 and Order No. 11/05/2018-Coord. by the Ministry of Power dated 17 September 2020 including any amendments or modifications to the same from time to time.

3.6.2. AMISP shall ensure that the Selected Bidder subscribes 100% (one hundred percent) equity shares of AMISP in accordance with the provisions of the Consortium Agreement, if applicable and continue to hold such shares for a period up to two years after Work Completion. AMISP shall ensure that the Selected Bidder shall maintain 51% (fifty-one percent) equity shares in AMISP for the entire term of this Contract. [AMISP shall ensure that in the event Selected Bidder was a

Consortium then the Lead Consortium Member holds 51% (fifty-one percent) equity shares of the AMISP at all times until the two years from Work Completion as per this Contract and 26% (twenty-six percent) for the remaining term of this Contract].

- 3.6.3. In the event AMISP is not able to install the meter(s) required to be installed for the purposes of Work Completion due to reasons not attributable to the AMISP, it shall immediately give notice to the Utility for removing such exigency.
- 3.6.4. In the event Utility is unable to remove the exigency notified in terms of Article 3.6.3 within 15 days from date of notice by the AMISP then such meter(s) shall be removed from the total number of meters to be considered for Work Completion.
- 3.6.5. Any direct and/ or indirect change in shareholding/ management of AMISP shall require prior approval of APDCL. AMISP undertakes that any change in shareholding shall be in compliance with applicable laws including but not limited to the guidelines issued vide Order No. F/No.6/18/2019-PPD by Ministry of Finance, Department of Expenditure, Public Procurement Division dated 23 July 2020 and rules for foreign direct investment in India.

3.6.6. RESPONSIBILITIES OF UTILITY

- a) APDCL shall provide necessary support to AMISP in the Project area, in relation to (amongst others) access to utility's/consumers premises, installation of AMI system, repair and maintenance services, signing of leasing and license agreements with the APDCLs/consumers. Utility shall also:
 - i. Provide necessary permission and isolations to carry out related activities to install and/or replace AMI system;
 - ii. Give access to AMISP supervisor or its operation & maintenance staff to work in the Project area during the Contract Period;
 - iii. Provide an office space for AMISP personnel as mentioned in Section 5 of Schedule F of this Contract document within the Utility premises;
 - iv. Give access to AMISP to use existing power and water supply, and other necessary equipment, as mutually agreed with the AMISP;
 - v. Not move, remove, modify, alter, or change the AMI system or any part thereof in the boundary of the AMI system installed by the AMISP without the prior written consent of AMISP. Utility shall take all reasonable steps to protect the AMI system from damage or injury and shall follow procedure for emergency action provided in advance by AMISP;
- b) Participate in periodic review meetings as per the project governance structure, and shall support with the required interventions requested;
- c) Facilitate AMISP for the timely implementation of the AMI Project and for its successful operation and maintenance during the Contract Period;
- d) Ensure reliable power supply in the Project area;
- e) Be responsible for operation and maintenance of power supply system, and promptly attend to any break down including repair or replacement of any equipment used/needed for maintaining continuity of electricity supply for AMI system operation;
- f) Safe and reasonable access to utility premises shall be facilitated for AMISP's personnel and third-party vendors by APDCL. This facilitation shall include, space for equipment on premise, working space including air conditioning, light, ventilation, electric power and outlets;
- g) Provide regulatory support/changes as required;
- h) Permit AMISP to perform the project activities during working hours, and also after working hours as necessary, to meet the requirements of Project Implementation Plan;
- i) Approvals/Suggestions for change in submitted documents/ reports to AMISP in time bound manner;

- j) Organize and participate in regular project review meetings;
- k) Release payments to AMISP as per agreed terms;
- l) Assist AMISP in obtaining any applicable permits for the Project and cooperate with AMISP in order to achieve the objectives of the Contract;
- m) Necessary support in creation of pre-payment infrastructure;
- n) At its own cost, replace or repair existing equipment (other than AMI systems), such as poles, cables including consumer service lines, and transformers etc. where necessary to make the AMI system operational and/ or safe from hazards and maintain in proper working condition all portions of all facilities that are not included in the AMISP's scope of maintenance;
- o) Attend to any irregularity with respect to AMI system operation, the cause of which has been brought to its attention by the AMISP;
- p) Promptly notify the AMISP of any events or circumstances that could affect the Project outcomes, or the AMISP's Services and obligations under this Contract;
- q) Allow AMISP (and/or its implementation partner, investor(s), authorized agency) unfettered access to network operation cum monitoring centre. Such covered and enclosed space as required by AMISP shall be provided to it by Utility free of cost during the Contract Period;
- r) Cooperate with AMISP in arranging financing for the Project, including by signing any relevant documents (such as substitution Contract) and providing such approvals, no-objections and waivers as may be required by investors/lenders;
- s) Utility shall facilitate its best effort in accessing consumer premises;
- t) Appoint and notify to AMISP of the names and contact details of the Utility representative and its dedicated staff for the Project, which would include:
 - i. An engineer-in-charge for the Project who shall render full support to AMISP for Service delivery during the Term of this Contract and shall coordinate for payment to AMISP;
 - ii. A nodal officer, to co-ordinate with AMISP in relation to the Project.
- u) Apart from the aforesaid, the Utility shall provide all other necessary support as may be required time to time.

3.7. EXCLUSION FROM AMISP'S SCOPE

Following shall be excluded from AMISP's scope:

- a) Construction of building for AMI Network Operation cum Monitoring Centre;
- b) Lighting system for AMI Network Operation cum Monitoring Centre;
- c) Interior and Integrated Building Management System (IBMS) of building for AMI Network Operation cum Monitoring Centre;
- d) Air conditioning and ventilation for AMI Network Operation cum Monitoring Centre;
- e) Firefighting system for AMI Network Operation cum Monitoring Centre;
- f) A.C. input power and back-up supply for AMI Network Operation cum Monitoring Centre;
- g) Service cable including electrical neutral connectivity to the transformer, wherever applicable;
- h) Any modifications required in the existing system of the Utility (Billing, Website, etc.).

3.8. OBLIGATIONS OF THE SELECTED BIDDER

- 3.8.1 Selected Bidder shall ensure that it subscribes to 100% (one hundred percent) of the equity share capital of the SPV and continue to hold such shares for a period up to two years after Work Completion. In the event Selected Bidder was a consortium then the shareholding pattern indicated in the Consortium Agreement, shall be complied with;
- 3.8.2 Selected Bidder shall continue to hold not less than 51% (fifty-one percent) for the entire term of the AMISP Contract;
- 3.8.3 Selected Bidder shall ensure no change in shareholding up to 2 (two) years after Work Completion

as per the AMISP Contract;

- 3.8.4 In the event, Selected Bidder is a Consortium, the Lead Consortium Member shall hold at least 51% (fifty-one per cent) of the equity of the AMISP at all times until the two years from Work Completion as per this Contract and 26% (twenty-six) for the remaining term of this Contract.
- 3.8.5 In the event the Selected Bidder is a Consortium, the Lead Member shall be liable to ensure that the Solution is provided to the Utility in accordance with the terms and conditions of this Contract in terms of the Project Implementation Schedule notwithstanding the failure and/ or non-performance by any other member of the consortium.

ARTICLE 4: SPECIFICATIONS AND STANDARDS

4.1. SPECIFICATIONS AND STANDARDS

4.1.1. Technical Specifications and Drawings:

- a) The AMISP shall ensure that the Solution comply with the Applicable Law, technical specifications and other provisions of the Contract.
- b) The Solution supplied under this Contract shall conform to the standards mentioned in the Schedule F of this Contract. When no applicable standard is mentioned, the standard shall be equivalent or superior to the official standards whose application is appropriate to the country of origin of the Goods.

4.1.2. Wherever references are made in the Contract to codes and standards in accordance with which the Solution shall be executed, the edition or the revised version of such codes and standards shall be those specified in the scope of work. During Contract execution, any changes in any such codes and standards shall be applied only after approval by APDCL and shall be treated as Change Order in accordance with Article 14.

4.2. PACKING AND DOCUMENTS

4.2.1. The AMISP shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to their final destination, as indicated in the Contract. During transit, the packing shall be sufficient to withstand, without limitation, rough handling and exposure to extreme temperatures, salt and precipitation, and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the final destination of the Goods and the absence of heavy handling facilities at all points in transit. APDCL shall not be responsible in any manner for any loss or damage caused to the Goods during transit.

4.2.2. The packing, marking, and documentation within and outside the packages shall comply strictly with best practices including such special requirements as shall be expressly provided for in the Contract and in any other instructions ordered by APDCL and Applicable Laws.

4.3. INSPECTION AND TESTS

4.3.1. The AMISP shall at its own expense carry out all such tests and/or inspections to ensure that the Solution are complying with the technical specifications, functional requirements, codes and standards specified in the scope of work.

4.3.2. The inspections and tests may be conducted on the premises of the AMISP, at point of delivery, and/or at the final destination of the Goods, or in another place in India as per the requirement. All reasonable facilities and assistance, including access to drawings and production data, shall be furnished to the inspectors.

4.3.3. Test and inspections are in the complete purview of the AMISP and its sub-vendors. It shall be ensured that there are no conflicts in roles played between AMISP personnel carrying out tests / inspections, and those assigned responsibilities of Quality Assurance (QA) and Quality Control (QC). The QA/QC team of the AMISP shall be an independent administrative and functional structure reporting via its manager to the AMISP's top management. The QA/QC manager(s) shall have the authority within the delegated areas of responsibility to resolve all matters pertaining to quality/tests when actual quality/results deviates from that stated in the work statement.

4.3.4. The AMISP shall maintain a Quality Assurance/Quality Control (QA/QC) program that provides that equipment, materials and services under this specification whether manufactured, designed or performed within the AMISP's plant, in the field, or at any sub-contractor's source shall be controlled at all points necessary to assure conformance to contractual requirements. The program shall provide for prevention and ready detection of discrepancies and for timely and positive

corrective action. The AMISP shall document objective evidence of quality conformance. Instructions and records for quality assurance shall be controlled and maintained at the system level.

- 4.3.5. The QA/QC Manager designate for the Project shall be the custodian of all inspection and test records/certificates. QA/QC Manager, either directly or through its authorized representative shall be responsible for all witness testing, approval of test records and in general, management of the QA/QC program of the project. The records of the same shall be provided to the Utility.
- 4.3.6. Starting from the dry run test period, a variance report shall be prepared by AMISP personnel each time a deviation from the requirements of this Specification is detected in areas such as system functions, design parameters, performance, documentation, test plans, and test procedures. Record of all such variances and their resolution shall be maintained by the QA/QC Manager.
- 4.3.7. In case a consumer complaints of the meter accuracy post Operational go-live and same isn't reasonably resolved through past consumption trend, Transformer Energy Audit, Check Meter (by Utility), etc. AMISP will be obliged to facilitate the meter testing. The AMISP shall undertake the meter accuracy test as per Schedule F of this Contract. In case the accuracy is reasonably supported, and Utility decides to test the meter for accuracy, the same shall be facilitated up to [0.5%] of the meter population under the contract. In case there is need for testing at third party laboratory, charges for same shall be tied-up and paid for directly to the lab by the Utility.

ARTICLE 5: RIGHTS, TITLE AND INTEREST TO AMI SYSTEM AND EQUIPMENT

- 5.1.** The ownership, rights and title to the AMI system and other equipment installed by AMISP for operation of the AMI system pursuant to this Contract shall vest with AMISP during the entire Term of Contract.
- 5.2.** Unless extended by mutual consent of the Utility and AMISP, after the Contract Period the ownership, rights and title of the installed AMI system and other equipment (if any) installed by AMISP for operation of the AMI system pursuant to this Contract shall be transferred to the Utility without any cost.
- 5.3.** In the event of Smart Meters supplied and installed by the AMISP is damaged for reasons not attributable to the AMISP such as theft, vandalism, burning, etc. but otherwise than as a result of Force Majeure Event, the AMISP shall not be liable for such damage. In such cases, upon receipt of Notice from the Utility, the AMISP shall repair or replace the damaged Smart Meters. AMISP shall be required to replace the Smart Meter no later than 15 days of notification by the Utility. Upon replacing the Smart Meter, AMISP shall be entitled to raise a supplementary invoice for [55]% of the amount computed by multiplying the AMISP Service Charge for the type of the meter, as provided in Schedule E of this Contract, with 90 months. The Supplementary Bill shall be paid along with the AMISP Monthly Fee for the immediately succeeding month. For the avoidance of doubt: (i) a damaged meter(s) shall be excluded from the total numbers installed and operational smart meters while conducting the SLA audit of the AMI system in accordance with Article 26; and (ii) in the event, AMISP replaces the Meter within 15 days of request by the Utility or Utility directs to continue operations without replacing the damaged Meter, the AMISP Service Charge *qua* such meter(s) shall be paid as if such damaged meter complies with the SLA prescribed in this AMISP Contract.
- 5.4.** AMISP shall prior to the Operational Phase, be required to prepare an “Exit Management Plan”, in accordance with the provisions of this Contract, more specifically Schedule B of this Contract, for transfer of operations to the Utility, in the event of termination or expiry of this Contract. Exit Management Plan shall ensure handover to the Utility, without affecting Services to stakeholders adversely. AMISP shall get the Exit Management Plan approved by Utility from time to time.

ARTICLE 6: CONTRACT PRICE AND PAYMENT

6.1. CONTRACT PRICE

- 6.1.1. The Contract Price shall be equal to the summation of total amounts payable by the Utility for each category of meter. The total amount for each category of meter shall be computed by taking into account total number of meter in such category, per meter rate for such meter as quoted in the Bid (AMISP Service Charge); multiplied by 90 months.
- 6.1.2. In the event any approval required for imports and/ or use of imported equipment is denied in accordance with all applicable laws including those in relation to testing issued by Ministry of Power (Order No No.9/16/2016-Trans-Part(2) dated 18 November 2020; as amended and/ or modified from time to time), the same shall neither entitle revision of Contract Price nor shall result in revision of the Project Implementation Plan as specified in Schedule A of this Contract.

6.2. PAYMENT MECHANISM

- 6.2.1. The payment shall be made to the AMISP in Indian Rupees (INR) only.
- 6.2.2. The payment to the AMISP shall commence only after: (i) Delivery, site installation and commissioning of Network Operations cum Monitoring Centre with related hardware, software and equipment; and (ii) Delivery, site installation, integration and operationalization of first lot of [5]% Smart Meters each with related hardware, software and equipment and successful Operational Go-Live of the system as defined in this Contract.
- 6.2.3. The payments due to the AMISP (AMISP Monthly Fee) from the Utility shall be paid on monthly basis as per the following payment structure:

Monthly Fees

S.No.	Milestone	AMISP Monthly Fee (in INR)
1.	<ul style="list-style-type: none"> a) Delivery, site installation and commissioning of Network Operations cum Monitoring Centre with related hardware, software and equipment; and b) Delivery, site installation, integration and operationalization of first lot of [5]% Smart Meters each with related hardware, software and equipment and successful Operational Go-live c) Submission of SLA performance report of first lot of [5]% Smart Meters at the end of 1 (one) month of its Operations post Operational Go-Live 	= (AMISP Service Charge X 5 % of total number of Smart Meters installed, integrated and operationalized)
2.	<ul style="list-style-type: none"> a) Payment terms for remaining meter population shall be staged on monthly basis based on the total delivery, installation, integration and operationalization of Smart Meters with the related software/ hardware, communication system b) Submission of SLA performance report of total number of smart meters installed, integrated and operationalized till date at the end of every month 	= (AMISP Service Charge X total number of Smart Meters installed, integrated and operationalized till date)

3.	c) Lumpsum payment on successful operational go-live of the AMI system	<p><i>The disbursement of lumpsum payment to the AMISP will follow the schedule or timeline for release of funds against smart meter component as per the Revamped Distribution Sector (RDS) Scheme Guidelines. The same will depend on achievement of meeting of targets set by Central Govt. under the Scheme.</i></p> <p><i>i) The Grant will be 22.5% of the Cost of meter worked out over the whole project period subject to maximum Rs. 1350.00 per consumer meter.</i></p> <p><i>ii) Additionally, an incentive of 11.25% of the Cost of meter worked out over the whole project period subject to maximum Rs. 675.00 per consumer meter will be provided from Central Govt. under the RDS Scheme for deployment of smart prepaid meters by December 2023.</i></p> <p><i>In both cases mentioned above, the grant will be made available only after installation, commissioning and demonstration of at least one prepaid billing period in the area specified by APDCL in the DPR approved by monitoring committee.</i></p>
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6.2.4. The actual payment shall be net of any applicable liquidated damages and/or penalty due to non-compliance of SLAs by the AMISP

6.2.5. AMISP will raise and deliver two copies of the invoice for AMISP Monthly Fee and the SLA performance report to the Utility for the monthly payments within first 5 (five) working days of every month. Utility will review the AMISP invoice and the SLA performance report raised by the AMISP, in accordance with Article 26, within 5 (five) working days from the date of submission of the invoice and SLA performance report by the AMISP. Utility may dispute the amount payable and shall pay the undisputed amount of the AMISP Monthly Fee by the second last day of the month in which the concerned invoice has been raised. In the event of failure of Utility to pay the undisputed amount within the period specified hereinabove, AMISP may recover the undisputed amount through the Payment Security Mechanism mentioned in Clause 6.4. The disputed amount, if any, shall be dealt as per Article 13 of this Contract.

6.2.6. In the event the AMISP fails to meet a particular performance criterion as mentioned under the Service Level Agreement (SLA) specified in Section 5.6 of Schedule F of this Contract for cumulatively 3 (three) months in past 6 (six) months, resulting in the maximum penalty for the particular performance criterion, Utility may issue a SLA Default Notice to the AMISP directing it to take steps within 90 days to comply with the performance criterion specified in the SLA³.

6.3. TAXES AND DUTIES

6.3.1. For Goods whether supplied from or outside India, the AMISP shall be entirely responsible for all taxes, duties, stamp duties, license fees, and other such levies imposed outside India.

³ For example, in the event AMISP fails to meet the norm specified for “**Availability of AMI System per month**” for three consecutive months leading to levy of maximum penalty thereof.

- 6.3.2. The AMISP shall provide a copy of all paid tax challans/ receipts to APDCL related to implementation of the AMI system for record.
- 6.3.3. Any statutory increase or decrease in the taxes and duties including GST and Cess as applicable or in the event of introduction of new tax/cess or cessation of existing tax/cess subsequent to the AMISP's offer shall be dealt with in accordance with provisions of Change in Law.
- 6.3.4. Notwithstanding anything above or elsewhere in the Contract, in the event that the input tax credit of the GST charged by the AMISP is denied by the tax authorities to the Utility for reasons attributable to the AMISP, the Utility shall be entitled to recover such amount from the AMISP by way of adjustment from any of the subsequent invoices submitted by the AMISP to the Utility.

6.4. PAYMENT SECURITY MECHANISM

- (a) Within 90 (ninety) days of execution of this Contract, utility shall enter into a Tripartite Agreement, with the AMISP and designated Bank, to establish a separate current Project Account, to be operated on the principles of that of an Escrow Account, in the designated Bank for ensuring prompt payment to the AMISP; Bank shall act as the Project Account Agent;
- (b) This Project Account shall be linked to the Utility Bank Account (where its revenue from sale of power are deposited) as well as the AMISP's Bank Account (where the AMISP Monthly Fee shall be credited to);
- (c) The Project Account Agent would act as the sole authorizing agency for any transaction related to the Project Account in line with the agreed terms and conditions of the agreement;
- (d) In this Project Account, Utility agrees and confirms that during the Term of this contract, it shall maintain a Minimum clearing Balance of **1.1 times** of the AMISP Monthly Fee (as defined under Article 6.2);
- (e) The Utility will authorize the Project Account Agent to automatically withdraw from the Utility Bank Account. In the event, the balance of this Project Account falls below the Minimum Clearing Balance (as defined under clause A.1.(d), the Project Account Agent shall be authorized to automatically withdraw the deficit amount (Minimum Clearing Balance – Actual Balance) up to a maximum of Minimum Clearing Balance from the linked Utility Bank Account (as mentioned in clause A.1.(b)) within 1(one) working day;
- (f) Lumpsum payment to the AMISP, if any, shall be deposited in this Project Account and the same shall be transferred to the AMISP by the Project Account Agent as per agreed terms and conditions of its disbursement.

A.2. AMISP will raise and deliver the invoice (AMISP Monthly Fee) and the SLA performance report to the Utility, along with a duplicate copy of the invoice to the Project Account Agent, for the monthly payments within first 5(five) working days of every month

A.3. The Project Account Agent will duly notify the Utility upon receipt of any invoice (AMISP Monthly Fee) from the AMISP to the Utility within 1 (one)working day

A.4. Utility will examine/verify the invoice and the SLA performance report raised by the AMISP, (in accordance with Article 26) and deliver the AMISP Monthly Fee, penalties and liquidated damages if any to the AMISP, along with a duplicate copy to the Project Account Agent, by the second last day of the month in which the concerned invoice is raised

A.5. In case the Utility doesn't deliver the revised AMISP Monthly Fee, penalties and liquidated damages Approved Amount Report as per A.4, it shall be deemed that the entire invoice amount as raised

by the AMISP, in accordance with clause A.2, as undisputed by the Project Account Agent

A.6. In case of any difference in the amount due in accordance with Clause A.2 and A.4, the disputed portion of the AMISP Monthly fee shall be dealt with in accordance with Article 13.

A.7. The Project Account Agent shall either transfer the AMISP Monthly fee reduced by the liquidated damages and penalties (in accordance with clause A.4) or the AMISP Monthly fee (in accordance with clause A.5) based on whichever is applicable, from the funds available in the project Account within 1(one) working day from the notification after the expiry of time period specified in A.4. For the avoidance of doubt, the Project Account Agent shall make payments only if the utility fails to pay a undisputed AMISP Monthly Fee within and including the Due Date in accordance with clause A.4.

A.8. The expenses and fees, in relation to the opening of the Project Account and the execution and delivery of this Contract shall be borne by the Utility and the interest accrued, if any, thereon on the Project Account Balance shall be transferred quarterly by the Project Account Agent to the Utility.

A.9. Non payment of the undisputed eligible monthly payment to the AMISP by the utility by the last day of the month in which the concerned invoice has been raised by the AMISP shall attract a default interest of 6% per annum from the first day of the succeeding month till the utility makes full payment of such invoice (and the default interest calculated in accordance with this article) to the AMISP. AMISP's right to claim default interest is without prejudice to any of its right to terminate this AMISP Contract in accordance with the provisions of this Contract or any other right or remedy available to it under this Contract or Applicable Laws.

Illustration: If X number of smart meters are installed, integrated and operationalized till 31st January of a year, then invoice for monthly AMISP service charge against X number smart meters shall be submitted to the utility by the AMISP within the first 5(five) working days of February of the concerned year and default interest shall be payable to the AMISP by the utility if the undisputed eligible payment against the above-mentioned invoice is not made to the AMISP by 28th February of the concerned year.

ARTICLE 7: PERFORMANCE SECURITY

- 7.1. The AMISP/OEM partner of the AMISP in respect of this project has furnished initial Performance Security in the form of an irrevocable bank guarantee valid up to a period of 30 (thirty) months from the date of execution of the Contract or extended thereafter, to the tune of 3% of the Contract Value (as per Order No. F. 9/4/2020-PPD dated 12 November 2020 issued by Procurement Policy Division, Department of Expenditure, Ministry of Finance, Government of India) on the format prescribed in the RFP. However, in case of delay in Work Completion, the validity of the initial Performance Security shall be extended by the period of such delay. In the event delay is solely due to acts and/ or omission of the Utility cost of extending the validity of Performance Security shall be reimbursed to the AMISP by the Utility.
- 7.2. Upon Work Completion, the initial Performance Security shall be discharged by APDCL without any interest and returned to the AMISP not later than 14 (fourteen) working days following the date of Work Completion.
- 7.3. The AMISP/OEM partner of the AMISP in respect of this project shall, within 14 (fourteen) working days of date of Work Completion, provide a separate Performance Security in the form of an irrevocable bank guarantee valid up to a period of 6 (six) months beyond the end of the Contract Period or extended thereafter, to the tune of 3% of the Contract Value as determined in accordance with numbers of meters considered for Work Completion, in the format prescribed in the RFP. This separate Performance Security needs to be submitted prior to discharge of the initial Performance Security.
- 7.4. Any payments shall be made to the AMISP only after receipt of the initial Performance Security by APDCL.
- 7.5. Except in case of Force Majeure (in accordance with Article 9) and Utility Event of Default (in accordance with Article 11.2), APDCL may at its sole discretion invoke the Performance Security, and appropriate the amount secured there under, in the event that the AMISP commits any delay or default in the implementation of the AMI system during the Contract Period or fails to meet the specifications and standards agreed between with the Utility.
- 7.6. Upon Termination of the Contract due to Utility Event of default or expiry of the Contract Period, the separate Performance Security shall be discharged by APDCL without any interest and returned to the AMISP not later than 14 (fourteen) working days following the date of Termination of the Contract.

Upon Termination of the Contract due to AMISP Event of default, the Performance Security shall be encashed by APDCL.
- 7.7. In case of any delay by the AMISP in performing the activities of the scope of work with respect to the Project Implementation Schedule, then upon APDCL's request, the AMISP shall extend the validity of the separate Performance Security for the period for which the Contract is extended.
- 7.8. In case the AMISP/OEM partner of the AMISP in respect of this project furnishes a Performance Bank Guarantee for shorter duration (not less than 18 months) then it shall be the sole responsibility of the AMISP to get the Performance Bank Guarantee extended at least three months before the expiry date in order to maintain the validity time

ARTICLE 8: Liquidated Damages, Penalty and Incentive

- 8.1. Except in case of Force Majeure or where the delay in delivery of the Solution is caused due to any delay or default of APDCL **if the Project Implementation Schedule is delayed by more than 30 (thirty) months from the date of execution of the Contract** the AMISP shall be liable to pay liquidated damages as per the rates specified in this Article.
- 8.2. APDCL shall without prejudice to all its other remedies under the Contract, deduct from the AMISP Monthly Fee, as liquidated damages, 50% of AMISP Service Charge for delayed Goods or Related Services for delayed period up to a maximum period of 12 (twelve) months.
- < For example, in case AMISP delays installation of say 100 similar type of meters by say 5 months out of a total meter installation of 1000 meters assuming AMISP service charges as Rs. 50 /meter/month for such meter. Liquidated Damages would be worked as $5*50*100*50\%=Rs.12,500$. Maximum Liquidated Damages that can be deducted in case of delay of say 13 months is limited to 12 months i.e. $12*50*100*50\%=Rs.30,000$. Further, Liquidated Damages will be levied as per the delay of Goods i.e. if 80 meters are implemented after 5 months of delay and rest 20 meters are implemented after 12 months of delay, then LD would be $5*80*50*50\%+12*20*50*50\%=Rs.16,000$. Please note LD would be imposed only on delay on overall timelines i.e. Work Completion. In the event more than one type of meter are delayed, the LD would be calculated for each category of the meter on basis of their respective AMISP Service Charge >*
- 8.3. The AMISP shall be liable to penalties in the event of non-compliance of Service Level Agreements as specified in Schedule F of this Contract;
- 8.4. In the event the Solution supplied do not meet the minimum specifications as per the Contract, and the same is not replaced/ modified by the AMISP to meet the requirements within 14 (fourteen) working days of being informed by APDCL, or as mutually decided between APDCL and AMISP, APDCL shall reserve the right to terminate this Contract and recover liquidated damages by forfeiting the Performance Security submitted to APDCL.
- 8.5. In the event of termination in terms of Article 8.4 hereinabove, the Utility shall have the right to get the Solution by a third-party vendor of its choice at the risk and cost of AMISP.

ARTICLE 9: FORCE MAJEURE

9.1. A Force Majeure means any event or circumstance or combination of events and circumstances including those stated below that wholly or partly prevents or unavoidably delays an Affected Party in the performance of its obligations under this AMISP Contract, but only if and to the extent that such events or circumstances are not within the reasonable control, directly or indirectly, of the Affected Party and could not have been avoided if the Affected Party had taken reasonable care or complied with prudent utility practices:

a) Natural Force Majeure Events:

act of God, including, but not limited to drought, fire and explosion (to the extent originating from a source external to the site), earthquake, epidemic, volcanic eruption, landslide, flood, cyclone, typhoon, tornado, or exceptionally adverse weather conditions which are in excess of the statistical measures for the last 100 (hundred) years,

b) Non-Natural Force Majeure Events:

i) Direct Non–Natural Force Majeure Events

a. Nationalization or compulsory acquisition by any Governmental instrumentality of any material assets or rights of the AMISP; or

b. the unlawful, unreasonable or discriminatory revocation of, or refusal to renew, any Consents, Clearances and Permits required by the AMISP to perform their obligations under the Contract or any unlawful, unreasonable or discriminatory refusal to grant any other Consents, Clearances and permits required for the development/operation of the Project, provided that a Competent Court of Law declares the revocation or refusal to be unlawful, unreasonable and discriminatory and strikes the same down; or

c. any other unlawful, unreasonable or discriminatory action on the part of any Governmental instrumentality which is directed against the Project, provided that a competent Court of law declares the action to be unlawful, unreasonable and discriminatory and strikes the same down.

d. any partial or complete shut-down of the internet services in the Project area

ii) Indirect Non - Natural Force Majeure Events:

a. an act of war (whether declared or undeclared), invasion, armed conflict or act of foreign enemy, blockade, embargo, riot, insurrection, terrorist or military action, civil commotion or politically motivated sabotage;

b. radioactive contamination or ionizing radiation originating from a source in India or resulting from any other Indirect Non-Natural Force Majeure Event mentioned above, excluding circumstances where the source or cause of contamination or radiation is brought or has been brought into or near the Site by the Affected Party or those employed or engaged by the Affected Party; or

c. industry wide strikes and labour disturbances, having a nationwide impact in India.

9.2. FORCE MAJEURE EXCLUSIONS

9.2.1. Force Majeure shall not include (i) any event or circumstance which is within the reasonable control of the Parties and (ii) the following conditions, except to the extent that they are

consequences of an event of Force Majeure:

- i. Unavailability, late delivery, or changes in cost of the machinery, equipment, materials, spare parts etc. for the Project;
- ii. Delay in the performance of any Contractors or their agents;
- iii. Non-performance resulting from normal wear and tear typically experienced in transmission materials and equipment;
- iv. Strikes or labour disturbance at the facilities of the Affected Party;
- v. Insufficiency of finances or funds or the AMISP Contract becoming onerous to perform; and
- vi. Non-performance caused by, or connected with, the Affected Party's:
 - a. negligent or intentional acts, errors or omissions;
 - b. failure to comply with an Indian Law; or
 - c. breach of, or default under this AMISP Contract or any Project documents.

9.3. NOTIFICATION OF FORCE MAJEURE EVENT

9.3.1 The Affected Party shall give notice to the other Party of any event of Force Majeure as soon as reasonably practicable, but not later than 7 (seven) days after the date on which such Party knew or should reasonably have known of the commencement of the event of Force Majeure. If an event of Force Majeure results in a breakdown of communications rendering it unreasonable to give notice within the applicable time limit specified herein, then the Party claiming Force Majeure shall give such notice as soon as reasonably practicable after reinstatement of communications, but not later than 1(one) day after such reinstatement. Provided that such notice shall be a precondition to the Affected Party's entitlement to claim relief under this AMISP Contract. Such notice shall include full particulars of the event of Force Majeure, its effects on the Party claiming relief and the remedial measures proposed. The Affected Party shall give the other Party regular reports on the progress of those remedial measures and such other information as the other Party may reasonably request about the Force Majeure.

9.3.2 The Affected Party shall give notice to the other Party of (i) the cessation of the relevant event of Force Majeure; and (ii) the cessation of the effects of such event of Force Majeure on the performance of its rights or obligations under this AMISP Contract, as soon as practicable after becoming aware of each of these cessations.

9.4. DUTY TO PERFORM AND DUTY TO MITIGATE

9.4.1. To the extent not prevented by a Force Majeure Event, the Affected Party shall continue to perform its obligations as provided in this AMISP Contract. The Affected Party shall use its reasonable efforts to mitigate the effect of any event of Force Majeure as soon as practicable.

9.5. AVAILABLE RELIEF FOR A FORCE MAJEURE EVENT

9.5.1. Subject to this Article 9

- a) no Party shall be in breach of its obligations pursuant to this AMISP Contract except to the extent that the performance of its obligations was prevented, hindered or delayed due to a Force Majeure Event;
- b) every Party shall be entitled to claim relief for a Force Majeure Event affecting its performance in relation to its obligations under this AMISP Contract;
- c) in the event on the 10th anniversary of the date of execution of this AMISP Contract, the AMISP has not operated the AMI system for Total Meter-Months of operating the AMI system after Operational Go- Live due to a Force Majeure Event(s) the Utility shall extend the term of this AMISP Contract by such duration as may enable the operation of AMI system for the Total Meter-Months of operating the AMI System after Operational Go-Live.

ARTICLE 10: INTELLECTUAL PROPERTY

- 10.1. All Intellectual Property Rights in all material (including but not limited to all Source code, Object code, records, reports, designs, application configurations, data and written material, products, specifications, reports, drawings and other documents), which have been newly created and developed by the AMISP solely during the performance of Related Services and for the purposes of inter-alia use or sub-license of such services under this Contract, shall be the property of the AMISP. The AMISP undertakes to disclose all such material, which have been newly created and developed by the AMISP solely during the performance of Related Services and for the purposes of inter-alia use or sub-license of such services under this Contract, to the Utility. The AMISP hereby grants to APDCL a perpetual, non-exclusive, non-transferable, irrevocable, royalty-free license to use all material disclosed to the Utility under the Contract. Nothing contained herein shall be construed as transferring ownership of any Intellectual Property Right from the AMISP to the Utility.
- 10.2. The AMISP shall ensure that while it uses any software, hardware, processes, document or material in the course of performing the Services, it does not infringe the Intellectual Property Rights of any person and the AMISP shall keep APDCL indemnified against all costs, expenses and liabilities howsoever, arising out any illegal or unauthorized use (piracy) or in connection with any claim or proceedings relating to any breach or violation of any permission/license terms or infringement of any Intellectual Property Rights by the AMISP or its personnel during the course of performance of the Related Services. In case of any infringement by the AMISP, the AMISP shall have sole control of the defence and all related settlement negotiations
- 10.3. Subject to Article 10, the AMISP shall retain exclusive ownership of all methods, concepts, algorithms, trade secrets, software documentation, other intellectual property or other information belonging to the AMISP that existed before the date of execution of the Contract.

ARTICLE 11: TERMINATION

11.1. AMISP EVENT OF DEFAULT

11.1.1. AMISP Event of Default means any of the following events arising out of any acts or omission of AMISP, its representative, sub-contracts, employees and which have not occurred solely as a result of any breach of this Contract by the Utility or due to Force Majeure, and where AMISP has failed to remedy these events within a period of 90 (ninety) days of issuance of a notice by Utility requiring AMISP to remedy such event.

- a) AMISP has failed to procure and arrange requisite finances for the implementation of the Project;
- b) AMISP abandons the implementation of the Project or repudiates this Contract or otherwise takes any action, or evidences or conveys an intention not to be bound by the Contract;
- c) AMISP, in the judgment of APDCL has engaged in corrupt, fraudulent, collusive, or coercive practices, in competing for or in executing the Contract; or
- d) AMISP is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for AMISP or for the whole or material part of its assets that has a material bearing on its ability to implement the Project;
- e) AMISP has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that in the reasonable opinion of APDCL would adversely affect AMISP's ability to implement the Project;
- f) A resolution for winding up of AMISP is passed, or any petition for winding up of AMISP is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (Ninety) days of the date thereof or AMISP is ordered to be wound up by a court of competent jurisdiction;
- g) In the event AMISP fails to cure the default as indicated in the SLA Default Notice within the time period specified therein;
- h) Failure of AMISP to furnish Performance Security in accordance with the provisions of this Contract;
- i) Failure of AMISP to provide Solution in accordance with Specifications as mentioned in the Schedule F;
- j) Any representation or warranty made by the AMISP during the term of the Contract is found to be false and/or misleading;
- k) Failure on account of AMISP to abide by Applicable Laws and regulations;
- l) The shareholding of the AMISP ceases to be in accordance with the provisions of this Contract;
- m) No person having System Integration (SI) experience in terms of the RFP remains a shareholder of the AMISP;
- n) In the event equipment installed or proposed to be installed by the AMISP is found to have any embedded malware/ trojans/ cyber threat;
- o) AMISP fails to comply with the local content requirement as specified in the Bid Submission;
- p) AMISP fails to comply with any of its material obligations under this Contract.

11.2. UTILITY EVENT OF DEFAULT

11.2.1. Utility Event of Default means any of the following events, unless such event has occurred as a consequence of the AMISP Event of Default or a Force Majeure event and where Utility has failed to remedy these events within a period of 90 (ninety) days of issuance of a notice by AMISP requiring Utility to remedy such event:

- a) Utility is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for Utility or for the whole or material part of its assets that has a material bearing on its ability to perform its obligations under this Contract;

- b) Utility has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that in the reasonable opinion of AMISP would adversely affect Utility's ability to perform its obligations under this Contract;
- c) A resolution for winding up of Utility is passed, or any petition for winding up of Utility is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within [90 (Ninety)] days of the date thereof or Utility is ordered to be wound up by a court of competent jurisdiction;
- d) The breach by Utility of its obligations under this Contract which has an adverse effect on the performance of AMISP's obligations under this Contract;
- e) Failure of Utility to pay the Monthly AMISP Fee in accordance with Article 6.2 or any other payment due from Utility under this Contract and more than 90 (ninety) days have elapsed since such payments became due;

11.3. TERMINATION FOR AMISP EVENT FOR DEFAULT

11.3.1. Without prejudice to any other right or remedy which Utility may have in respect thereof under this Contract, upon the occurrence of AMISP Event of Default, Utility shall be entitled to terminate this Contract in the manner provided in Article 11.3.2.

11.3.2. Utility shall issue a Preliminary Notice to AMISP providing 90 (Ninety) Days, or such extended period as the Utility may allow, to cure the underlying Event of Default. If AMISP fails to cure the underlying Event of Default within such period allowed, Utility shall be entitled to terminate this Contract by issuing a termination notice to AMISP.

11.4. TERMINATION FOR UTILITY EVENT FOR DEFAULT

11.4.1. Without prejudice to any other right or remedy which AMISP may have in respect thereof under this Contract, upon the occurrence of a Utility Event of Default, AMISP shall be entitled to terminate this Contract in the manner provided in Article 11.4.2.

11.4.2. AMISP shall issue a Preliminary Notice to Utility providing 90 (Ninety) Days, or such extended period as the AMISP may allow, to cure the underlying Event of Default. If Utility fails to cure the underlying Event of Default within such period allowed, AMISP shall be entitled to terminate this Contract by issuing a termination notice to Utility.

11.5. CONSEQUENCES OF TERMINATION

Upon Termination of the Contract, the AMISP shall:

11.5.1. Notwithstanding anything to the contrary contained in this Contract, any termination of this Contract pursuant to its term shall be without prejudice to accrued rights of any Party, including its right to claim and recover damages and other rights and remedies which it may have in law or contract. All accrued rights and obligations of any of the Parties under this Contract, shall survive the termination of this Contract to the extent such survival is necessary for giving effect to such rights and obligations.

11.5.2. Following issue of the Termination Notice by Utility or AMISP, Utility take possession and control of [AMISP]'s control room and call centre and the exclusivity granted to [AMISP] under Article 5 will come to an end.

11.5.3. Upon termination of this Contract by APDCL or AMISP on account of [AMISP]'s Event of Default (in accordance with Article 11.1), or termination of this Contract on account of APDCL's event of default (in accordance with Article 11.2), , [AMISP] shall be entitled to a termination payment subject to proper transfer of the installed AMI System, as agreed mutually upon, basis the following criteria:

- a) In case termination of this Contract on account of [AMISP]'s event of default: Termination payment to AMISP after Work Completion has been declared shall be [60]% of the termination payment Value as determined in terms of this Contract.
- b) In case termination of this Contract on account of APDCL's event of default: Termination payment to AMISP after Work Completion has been declared shall be [100]% of the termination payment Value as determined in terms of this Contract.
- c) In case termination of this Contract prior to Work Completion the Termination payment shall be equal to:
 - i. [60]% of the value of the assets proposed to be handed over to the Utility as certified by an independent valuer in the event termination is on account of AMISP event of default—and
 - ii. [100%] of the asset values shall be paid to the AMISP in the event termination is on account of Utility event of default

For the avoidance of doubt, it is clarified that in the event lumpsum payment in terms of Article 6 has been made then such payment shall be reduced from the amount determined in accordance with this Article 11.5.3.(c)

- d) In case termination of the Contract prior to-the Work Completion- The Goods that are complete and ready for shipment within 28 (twenty-eight) days after the AMISP's receipt of the Notice of termination shall be taken into account while determining value of the assets proposed to be handed over to the Utility.
- e) In the event of termination prior to Work Completion, Utility may request the AMISP to complete any part of the Solution. The cost of such works shall be agreed between the Parties. In the event Parties deem it appropriate the cost may be determined by the Independent Valuer.

Upon termination of this Contract by APDCL or AMISP on account of [AMISP]'s Event of Default (in accordance with Article 11.1), or termination of this Contract on account of APDCL's event of default (in accordance with Article 11.2), [AMISP] shall be entitled to raise a supplementary invoice for an amount which is equal to the termination payment. The Supplementary invoice shall be paid separately by the Utility within 30 (thirty) days from the date of such invoice.

11.5.4. The Termination payment value would be calculated basis the following mechanism:

- a) The present value of the receivables for the AMI system installed shall be calculated by multiplying the outstanding meter-months of operating the AMI system with percentage of total meters installed, integrated and operationalized as on the date of termination, and AMI Service Charge, and discounting the same as on date of termination at [12]% (“**Present Value**”).
- b) All amounts due, but not paid by the Utility, including the aggregated AMISP Monthly Fee, but not paid or recovered from the Utility, for the AMI system operations and maintenance as defined in the RFP by the AMISP, shall be calculated and factored in to arrive at the net outstanding receivables of the AMISP (“**Outstanding Receivables**”);
- c) All amounts due, but not paid by the AMISP, including the aggregated applicable liquidated damages and/(or) penalties due to non-compliance of SLAs by the AMISP, but not paid or recovered from the AMISP, for the AMI system operations and maintenance as defined in the RFP by the AMISP, shall be calculated and factored in to arrive at the net outstanding payables by the AMISP (“**Outstanding Payables**”);
- d) Termination Payment Value shall be equal to the sum of Net Present Value and Outstanding Receivables as per Article 11.5.4.(a) and (b); reduced by Outstanding Payables as per Article

11.5.4.(c) and the sum of insurance proceeds received by the AMISP for the AMI system, (if any).

11.5.5. Upon Termination of the Contract or expiry of the contract period, the AMISP shall prepare and present a detailed Exit Management Plan within 5 (five) working days of termination notice receipt to the APDCL (“**Exit Management Plan**”) in accordance with Schedule B to this Contract.

11.5.6. The APDCL or its nominated agency will review the Exit Management plan. If approved, AMISP shall start working on the same immediately. If the plan is rejected, AMISP shall prepare alternate plan within 2(two) working days. If the second plan is also rejected, APDCL will provide a plan for AMISP and it should be adhered by in totality.

11.5.7. The Exit Management Plan should cover at least the following:

- a) Execute all documents that may be necessary to effectively transfer the ownership and title, including OEM warranties in respect of all equipment;
- b) Handover all developed codes, related documentation and other Configurable Items, if any in his possession;
- c) Handover the list of all IT Assets, passwords at all locations to APDCL.

11.5.8. The AMISP and the Authorized personnel from APDCL will sign a completion certificate at the end of successful completion (all points tracked to closure) of the Exit Management Plan.

ARTICLE 12: LIABILITY/ INDEMNITY

- 12.1. The AMISP hereby agrees to indemnify APDCL, for all conditions and situations mentioned in this Article, in a form and manner acceptable to APDCL. The AMISP agrees to indemnify APDCL and its officers, servants, agents (“ APDCL Indemnified Persons”) from and against any costs, loss, damages, expense, claims including those from third parties or liabilities of any kind howsoever suffered, arising or incurred inter alia during and after the Contract Period out of:
- a) any negligence or wrongful act or omission by the AMISP or its agents or employees or any third Party associated with AMISP in connection with or incidental to this Contract; or
 - b) any infringement of patent, trademark/copyright or industrial design rights arising from the use of the supplied Solution or any part thereof.
- 12.2. The AMISP shall also indemnify APDCL against any privilege, claim or assertion made by third party with respect to right or interest in, ownership, mortgage or disposal of any asset, property, movable or immovable as mentioned in any Intellectual Property Rights, licenses and permits.
- 12.3. Without limiting the generality of the provisions of the Article 12.1 and 12.2, the AMISP shall fully indemnify, hold harmless and defend APDCL Indemnified Persons from and against any and all suits, proceedings, actions, claims, demands, liabilities and damages which APDCL Indemnified Persons may hereafter suffer, or pay by reason of any demands, claims, suits or proceedings arising out of claims of infringement of any domestic or foreign patent rights, copyrights or other intellectual property, proprietary or confidentiality rights with respect to the Solution, information, design or process supplied or used by the AMISP in performing the AMISP’s obligations or in any way incorporated in or related to the Project. If in any such suit, action, claim or proceedings, a temporary restraint order or preliminary injunction is granted, the AMISP shall make every reasonable effort, by giving a satisfactory bond or otherwise, to secure the suspension of the injunction or restraint order. If, in any such suit, action, claim or proceedings, the Solution or any part thereof or comprised therein, is held to constitute an infringement and its use is permanently enjoined, the AMISP shall promptly make every reasonable effort to secure for APDCL a license, at no cost to APDCL, authorizing continued use of the infringing work. If the AMISP is unable to secure such license within a reasonable time, the AMISP shall, at its own expense, and without impairing the specifications and standards, either replace the affected work, or part, or process thereof.

12.4. SURVIVAL ON TERMINATION

- 12.4.1. The provisions of this Article 12 shall survive the Termination of the Contract

12.5. DEFENCE OF CLAIMS

- 12.5.1. If any proceedings are brought or any claim is made against APDCL arising out of the matters referred to in Article 12, APDCL shall promptly give the AMISP a notice thereof, and the AMISP may at its own expense and in APDCL’s name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claims.
- 12.5.2. If the AMISP fails to notify APDCL within 28 (twenty-eight) days after receipt of such notice that it intends to conduct any such proceedings or claim, then APDCL shall be free to conduct the same on its own behalf.
- 12.5.3. APDCL shall, at the AMISP’s request, afford all available assistance to the AMISP in conducting such proceedings or claim, and shall be reimbursed by the AMISP for all reasonable expenses incurred in so doing.

12.6. LIMITATION OF LIABILITY

12.6.1. Except in cases of gross negligence or wilful misconduct:

- a) Neither Party shall be liable to the other Party for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the AMISP to pay liquidated damages to the APDCL; and
- b) The aggregate liability of the AMISP to APDCL, whether under the Contract, in tort, or otherwise, shall not exceed the Contract Value. Provided that this limitation shall not apply to the cost of repairing or replacing defective equipment, or to any obligation of the AMISP to indemnify APDCL with respect to infringement of any Intellectual Property Rights.

ARTICLE 13: GOVERNING LAW AND SETTLEMENT OF DISPUTES

- 13.1. APDCL and the AMISP shall make every effort to resolve amicably any disagreement or dispute arising between them under or in connection with the Contract, by direct informal negotiation.
- 13.2. If APDCL and the AMISP fail to resolve such a dispute (the date of commencement of the dispute shall be taken from the date when this Article reference is quoted by either Party in a formal communication clearly mentioning existence of dispute or as mutually agreed) or difference by mutual consultation within 28 (twenty-eight) days from the commencement of such consultation, either Party may require that the dispute be referred for resolution to the formal mechanisms specified in this Article.13.
- 13.3. All disputes or differences in respect of which the decision, if any, has not become final or binding as aforesaid shall be settled by arbitration in the manner hereinafter provided. The arbitration shall be conducted by three arbitrators, one arbitrator each to be nominated by the AMISP and the APDCL and the third to be appointed as the presiding arbitrator by both the arbitrators in accordance with the Arbitration and Conciliation Act,1996. If either of the parties fails to appoint its nominee arbitrator within 60 (sixty) days after receipt of a notice from the other party invoking the arbitration, the nominee arbitrator appointed by one of the party invoking the arbitration clause shall act as the sole arbitrator to conduct the arbitration under the Arbitration and Conciliation Act 1996, as amended from time to time.
- 13.4. The arbitration shall be conducted in accordance with the provisions of the Arbitration and Conciliation Act, 1996 or any statutory modification thereof. The seat of arbitration shall be Guwahati, Assam
- 13.5. The Contract shall be governed by and interpreted in accordance with laws of the India. The Gauhati High Court shall have exclusive jurisdiction in all matters arising under this Contract.
- 13.6. Parties to Perform Obligations: Notwithstanding the existence of any Dispute and difference referred to the Arbitration Tribunal as provided in Article 13.3 and save as the Arbitration Tribunal may otherwise direct by a final or interim order, the Parties hereto shall continue to perform their respective obligations (which are not in dispute) under this Contract.

ARTICLE 14: CHANGE ORDER

14.1. Change Orders and Contract Amendments

14.1.1. APDCL may at any time direct the AMISP through a written notice to change the number of meters proposed to be installed (“**Change Order**”). No Change Order that has the effect of varying the number of meters to be installed beyond +/- 20% of the original number of meters shall be issued by the Utility without prior consent of AMISP.

Provided however that upon expiry of time period specified in 3.3.2(o) of this AMISP Contract if the Utility has not been able to provide clearance/ approval/ permits for installation of the meters, the Utility shall issue a Change Order no later than 7 days of expiry of such time period confirming the actual number of meters for which clearance/ approval/ permits is available.

14.1.2. In the event a Change Order causes an increase or decrease in the time required for, the AMISP’s performance of any provisions under the Contract, an equitable adjustment shall be made in the Project Implementation Schedule as provided in Schedule A of this AMISP Contract and the Contract shall accordingly be amended. Any claims by the AMISP or the Utility for adjustment under this Article must be asserted within 28 (twenty-eight) days from the date of the AMISP’s receipt of the Change Order. The Parties agree that any change in the delivery and Project Implementation Schedule shall result in an proportional change in the Term of the Contract.

14.1.3. In the event a Change Order, issued up to 24 months after the date of execution of this AMISP Contract, modifies the total number of Smart Meters to be installed then such revised quantity shall be deemed to be the basis for determination of Work Completion.

14.1.4. The Total meter-months of operating the AMI System after Operational Go-Live shall be computed taking into account all Change Orders issued by the Utility.

14.1.5. No Change Order for reduction of quantity shall be issued after Work Completion. In the event of loss of a consumer after Work Completion the Utility may request the AMISP to relocate a Smart Meter at a different location, however AMISP shall continue to receive the AMISP Service Charge *qua* all the Smart Meters installed.

ARTICLE 15: MISCELLANEOUS

15.1. WAIVER

15.1.1. Subject to Article 15.1.2, no relaxation, forbearance, delay, or indulgence by either Party in enforcing any of the terms and conditions of the Contract or the granting of time by either Party to the other shall prejudice, affect, or restrict the rights of that Party under the Contract. Neither shall any waiver by either Party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract.

15.1.2. The waiver by either Party of a breach or default of any of the provisions of this Contract by the other Party shall not be interpreted as:

- a) A waiver of any succeeding breach of the same or other provision, nor shall any delay or omission on the part of the other Party to exercise; or
- b) A way to avail itself of any right, power, or privilege that it has or may have under this contract to operate as waiver of any breach or default by the other Party.
- c) Any waiver of a Party's rights, powers, or remedies under the Contract must be in writing, dated, and signed by an authorized representative of the Party granting such waiver, and must specify the right and the extent to which it is being waived.

15.2. EXTENSIONS OF TIME

15.2.1. If at any time during performance of the Contract, the AMISP or its subcontractors should encounter conditions impeding timely delivery of the Goods or completion of Related Services pursuant to this Contract, the AMISP shall promptly notify APDCL in writing of the delay, its likely duration, and its cause. As soon as practicable after receipt of the AMISP's notice, APDCL shall evaluate the situation and may at its discretion extend the AMISP's time for performance, in which case the extension shall be ratified by the Parties by amendment of the Contract.

15.2.2. Except in case of Force Majeure, as provided in Article 9 or where the delay in delivery of the Goods or completion of Related Services is caused due to any delay or default of APDCL, any extension granted under Article 15.2.1 shall not absolve the AMISP from its liability to the pay of liquidated damages pursuant to Article 8. Time will be the essence of the Contract and no variation shall be permitted in the delivery time/delivery schedule mentioned in the order unless agreed by APDCL. The AMISP is expected to implement the systems for the project area as per the schedule indicated in the Contract.

15.3. INSURANCE

15.3.1. The Goods supplied under the Contract shall be fully insured by the AMISP against loss or damage incidental to manufacture or acquisition, transportation, storage, delivery, and operations, in the manner specified in the Contract.

15.3.2. The AMISP shall furnish to the Utility copies of certificates and policies of the Insurances as soon as they are effected and renewed by or on behalf Of the AMISP from time to time in terms of Article 15.

15.4. TRANSPORTATION

15.4.1. The AMISP shall at its own risk and expense transport all the AMISP's equipment to the site by the mode of transport that the AMISP judges most suitable under all the circumstances.

15.4.2. Unless otherwise provided in the Contract, the AMISP shall be entitled to select any safe mode of transport operated by any person to carry the AMISP's equipment.

15.4.3. The AMISP shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the AMISP's equipment to the Project site. APDCL shall use its best endeavours in a timely and expeditious manner to assist the AMISP in obtaining such approvals, if requested by the AMISP.

ARTICLE 16: CONFIDENTIAL INFORMATION

- 16.1. Both AMISP and APDCL undertake to each other to keep confidential all information (written as well as oral) concerning the business and affairs of the other, which has been obtained or received as a result of the discussions leading up to or the entering of the Contract.
- 16.2. After the entering of the Contract, APDCL and the AMISP shall keep confidential and shall not, without the written consent of the other Party hereto, divulge to any third party any documents, data, or other information furnished directly or indirectly by the other Party hereto in connection with the Contract, whether such information has been furnished prior to, during or following completion or termination of the Contract. Notwithstanding the above, the AMISP may furnish to its subcontractors such documents, data, and other information it receives from APDCL to the extent required for the subcontractors to perform its work under the Contract, in which event the AMISP shall obtain from such subcontractors an undertaking of confidentiality similar to that imposed on the AMISP under this Article 16.
- 16.3. APDCL shall not use such documents, data, and other information received from the AMISP for any purposes unrelated to the Contract. Similarly, the AMISP shall not use such documents, data, and other information received from APDCL for any purpose other than the design, procurement, or other work and services required for the performance of the Contract.
- 16.3.1. The obligation of a Party under Articles 16.1 and 16.2 above, however, shall not apply to information that:
- a) APDCL or AMISP need to share with the institutions participating in the financing of the Contract;
 - b) now or hereafter enters the public domain through no fault of that Party;
 - c) can be proven to have been possessed by that Party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other Party; or
 - d) Otherwise lawfully becomes available to that Party from a third Party that has no obligation of confidentiality.
- 16.3.2. The above provisions of this Article 16 shall not in any way modify any undertaking of confidentiality given by either of the Parties hereto prior to the date of execution of the Contract in respect of the Supply or any part thereof.
- 16.3.3. Each of the Parties to this Contract, undertakes to the other to take all such steps as shall from time to time be necessary to ensure compliance with the provisions of the above Articles by its employees, agents and sub-contractors.
- 16.3.4. The provisions of this Article 16 survive completion or termination, for whatever reason, of the Contract.

ARTICLE 17: SUBCONTRACTING

- 17.1. The AMISP shall be permitted to appoint subcontractor(s) so as to meet its obligations under the Contract with APDCL, with intimation to the APDCL, provided they ensure that any person engaged by AMISP are not blacklisted/ barred by any Government organization or regulatory agencies or Government Undertaking (as defined under the RFP).
- 17.2. AMISP shall engage only such sub-contractor(s) who satisfy the eligibility requirement in terms of applicable laws including the guidelines issued vide Order No. F/No.6/18/2019-PPD by Ministry of Finance, Department of Expenditure, Public Procurement Division dated 23 July 2020 and as amended from time to time.

ARTICLE 18: WARRANTY

- 18.1. The AMISP warrants that all the Goods that would be used as part of Solution would be new, unused, and of the most recent or current models, and that they incorporate all recent improvements in design and materials, unless provided otherwise in the Contract.
- 18.2. The AMISP further warrants that the Goods shall be free from defects arising from any act or omission of the AMISP or arising from design, materials, and workmanship, under normal use in the conditions prevailing in the country of final destination.
- 18.3. The warranty of the AMI system shall remain valid till expiry of the Contract Period.
- 18.4. The AMISP shall be responsible for comprehensive maintenance of all the equipment and systems supplied & installed under this Contract during the Operational Period. There may be some variation during detailed engineering. AMISP will have to make their own assessment of the systems and deploy manpower accordingly. However, it is to be ensured that specified manpower of requisite qualification is deployed.
- 18.5. The maintenance of the system supplied & installed by the AMISP shall be comprehensive. The AMISP shall be responsible for providing all the spares as mentioned in Schedule F of this Contract. The spares shall be maintained by the AMISP at no extra cost to Utility.

ARTICLE 19: CHANGE IN LAWS AND REGULATIONS

- 19.1. Unless otherwise specified in the Contract, if after the Bid due date any law, regulation, ordinance, order or bylaw having the force of law is enacted, promulgated, abrogated, or changed in India where the sites is located (which shall be deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the project delivery, then such delivery shall be correspondingly amended, to the extent that the AMISP has thereby been affected in the performance of any of its obligations under the Contract.
- 19.2. The Party affected by a change in law shall give notice giving details of the likely impact of the change in law. The Parties shall negotiate in good faith to place the affected party at the same economic position as if no change in law had occurred. Provided only such change in law events which have financial impact beyond a threshold of [1% of the Contract Value] are to be considered for the purposes of grant of relief to the affected Party.
- 19.3. Notification of Change In Law: If the AMISP is affected by a Change in Law in accordance with Article 19.1 and wishes to claim relief for such Change in Law under this Article 19, it shall give notice to Utility of such Change in Law as soon as reasonably practicable after becoming aware of the same. Any notice served pursuant to Articles 19 shall provide, amongst other things, precise details of the Change in Law and its effect on the AMISP.

ARTICLE 20: SEVERABILITY

- 20.1. If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract or the Contract as a whole and the remaining provisions of the Contract shall remain in full force and effect.

ARTICLE 21: LANGUAGE

- 21.1. The official language of the Contract is English. Contract as well as all correspondence and documents relating to the Contract exchanged by the AMISP and APDCL, shall be written in English. Supporting documents and printed literature that are part of the Contract may be in another language provided they are accompanied by an accurate translation of the relevant passages in English, in which case, for purposes of interpretation of the Contract, the English translation shall govern.
- 21.2. The AMISP shall bear all costs of translation to English and all risks of the accuracy of such translation. The AMISP shall be bound to the English translation and what has been stated therein.

ARTICLE 22: ASSIGNMENT

- 22.1. The AMISP shall not assign, in whole or in part, their obligations under this Contract without prior permission of the Utility.
- 22.2. The permission for assignment of whole or part of this contract shall only be requested/permitted at least two years after Work Completion.

ARTICLE 23: ENTIRE AGREEMENT

- 23.1. This Contract along with all its annexures, schedule and the provisions of the RFP reflect the entire understanding of the Parties.
- 23.2. No variation or modification of the terms of the Contract shall be made except by written amendment signed by the Parties.

ARTICLE 24: DISCLAIMER

- 24.1. APDCL reserves the right to share, with any consultant of its choosing, any resultant proposals in order to secure expert opinion.
- 24.2. APDCL reserves the right to accept any proposal deemed to be in the best interest of the APDCL.

ARTICLE 25: PUBLIC DISCLOSURE

- 25.1. All materials provided to APDCL by the AMISP may be disclosed in accordance with the provisions of applicable law including but not limited to the Right To Information Act, 2005 (RTI), etc.
- 25.2. The AMISP's team shall not make or permit to be made a public announcement or media release about any aspect of this Contract unless APDCL first gives the AMISP its written consent.

ARTICLE 26: SLA AUDIT

- 26.1. A designated team/ person from APDCL may review the system generated SLA performance report of AMISP each month. The review/ audit report will form basis of any action relating to imposing penalty on or breach of Contract of the AMISP .
- 26.2. In case, there is no review/ audit report submitted within 10 (ten) working days of every month, it shall be deemed that all SLAs were met in the previous month.

Article 27 ADHERENCE TO SAFETY PROCEDURES, RULES, REGULATIONS AND RESTRICTION

- 27.1. AMISP shall comply with the provision of all laws including labour laws, rules, regulations and notifications issued there under from time to time. All safety and labour laws enforced by statutory agencies and by APDCL shall be applicable in the performance of this Contract and AMISP's team shall abide by these laws.
- 27.2. Access to the APDCL's locations shall be strictly restricted. No access to any person except the designated personnel belonging to the AMISP who are genuinely required for execution of work or for carrying out management/maintenance who have been explicitly authorized by APDCL shall be allowed entry to the APDCL's locations. Even if allowed, access shall be restricted to the pertaining equipment of APDCL only. The AMISP shall maintain a log of all such activities.
- 27.3. The AMISP shall take all measures necessary or proper to protect the personnel, work and facilities and shall observe all reasonable safety rules and instructions. AMISP's team shall adhere to all security requirement/regulations of APDCL during the execution of the work. APDCL's employees and associates also shall comply with safety procedures/policy.
- 27.4. The AMISP shall report as soon as possible any evidence, which may indicate or is likely to lead to an abnormal or dangerous situation and shall take all necessary emergency control steps to avoid such abnormal situations.
- 27.5. APDCL will be indemnified for all the situations mentioned in this Article in the similar way as defined in Article 12.

ARTICLE 28: NON-SOLICITATION OF STAFF

- 28.1. For the purpose of this Contract, all Parties to this Contract agree, not to solicit either directly or indirectly with a view to provide or offer employment to, offer to contract with or entice a staff member of the other Party to leave without the consent of the other during the Term of the Contract and for an additional period of 180 (one-hundred and eighty) days after termination.

ARTICLE 29: SURVIVAL

- 29.1. The Articles of this contract, which by nature are intended to survive termination of this Contract, shall remain in effect after such termination.

ARTICLE 30: NOTICES

- 30.1. All notices to be given under this Contract shall be in writing and in the English language.
- 30.2. A Notice shall be effective when delivered or on the notice effective date, whichever is later.
- 30.3. All notices must be delivered personally, by registered or certified mail or by facsimile transmission or email.
- 30.4. All notices shall be effective:
 - 30.4.1. If sent by facsimile transmission or email, when sent (on receipt of confirmation of the correct number or address);
 - 30.4.2. If sent by registered post or certified mail, within 5 (five) days of dispatch;
 - 30.4.3. If delivered personally, on receipt by intended recipient, provided that all notices given by facsimile transmission shall be confirmed by registered or certified mail.
- 30.5. Each party shall forthwith notify the other party of any change in its address to which notices under this Contract are to be delivered, mailed or facsimiled.

IN WITNESS WHEREOF, the AMISP, the Selected Bidder and the APDCL, executed these presents and affixed common seals of their respective companies on the Day, Month and Year first mentioned above.

1. Common Seal of APDCL has been affixed in my/ our presence pursuant to Board Resolution dated

.....
.....
.....

For APDCL

[Signature of Authorized Representative]

.....
.....

[Name of the Authorized Representative] [Designation of the Authorized Representative]

2. Common Seal of [Name of the Lead Consortium Member/ Sole Bidder], has been affixed in my/ our presence pursuant to Board Resolution dated

For [Selected Bidder]

[Name of the Lead Consortium Member/ Sole Bidder], [Signature of Authorized Representative]

.....
.....

[Name of the Authorized Representative] [Designation of the Authorized Representative]

3. Common Seal of [Name of the AMISP], has been affixed in my/ our presence pursuant to Board Resolution dated

For [AMISP]

[Name of the AMISP], [Signature of Authorized Representative]

.....
.....

[Name of the Authorized Representative] [Designation of the Authorized Representative]

WITNESS:

1.

.....

.....

Designation.....

.....

(Signature)
Name

2.

(Signature)
Name

.....

.....

Designation.....

.....

Attested:

.....

..... [Signature]

(Notary Public)

Place:

Date:

FORM 1: FORMAT OF PERFORMANCE SECURITY BANK GUARANTEE TO BE PROVIDED BY AMISP

[To be on non-judicial stamp paper of Rupees One Hundred Only (INR 100/-) or appropriate value as per Stamp Act relevant to place of execution, duly signed on each page. Foreign entities submitting Bid are required to follow the applicable law in their country]

Reference No. Bank Guarantee No. Dated:

..... To:
The Chief General Manager (PP&D)
APDCL

Dear Sir/ Madam,

WHEREAS..... *[Insert name of the AMISP]* having its registered office at *[Insert address of the AMISP]* (hereinafter, the “Contractor”), subsequent to participation in Tender No. [Tender Details] (the “RFP”) issued by APDCL (hereinafter, the “Beneficiary”) for Appointment of AMI Service Provider for Implementation of AMI Project, have been selected as the AMISP. AMISP entered into a contract dated [•] with the Utility for execution of the Scope of Work (“**AMISP Contract**”).

And WHEREAS a Bank Guarantee for Rupees *[Insert amount in words equivalent]* (.....) *[Insert amount in figures]* valid till..... *[Insert contract period]* is required to be submitted by the Contractor as per the terms and conditions of the AMISP Contract.

We,.....*[Insert name of the Bank and address of the Branch giving the Bank Guarantee]* having our registered office at*[Insert address of the registered office of the Bank]* hereby give this Bank Guarantee No.*[Insert Bank Guarantee number]* dated*[Insert the date of the Bank Guarantee]*, and hereby agree unequivocally and unconditionally to pay immediately on demand in writing from the Beneficiary any officer authorized by it in this behalf any amount not exceeding Rupees *[Insert amount in words]* (.....) *[Insert amount in figures]* to the said Beneficiary on behalf of the Contractor.

We *[Insert name of the Bank]* also agree that any default by the AMISP of any of the provisions of the Contract entered into with Utility during the term of the Contract or any violation to the relevant terms stipulated in the RFP would constitute a default on the part of the AMISP and that this Bank Guarantee is liable to be invoked and encashed within its validity by the Beneficiary in case of any occurrence of a default on the part of the AMISP and that the encashed amount is liable to be forfeited by the Beneficiary.

This agreement shall be valid and binding on this Bank up to and inclusive of *[Insert the date of validity of the Bank]* and shall not be terminable by notice or by change in the constitution of the Bank or the firm of the Selected Bidder and/ or the AMISP or by any reason whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations or alternations made, given, conceded with or without our knowledge or consent by or between the Selected Bidder and the Beneficiary.

NOTWITHSTANDING anything contained hereinbefore, our liability under this guarantee is restricted to Rupees *[Insert amount in words equivalent]*. Our Guarantee shall remain in force till *[Insert the contract period]*. Unless demands or claims under this Bank Guarantee are made

to us in writing on or before..... [*Insert contract period*], all rights of the Beneficiary under this Bank Guarantee shall be forfeited, and we shall be released and discharged from all liabilities there under.

[Insert the address of the Bank with complete postal branch code, telephone and fax numbers, and official round seal of the Bank]

[Insert signature of the Bank's Authorized Signatory]

Attested:

..... [Signature] (Notary Public)

Place: Date:

INSTRUCTIONS FOR SUBMITTING BANK GUARANTEE

1. Bank Guarantee to be executed on non-judicial stamp paper of appropriate value as per Stamp Act relevant to place of execution.
2. The Bank Guarantee by Selected Bidder shall be given from any Scheduled Bank having a branch in Guwahati.
3. The full address along with the Telex/Fax No. and e-mail address of the issuing bank to be mentioned.

SCHEDULE A: PROJECT IMPLEMENTATION SCHEDULE

The Project Implementation Schedule for AMI system establishment and timelines for Related Services milestones from date of execution of the Contract are given below:

S.No.	Milestone	Timeline (in months)
1.	Submission of detailed Project Implementation Plan giving the compliance sheet along with the make and model of various infrastructure, hardware & software that are proposed for delivery and operations incl.: <ul style="list-style-type: none"> • Specification of System • Architecture and Software Solution 	Within 60 days from the date of execution of the Contract
2.	Approval of detailed Project Implementation Plan by Utility	Within 15 days from the date of submission of Project Implementation Plan.
3.	<ul style="list-style-type: none"> • Delivery, site installation and commissioning of Network Operations cum Monitoring Centre with related hardware, software and equipment; and • Delivery, site installation, integration and operationalization of 5% of Smart Meters each with related hardware, software and equipment and successful operational go-live 	Within 9 months from the date of execution of the Contract
4.	Delivery, site installation, integration and operationalization of 50% of Smart Meters each with related hardware, software and equipment	Within 20 months from the date of execution of the Contract
5.	Work Completion	Within 30 months from the date of execution of the Contract
6.	Certification of Work Completion in accordance with the provisions of this Contract by Utility	Within 15 days from the date of Work Completion.
7.	Operational period of the AMI system	<p>Completion of: 'Total meter-months of operating the AMI System after operational go-live'.</p> <p><i>Where 'Total meter-months of operating the AMI System after operational go-live' is calculated as:</i></p> <p><i>= (Total number of Smart Meters to be installed in the AMI Project X 90 months)</i></p>
8.	Transfer of AMI system to the utility	At the end of Term of the Contract In accordance with Exit Management Plan provided in Schedule B

Please Note:

1. The Utility expects the timeline for successful installation, integration and operationalization of all (100%) AMI Hardware, Software, field material in Project area shall not exceed timeline as described above from the date of execution of the Contract (Serial Number 5(five) of the Project

Implementation Schedule);

2. The Utility, at its own discretion, may extend the operation and maintenance period of the AMI system at terms mutually agreed upon with the AMISP.

The methodology for determining the ‘Total Meter-Months of operating the AMI system after operational go-live’ as well as ‘Operation and Maintenance Period of the AMI system’ is provided below:

Assuming a deployment of 1 million Smart Meters to be installed in Project area A, ‘Total Meter-Months of operating the AMI system after operational go-live’ is determined as below:

‘Total Meter-Months of operating the AMI system after operational go-live’ = (Total number of smart Meters to be installed in the AMI Project X 90 months) = 1 million meters X 90 months = 90 million meter-months (A)

The implementation of the AMI system is aligned to the schedule provided above. This implies the following:

- a) 50,000 Smart Meters (5% of total) are operationalized at the end of 9th Month from date of execution of the Contract;
- b) From there on, ~40,909 Smart Meters (4.09% of total) are operationalized every month till 500,000 Smart Meters (50% of total) are operationalized at the end of 20th Month from date of execution of the Contract;
- c) From there on, 50,000 Smart Meters (5 % of total) are operationalized every month till 1,000,000 smart meters (100% of total) are operationalized at the end of 30th Month from date of execution of the Contract.

The accrual of meter-months of the AMI system will commence as soon as the first lot of 5% of total Smart Meters are installed and operationalized at the end of 9th Month from date of execution of the Contract. Hence, ‘Meter-Months’ of AMI system operated after operational go-live is determined as below:

Month	Total Smart Meters Installed	Meter-Months of AMI system operated
9	50,000	0
10	90,909	50,000
11	131,818	90,909
12	172,727	131,818
13	213,636	172,727
14	254,545	213,636
15	295,455	254,545
16	336,364	295,455
17	377,273	336,364
18	418,182	377,273
19	459,091	418,182
20	500,000	459,091
21	550,000	500,000
22	600,000	550,000
23	650,000	600,000
24	700,000	650,000
25	750,000	700,000

Month	Total Smart Meters Installed	Meter-Months of AMI system operated
26	800,000	750,000
27	850,000	800,000
28	900,000	850,000
29	950,000	900,000
30	1,000,000	950,000
Total	1,000,000	10,050,000

Basis the above table, the AMI System would have been already operational for 10,050,000 meter-months prior to Work Completion (B)

Hence, AMI system will remain operational for the remaining Contract period, i.e.,

$$\begin{aligned}
&= [\text{'Total Meter-Months for operating the AMI system after operational go-live' (A)} - \text{'Meter-Months' of AMI system operated prior to Work Completion (B)}] \text{ (C)} \\
&= (90,000,000 - 10,050,000) \text{ meter-months} \\
&= 79,950,000 \text{ meter-months}
\end{aligned}$$

Time period (in months) for operating AMI system after Work Completion is,

$$\begin{aligned}
&= [\text{'Meter-Months' of operating Work Completion concurrently} / (\text{Total number of Smart Meters installed in the AMI Project})] \text{ (D)} \\
&= 79,950,000 / 1,000,000 \\
&= \sim 79.95 \text{ months}
\end{aligned}$$

Hence the Total **'Operation and Maintenance period of the AMI system'** = (*'Months' of operating Smart meters prior to Work Completion* + *'Months' of operating AMI system after Work Completion*) = 21 months + 79.95 months = **100.95 months**

SCHEDULE B: EXIT MANAGEMENT PLAN

In case the Contract with the Utility ends or is terminated before the expiry date of Contracts, the Parties shall agree at that time whether, and if so during what period, the provisions of this Exit Management Plan shall apply. The Parties shall ensure that their respective associated entities carry out their respective obligations set out in this Exit Management Plan. The exit management shall be done in such a manner that operations should continue without any restriction on access/usage of any kind of functionality. At the end of the Contract period, AMISP shall provide necessary handholding and transition support to the Utility or its agency for maintaining the system post the Contract with the AMISP. This includes (but not limited to):

- a) Conducting detailed walkthrough and demonstrations for the AMI Solution;
- b) Handing over of AMI Solution, Utility's data and all other relevant documentation;
- c) Addressing the queries/clarifications of the designated staff / new agency with respect to the working / performance levels of the infrastructure;
- d) Conducting training sessions;
- e) Knowledge Transfer;
- f) Any other activity, over and above these, as may be deemed necessary to meet the service levels and requirements specified in the RFP.

B.1 Transfer of Assets / AMI Solution

- a) Utility shall be entitled to serve notice in writing on the AMISP at any time during the Exit Management Period requiring the AMISP and/or its sub-contractor to provide the Utility with a complete and up to date list of the Assets within 30 (thirty) days of such notice. Utility shall also be entitled to serve notice in writing on the AMISP at any time prior to the end of the Exit Management Period requiring the AMISP to transfer to the Utility or its nominated agencies in accordance with Article 9.
- b) In case of contract being terminated by Utility, Utility reserves the right to ask AMISP to continue running the project operations for a period of 3 months after termination orders are issued. In case of contract being terminated by AMISP, Utility reserves the right to ask the AMISP to continue running the project operations for a period of 6 (six) months after termination notice is served by AMISP. In such case, payments during the Exit Management Period shall be made in accordance with the Article 6.2 and 11.5 (as the case may be).
- c) Upon service of a notice under this Plan, the following provisions shall apply:
 - i. All title to the assets shall be transferred to Utility, on or before the last day of the Exit Management Period.
 - ii. Payment to the outgoing AMISP shall be made to the tune of last set of completed Services / deliverables, subject to SLA requirements.

B.2 Cooperation and provision of information

During the Exit Management Period:

- a) AMISP will facilitate / allow the Utility or its nominated agency access to information reasonably required to define the then current mode of operation associated with the provision of the services to enable the Utility to assess the existing services being delivered;
- b) Promptly on reasonable request by the Utility, the AMISP shall provide access to and copies of all information held or controlled by them which they have prepared or maintained in accordance with this

Contract relating to any material aspect of the services (whether provided by the AMISP or sub-contractors appointed by the AMISP) to the Utility or its nominated agency. Such information shall include details pertaining to the services rendered and other performance data. AMISP shall permit the Utility or its nominated agencies to have reasonable access to its employees and facilities to understand the methods of delivery of the services employed by the AMISP and to assist appropriate knowledge transfer; and

- c) In the event of Termination prior to Work Completion, AMISP and Utility shall jointly appoint an Independent Valuer to certify the value of assets proposed to be handed over to the Utility upon termination. The cost of Independent Valuer shall be paid by the AMISP.

B.3 Confidential information, security and data

AMISP shall promptly on the commencement of the Exit Management Period supply to the Utility or its nominated agency the following:

- a. information relating to the current Services rendered and consumer and performance data relating to the performance of sub-contractors in relation to the Services;
- b. documentation relating to the Project's Intellectual Property Rights;
- c. documentation relating to sub-contractors;
- d. all current and updated data as is reasonably required for purposes of Utility or its nominated agencies transitioning the services in a readily available format;
- e. all other information (including but not limited to documents, records and agreements) relating to the services reasonably necessary to enable Utility or its nominated agencies, to carry out due diligence in order to transition the provision of the Services to Utility or its nominated agencies, (as the case may be).

B.4 Transfer of certain agreements

On request by the Utility or its nominated agency, the AMISP shall affect such assignments, licenses and sub-licenses as Utility may require in favour of the Utility or its nominated agency reasonably necessary for the carrying out of replacement services. These agreements may include equipment lease, maintenance or service provision agreement between selected AMISP and third-party lessors, service providers, and any other agreements related to the Services.

B.5 General obligations of the AMISP during Exit Management Period

- a. The AMISP shall provide all such information as may reasonably be necessary to effect as seamless a handover as practicable in the circumstances to the Utility or its nominated agency and which the AMISP has in its possession or control at any time during the Exit Management Period.
- b. For the purposes of this Schedule, anything in the possession or control of the AMISP or associated entity, or sub-contractors is deemed to be in the possession or control of the AMISP.
- c. The AMISP shall commit adequate resources to comply with its obligations under this Exit Management Schedule.

B.6 Exit management process

The AMISP shall prepare an Exit Management Plan for transfer of operations to the Utility or its nominated agency, in the event of termination or expiry of the contract with the Utility, without affecting services to stakeholders adversely. AMISP shall get this process approved by Utility. The Plan shall include, but not be limited to, the following-

- b. A detailed program of the transfer process including details of the means to be used to ensure continuing provision of the Services throughout the transfer process or until the cessation of the Services and of the

management structure to be used during the transfer;

- c. Plans for the communication with such of the AMISP's subcontractors, staff, suppliers, customers and any related third party as are necessary to avoid any material detrimental impact on the Utility's project operations and AMI Services to other stakeholders as a result of undertaking the transfer;
- d. Plans for provision of contingent support to Utility or its nominated Agency for a reasonable period after transfer.
- e. The Exit Management Plan including all updates shall be presented by the AMISP to and approved by the Utility or its nominated agencies.
- f. During the Exit Management Period, the AMISP shall use its best efforts to deliver the services.
- g. Payments during the Exit Management Period shall be made in accordance with the Articles 6.2 and 11.5 (as the case may be)
- h. The Exit Management plan shall be furnished in writing to the Utility or its nominated agencies within 90(ninety) days from date of execution this AMISP contract
- i. The AMISP shall re-draft the Exit Management Plan annually thereafter to ensure that it is kept relevant and up to date. The updated plan shall be furnished in writing to the Utility or its nominated agencies within 15 days from the end of such period.

SCHEDULE C: PAYMENT MECHANISM

As mentioned in Article 6 of this document.

SCHEDULE D: Existing IT-OT applications of APDCL

- a) APDCL Revenue Management System (ARMS): ARMS handles the MBC operations, Reconnection-Disconnection operations, CRM, Consumer Portal, Online Payment by consumers, MIS, Energy Audit operations
- b) SAP-ERP: APDCL's ERP system runs on SAP. Material Management, Project Systems, Human Capital Management and FICO modules have been implemented.
- c) Meter Data Acquisition System (MDAS) is operational for feeder and DTR meters of urban areas and all HT consumer meters across APDCL.
- d) GIS based asset mapping and consumer survey was carried out during implementation of R-APDRP-Part-A scheme in urban areas of APDCL.
- e) SCADA has been implemented in Guwahati city for 36 numbers of 33/11 kV Sub-Stations.

SCHEDULE E: TECHNICAL AND FINANCIAL BID AS SUBMITTED BY THE SELECTED BIDDER

<The complete Technical and Financial Bid as submitted by the Selected Bidder shall be attached as an annexure to the AMISP Contract>

SCHEDULE F: TECHNICAL SPECIFICATIONS, FUNCTIONAL REQUIREMENTS AND SERVICE LEVEL AGREEMENT

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Abbreviations

AMI	Advanced Metering Infrastructure
AMISP	Advanced Metering Infrastructure Service Provider
BIS	Bureau of Indian Standards
BOQ	Bill of Quantity
CAIDI	Consumer Average Interruption Duration Index
CAIFI	Consumer Average Interruption Frequency Index
CEA	Central Electricity Authority
CERT-In	Indian Computer Emergency Response Team
CIM	Common Information Model
CIS	Consumer Information System
CPU	Central Processing Unit
CRM	Consumer Relationship Management
CT	Current Transformer
CUM	Cumulative
DBMS	Database Management System
DBFOOT	Design Build Finance Own Operate and Transfer
DCU	Data Concentrator Unit
DMZ	Demilitarized Zone
DT	Distribution Transformer
ESB	Enterprise Service Bus
FAT	Factory Acceptance Test
GPRS	General Packet Radio Service
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
HES	Head End System
HHU	Handheld Unit
IBMS	Integrated Building Management Systems
IDS	Intrusion Detection Systems
IEC	International Electrotechnical Commission

IP	Internet Protocol
IS	Indian Standard
ISP	Internet Service Provider
IVRS	Interactive Voice Response System
LCD	Liquid Crystal Display
LED	Light Emitting Diode
kVA	kilo Volt-Ampere
kW	kilo Watt
LAN	Local Area Network
MCB	Miniature Circuit Breaker
LT	Low Tension
MICC	Mineral-Insulated Copper-Clad Cable
MD	Maximum Demand
MDAS	Meter Data Acquisition System
MDM	Meter Data Management system
M&V	Monitoring and Verification
NAN	Neighbourhood Area Network
NIC	Network Interface Card
NTP	Network Time Protocol
NMS	Network Management System
NOMC	Network Operation cum Monitoring Center
OEM	Original Equipment Manufacturer
OSF	Open Software Foundation
OS	Operating System
PCI	Payment Card Industry
PT	Potential Transformer
PLCC	Power Line Carrier Communication
PV	Photovoltaic System
QA	Quality Assurance
QC	Quality Control
QR	Qualification Requirement

RAM	Random Access Memory
R-APDRP	Restructured Accelerated Power Development and Reforms Programme
RDBMS	Relational Database Management System
RF	Radio Frequency
RFP	Request for Proposal
RPO	Recovery Point Objective
RTC	Real Time Clock
RTO	Recovery Time Objective
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAN	Storage Area Network
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SLA	Service Level Agreement
SNMP	Simple Network Management Protocol
SOA	Service Oriented Architecture
SQL	Structured Queried Language
TCP	Transmission Control Protocol
TOD	Time of Day
TOU	Time of Use
UDP	User Datagram Protocol
UPS	Uninterrupted Power Supply
VEE	Validation Estimation and Editing
VM	Virtual Machine
WAN	Wide Area Network
WPC	Wireless Planning & Coordination Wing
XML	Extensible Mark-up Language

1. AMI Specifications

1.1 AMI Functional Requirement

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

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

- a) Remote Meter data reading (Scheduled / Instantaneous) at configurable intervals (push/pull)
- b) Time of Use (TOU) metering;
- c) Post-paid functionality with provision of pre-paid functionality without need for any additional infrastructure;
- d) Net Metering;
- e) Alarm/Event detection, notification and reporting;
- f) Load Limiter and connection/ disconnection at defined/on demand conditions which can be configured remotely in advance;
- g) Network Monitoring System for the field area network (NAN/WAN), Remote firmware upgrade, configuration of network nodes and system time synchronisation across all devices to ensure accuracy of time stamping;
- h) Integration with other existing systems as described in this RFP and delineated in the approach paper created for the purpose;
- i) Import of legacy data from existing modules/ Meter Data Acquisition System (MDAS) of RAPDRP wherever possible. The extent and modalities of integration with the existing system including RAPDRP shall be worked out by the AMISP in line with the methodology laid out in the approach paper.
- j) Security features to prevent unauthorized access to the AMI including Smart Meter & meter data etc.
- k) The system should be capable to support the other functionalities as per requirement of utilities in line with the RFP

The System should accurately maintain system time synchronization across all devices to ensure accuracy of data. The communication network shall preferably be able to support multiple applications. In line with the methodology described in the approach paper created as part of the project implementation plan, AMISP shall define standard interfaces to integrate the MDM with pre-existing utility applications. All future utility application shall use these interfaces to integrate with the MDM system. The future utility applications may include but not be limited to the following:

- a) Peak Load Management
- b) Demand Response
- c) Supervisory control and data acquisition (SCADA)
- d) Network planning and analysis
- e) Load Forecasting
- f) Outage Management System (OMS)
- g) Distribution automation including self-healing system,
- h) GIS

- i) DT monitoring units
- j) Billing System
- k) Consumer and Industrial Portal
- l) Consumer Care System (CCS)
- m) Smart Electric Vehicle charging system

1.2 General AMI System Requirement

Smart Meters (Single phase whole current, three phase whole current) for consumers/ system shall be provided in accordance with the technical specifications as provided in Annexure A, B and C.

The AMISP shall ensure proper data exchange among Smart Meter, Gateway (if applicable), MDM, HES and other operational/requisite software as part of fully functional AMI system.

AMISP shall adhere with the appropriate security algorithm for encryption and decryption as per established cyber security guidelines. For smooth functioning of the entire system, it is essential that the AMISP shall provide in the form of a document enough details of such algorithm including the mechanism of security key generation to the Utility. In case of proprietary or secret mechanism, the same shall be kept in a secured escrow account.

AMISP may design appropriate architecture for providing end to end metering solution. AMISP is free to decide upon the best solution out of all the available options. However, the entire responsibility of fully functional AMI system shall rest with the AMISP in order to meet the performance levels as given in this document.

The AMI system shall have following core components of AMI system:

- a) Smart Meters;
- b) Communication infrastructure;
- c) Head End System (HES).
- d) Meter Data Management System (MDM);
- e) Network Management System (NMS).
- f) **Web application and mobile app:** Web application with updated on-line data of consumers (consumer data shall be integrated with existing consumer portal of utility) etc. AMISP shall also provide a mobile app through which consumer shall be able to log in to see information related to his/her energy consumption. App shall also facilitate platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc. Features in this app which supports demand response (as per 1.6.5.(e) of this Schedule) should also be provided. This mobile app shall be part of delivered system and therefore no additional cost shall be payable for upgradation / maintenance separately. The AMISP may be required to integrate the MDMS with an existing mobile app of the utility for providing the above mentioned services to the consumers.

Applicable Standards

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

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.

Technical Obsolescence

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

1.3 Smart Meters

Single phase whole current Smart Meters shall comply with technical specifications as provided in Annexure – A, three phase whole current Single Smart Meters shall comply with technical specifications as provided in Annexure – B. The AMISP has to furnish valid BIS certification before the supply of meters.

After meter installation, details of consumer connections, such as consumer identification no., meter ID, its hardware & software configuration, name plate details, make, type i.e. 1 Phase or 3 Phase shall be updated in the system. The information would also be updated on the consumer portal and app for providing information to consumers.

Reference, the Smart Meter communication, it is envisaged that plug and play type communication modules shall be deployed in the smart meter, for any given communication technology. These modules shall be field- deployable, with corresponding communication interface modules being used in the Gateway or BTS of wide area network in accordance with the details provided in Annexure E. The Network Interface Card (NIC) / Communication Module should be integrated with meters in India to enable the respective meters to seamlessly integrate with proposed HES and/or MDM thus enabling interoperability of the system. In future, it would be AMISP's responsibility to integrate new meter in consultation with APDCL or facilitate integration of other application as per the approach paper submitted under the Project Implementation Plan.

1.4 Communication Infrastructure

The communication infrastructure should either be based on Canopy based RF mesh / PLCC /cellular network (4G/Nb-IOT) or a combination of these. Communication network shall provide reliable medium for two-way communication between various nodes (Smart Meter, Gateway/Router/Access Point (wherever applicable)) & HES. Canopy based RF based network should use licensed / unlicensed frequency band as permitted by WPC. The engagement of network service provider would be in the scope of AMISP to meet the performance level as given in the document.

Meter data shall be routed / collected by field devices like Gateway/Router/Access Point wherever applicable given the communication technology used and transported to HES through WAN backhaul connectivity.

1.4.1 General Requirements

The AMISP shall design / hire reliable, interference free & robust communication network. It shall be effective for providing communication in terrain, topology & the consumer density of the project site.

During designing, suitable consideration shall be kept for future expansion as mentioned in Annexure-D. Before designing the communication network, the AMISP shall do the site survey and would provide the most efficient communication infrastructure.

The entire infrastructure & associated civil works required for installation & commissioning of equipment/devices such as DCUs, repeaters, routers & access points etc. shall be within the scope

of AMISP. However, routers/access points/gateways may be installed at existing poles/buildings of APDCL if feasible provided that if such routers/access points/gateways installed at existing poles/buildings of APDCL are needed to be dismantled/uninstalled for any reason whatsoever within the contract period. the erection of necessary structures for reinstallation of the concerned routers/access points/gateways shall be the absolute responsibility of the AMISP at their own cost.

The network Solution deployed by the AMISP should have disaster recovery mechanism in place. The redundancy mechanism of HES and MDM and their disaster recovery plan shall also be highlighted by the AMISP. AMISP shall satisfy itself through the operational testing of network as a whole and its element for reliability before starting operations and billing.

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

A suitable NMS shall be built to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration & parameterization of the networking devices and the nodes. In case of public network such as cellular, the web-based portal (for example Open Network platform) should be provided to have the network view at location of installed devices. The portal shall have connectivity & subscription management.

A suitable digital platform (cloud-based application) and mobile apps could be provided to support field installation and capture field related activities and to manage the field operation & maintenance activity during the contract period. This platform shall manage project life cycle.

1.4.2 Network Security

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

- a) Secure Access Controls
- b) Authorization Controls
- c) Logging
- d) Hardening
- e) Malicious Software Prevention
- f) Network Security
- g) Device Security

1.4.3 Communication Network Elements

Following sections provide detail on router-based RF mesh network. The AMISP shall select relevant parts as applicable for designing and establishing communication infrastructure. The network, shall be horizontally and vertically scalable to accommodate future meter installations. The network elements may be comprised of the following.

1.4.3.1 Gateway/ Router/ Access Point based RF Mesh Network

In this type of communication network, different network nodes including end points (Smart

Meters) shall interconnect with each other using RF mesh network and they shall communicate with nearby gateways/ routers to transfer the data to access points. If any gateways/ routers/ repeaters/ access points fail, then nodes connected on that device shall automatically reconfigure the mesh with available nearby nodes.

1.4.3.1.1 General Requirement of RF Mesh Network:

- a) The communication network shall have dynamic & self-healing capability. If one of the communication elements such as gateways/ routers/ access points fails, then nodes connecting to that element shall switch to best available element for communication of data to HES.
- b) It shall support IPv6 network addressing.
- c) Each node shall keep a track of best available nearby nodes or access points.
- d) The communication network equipment shall use Unlicensed or Licensed frequency band as permitted by WPC/Statutory Bodies as applicable.
- e) All the communication network equipment shall be as per WPC guidelines, Government of India for operation in licensed / license free frequency band.
- f) Suitable NMS shall be available to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration, parameterization of the networking devices and the nodes.
- g) It shall support remote firmware upgrading
- h) It shall be secure enough to avoid all cyber threats
- i) The communication network shall ensure secure communication of data to HES.
- j) The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP65). A suitable mounting provision shall be made for the equipment.
- k) The list of standards followed in all the devices/equipment used in communication network shall be furnished.

1.4.3.1.2 Configuration, Functionality & Interface

Access points shall have following configuration functionalities:

- a) It shall be able to configure the communication with underlying nodes/end points.
- b) It shall support on demand read and ping of individual/group of meters.
- c) It shall push events such as tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters.
- d) It shall have Wide Area Network (WAN) connectivity to the HES through suitable means.
- e) It shall communicate with gateways/ routers/ nodes/ end points/ access points on RF mesh network (Unlicensed or Licensed frequency band as permitted by WPC/Statutory Bodies in country of deployment as applicable).
- f) It shall periodically monitor meter reads/downstream commands and shall retry and

reconnect in case of failed events/reads.

- g) After power Interruption, on restoration of power supply, it shall establish communication with underlying devices as well as upstream application (HES) automatically.
- h) Access point shall facilitate recording of minimum of the following events at HES (for seven (7) days):
 - i. No of lost packets
 - ii. Retry attempts
 - iii. Missed periodic reading
 - iv. Failure to connect
 - v. Tamper events
- i) Access point shall be capable to handle interval data of suitable nos. of any type of smart meter (1ph/3ph). Access point shall be able to acquire and send data to HES for full capacity (No. of meters/field devices it is designed for) within a suitable time period to achieve the performance level. Full capacity of access point is required to be indicated in the offer.
- j) Gateway / Router / Access point shall support remote firmware upgrades as well as remote configuration from the Network Operation cum Monitoring Centre.
- k) The Gateway / Router / Access Points shall have provision to maintain the time and date information and shall always be in Time synchronization to the HES server via NTP to sub second accuracy. The Gateway / Router / Access Points, shall support time distribution to each Mesh Node

1.5 Head End System (HES)

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

The AMISP shall provide a HES which is suitable to support the collection and storage of data as per performance level for a defined no. of Smart Meters with facility of future expansion as and when required.

HES shall be responsible for discovery of all Smart Meters once deployed in the field, the periodic collection of all meter data as well as the processing of all alarms and commands such as connect/disconnect for those meters.

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

HES shall be developed on open platform based on distributed architecture for scalability without degradation of the performance using additional hardware. The scalability shall ensure the ability to handle applicable workloads including the following:

- a) [5/15] mins interval meter reads

- b) Other events and statuses coming from meters.

The HES shall be cloud enabled and support deployment with high availability clustering and automatic load balancing that ensure hardware as well as application failover. Adequate data base and security features for storage of data at HES need to be ensured.

The suggested functions of HES (not exhaustive) may be:

- a) On power up after installation, Smart Meter shall register itself automatically into the HES along with its metering profile. The HES shall store meter profile status by meter type, hardware & software versions, device IDs, logged in / logged out details etc.
- b) Upon deployment and establishment of communication, it shall be possible for field level end device nodes (NAN/WAN) like Router/Gateway, Access Point, DCU to have self-discovery and registration.
- c) Acquisition of meter data on demand & at user selectable periodicity. On demand meter read may be for single meter (unicast) or for a group of meters (multicast).
- d) Two-way communication with meter/Gateway
- e) Signals for connect & disconnect of switches present in end points such as meters. This facility shall be provided for both single meter (unicast) as well as for a group of meters (multicast).
- f) Audit trail and Event & Alarm Logging
- g) Ability to redirect messages including configuration commands from the MDM in order to reach the desired meter
- h) Maintain time sync with Gateway / meter
- i) Store raw data for defined duration (minimum 3 days). HES shall hold the data before it is transferred to the MDM
- j) Handling of Control signals / event messages on priority
- k) Manage time distribution to ensure that nodes / meters always have an accurate RTC using NTP servers. The time distribution mechanism shall take into account the network latencies.
- l) Setting of Smart Meter configurable parameters
- m) Critical and non-critical event reporting functionality
- n) Device management functionality to get periodic updates from devices on health check, hardware & firmware version, location mapping etc.

1.5.1 Configuration

HES shall facilitate configuration of following minimum AMI parameters:

- a) Load profile capture period
- b) Demand integration period
- c) Setting of parameters for TOU billing
- d) Prepaid / post-paid configuration
- e) Net metering
- f) Billing date / month-to-date for prepaid meters
- g) Clock setting/time synchronizations
- h) Load curtailment limit
- i) Event setting for connect/disconnect
- j) Number of auto reconnection attempt

- k) Time interval between auto reconnection attempt
- l) Lock out period for endpoint (meter) relay
- m) Remote firmware update: It shall be possible to update the firmware of the meters in both Unicast (one to one) and in Multicast fashion (Group of meters). It shall be also possible to have remote firmware upgrade for an individual and a group of nodes (NAN/WAN, Routers/Gateways/Access Point, DCU).
- n) Password setting
- o) Push schedule
- p) Setting threshold limits for monitored parameters

1.5.2 Communication

The following communication functions with network devices shall be supported:

- a) HES shall communicate with DCUs/access points using WAN technology
- b) HES shall encrypt data for secure communication
- c) HES shall be able to accept data according to IS 15959 part-2 /part 3 and latest amendments
- d) HES shall automatically retry for missed data; the number of retry attempts shall be configurable
- e) To receive confirmation on successful execution of a command
- f) HES shall ensure data integrity checks, for example, checksum, time check, pulse, overflow, etc. on all metered data

1.5.3 Network Management System (NMS)

The Network Management System (NMS) function within the HES shall manage communication network and its associated devices and monitor the performance of network. This module shall provide real time information about the IP network and its associated NAN/WAN modules in the field device/s.

- a) NMS shall be able to collect parameters viz. terminal status, device status, next hop information, RF / PLC signal strength, Hardware/software version numbers, communication logs/events etc. For cellular WAN network, it shall be able to constantly monitor the meter WAN module for its connectivity and signal strength and quality
- b) NMS function shall be able to perform ping & trace-route to an individual and a group of Nodes (NAN / WAN), Routers /Gateways / Access Point, DCU.
- c) NMS function shall routinely check the logged in status of the end node / field device and its availability in the network for data exchange. In case of failure to get the 'alive' message from the end node/field device, it shall mark and notify the node as logged out. It shall be also possible to restart of a node (NAN/WAN) as well as trigger a hardware reset of the node.
- d) NMS function should be able to collect and store monitoring profiles from End Points (NAN/WAN modules) and network devices for performance evaluation, and troubleshooting purposes. Historical logs of monitored profiles shall be available analysis through standard reporting tool.

- e) If GIS is enabled, then topology, location (lat/long) and status of all network nodes shall be visible on GIS map.

1.5.4 Monitoring and Reporting Capability

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

1.5.4.1 Critical Reporting

HES shall have alarms and keep record of following events:

- a) Event log for node's (meter) events such as tamper/power failures etc.
- b) Data not received from nodes/end points
- c) Relay does not operate for connect / disconnect
- d) Communication link failure with nodes/end points
- e) Network Failure
- f) Power Failure

1.5.4.2 Non-Critical Reporting

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

- a) Retry attempts
- b) Missed periodic reading
- c) Failure to connect

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

1.5.4.3 Integration

HES shall export all meter data to MDM and pass control commands from MDM. HES should conform to IEC 61968-9 as well as support CIM 2.0 / MultiSpeak v3.0 standards. It may use any other standard interfaces as outlined in the approach paper, submitted as part of project implementation plan, for integrating with the MDM. In case, utility has implemented any Service Oriented Architecture (SOA)/ Enterprise Service Bus (ESB) architecture, the data exchange to and from HES shall be through this ESB.

The data collected by the Network Management function of the HES shall be integrated with overall Data Centre level NMS module for easy monitoring, analysis and reporting.

1.6 Meter Data Management system (MDM)

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

data to various other systems sources and services in the agreed format. It shall provide validated data for upstream systems such as billing, analytics, reporting, etc.

As mentioned in Section 1.1 of this Schedule, MDM should support the future requirement of utility by way integration with other smart grid functionalities as listed in section 1.1 as and when implemented by APDCL. In this effort, the methodology as outlined in the approach paper shall be followed.

The key use cases to be enabled by AMISP are provided below. Please note that these are illustrative list of use cases only and is not an exhaustive list. Further please note that all IS Standards shall be applicable.

Sr.	Use Case Activity Description	Source	Destination	Info Exchanged
1.	Scheduled Meter Read Automatically from Consumer Premises			
1.1	At scheduled frequency meter sends data to HES. Consumption details including non-critical events will be in 15 min block data, and data could be incremental to what was sent by meter in preceding instance	Meter	HES	Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date
1.2	At scheduled frequency meter sends billing Data to HES	Meter	HES	Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF
1.3	Scheduled meter data reaches MDM	HES	MDM	Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date
2.	Remote Meter disconnection / reconnection			
2.1	Meter re-connect / disconnect operation command	MDM	HES	Meter Number, group of meters, instruction to close switch

Sr.	Use Case Activity Description	Source	Destination	Info Exchanged
2.2	Consumer meter re-connection / disconnection	HES	Meter	Meter number, action (reconnect/ disconnect)
2.3	Connection Status Update	Meter	HES	Meter Number, switch status
2.4	Connection Status Update	HES	MDM	Meter Number, group of meters, switch status
3.	Utility detects tampering at consumer site			
3.1	High priority events captured by Meter sent to HES as and when occurred	Meter	HES	Meter Number, event date & time, event Code /description
3.2	High priority events reach MDM for further action.	HES	MDM	Meter Number, event date & time, event Code /description
3.3	Notify utility personnel for site inspection	MDM	Email/SMS Gateway	Consumer number, Meter Number, Tamper code, address
3.4	On analysis and detection of valid tamper event or malfunction, connection is disconnected.	MDM	HES	Consumer number, meter number, action to be triggered (disconnect), action date & time
3.5	HES sends disconnect command to meter	HES	Meter	Meter Number, action (disconnect)
3.6	Tamper event shared with CIS. Billing determinants are updated for tamper invoicing	MDM	CIS / Billing Determinants	Meter Number, event date & time, event Code /description
3.7	Meter re-connection order once tamper issue is resolved	MDM	HES	Meter number, action (re-connect)
3.8	HES sends re-connect command to meter	HES	Meter	Meter Number, action (re-connect)
4.	Missed interval readings			
4.1	On identifying missed interval, HES will re-acquire data for the missing period from meter	HES	Meter	Meter Number, from date & time, to date & time (for which data is missing)
4.2	On receiving data request command, meter will send data to HES	Meter	HES	Meter Number, reading date & time, kW, kVA, kWh, kVAh
4.3	Missed Interval and Reads Data acquired by MDM	HES	MDM	Meter Number, readings with date & time
5.	Consumer connection outage/restoration event			
5.1	Outage/restore event recorded by meter is sent to HES as and when event occurs	Meter	HES	Meter Number, Outage / restoration Date / Time, Power On or Off count
5.2	Outage / Restoration Notification	HES	MDM	Meter Number, Outage / restoration Date / Time, Power On or Off count

Sr.	Use Case Activity Description	Source	Destination	Info Exchanged
5.3	Sharing Outage / Restoration Notification	MDM	OMS/CIS-CRM	Meter Number, Outage / restoration Date / Time, Power On or Off count
5.4	Meter read request from OMS to identify service outage / restoration	OMS	MDM → HES	Meter Number,
5.5	Meter responds to event poll from HES	Meter	HES	Meter number, Status (live/dead)
6.	Remote firmware upgrades/ meter configuration changes			
6.1	Remote firmware upgrade	MDM→HES	Meter	Firmware
6.2	Configuration Commands: Change tariff parameters, Synchronize clock, Registers reset (status, max, tampering)	MDM → HES	Meter	Meter number, tariff parameters, registers status, event type and priority
6.3	Status update of Firmware / Configuration	Meter	HES → MDM	
7.	Load monitoring at demand side			
7.1	When there is a load violation event recorded in the meter, the information is sent to the CC	Meter	HES → MDM	Meter Number, max demand, date & time of load violation
8.	Time synchronization			
8.1	Synchronising RTCs of meters / DCUs/ACP	HES	DCU/Meter	Time Setting
9.	Metering network changes			
9.1	Change / new installation in Meter / DCU Network Hierarchy	Meter / DCU	HES	Network identification info including DCUs
9.2	Change / new installation in Meter / DCU Network Hierarchy	HES	MDM	Network identification info including DCU
10.	New consumer connection			
10.1	Receive pre & post-paid new consumer requests	CIS-CRM	MDM	Consumer name, address. Connection request etc.
10.2	Verify new consumer has paid as per regulation	Billing	MDM	Consumer connection request, Payment details
10.3	Generate meter installation order	MDM	CIS-CRM /WFM	Consumer ID & details
10.4	Receive meter installation report	WFM	MDM	Meter number, DT no, Feeder & reading
10.5	Requesting instant, interval & events data from meters	MDM	HES → Meter	Meter Number, Reading Date & time, reading params (kWh, kVAh, kW etc.)
10.6	Acquire instant, interval / events data from meter by HES which then reaches MDM system.	HES	MDM	Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.)

Sr.	Use Case Activity Description	Source	Destination	Info Exchanged
10.7	Once new meter remote read verification is over, confirm new connection with other applications	MDM	Billing / CIS-CRM	Consumer ID, Consumer address, Meter Number, initial reading etc.
11.	Migrate post-paid consumer to prepaid mode			
11.1	Receive migration request	CIS-CRM	MDM	Migration request for post-paid consumer with profile
11.2	Get billing attributes	Billing	MDM	Billing attributes
11.3	Setup prepaid consumer profile in prepaid engine. If no change in meter is required, skip next two steps	MDM	Prepaid Engine	Prepaid consumer profile
11.4	Generate prepaid meter installation order if required	MDM	CIS-CRM / WFM	Consumer ID & details
11.5	Receive meter installation report	WFM	MDM	Meter number, DT no, Feeder & reading
11.6	Enable prepaid mode in meter	Prepaid engine	HES → Meter	Engineering token
11.7	Receive activation confirmation	HES	MDM	Activation status
11.8	Request instant, interval & events data from meter	MDM	HES → Meter	Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.)
11.9	Acquire instant, interval / events data from meter by HES which then reaches MDM system.	HES	MDM	Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.)
11.10	Once meter remote read verification is over, share migration request completion detail with other modules	MDM	Billing / CIS-CRM	Prepaid consumer profile
12.	Migrate prepaid consumer to post-paid mode			
12.1	Receive migration request	CIS-CRM	MDM	Migration request for prepaid consumer with profile
12.2	Request meter data	MDM	HES → Meter	Meter Number, Consumer ID
12.3	Acquire instant, interval / events data from meter by HES which then reaches MDM system.	HES	MDM	Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) with balance credit
12.4	Send meter disconnect command	MDM	HES → Meter	
12.5	Receive connection status	HES	MDM	Disconnect status
12.6	Enable post-paid mode in meter	MDM	HES → Meter	Engineering token
12.7	Receive activation of post-paid mode	HES	MDM	Activation Status
12.8	Request instant, interval & events data from meter	MDM	HES → Meter	Meter Number, Consumer ID

Sr.	Use Case Activity Description	Source	Destination	Info Exchanged
12.9	Acquire instant, interval / events data from meter by HES which then reaches MDM system.	HES	MDM	Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.)
12.10	Once meter remote read verification is over, share migration request completion detail with other modules	MDM	Billing / CIS-CRM	Post-paid consumer profile and meter data along with credit balance
13.	Consumer Registration in Consumer Portal/ App			
13.1	Consumer clicks on new user on Consumer portal/ App, provides RMN or email ID and submits data	Portal/ App	MDM	Request for registration with RMN/email ID
13.2	Utility receives request for registration and sends OTP after verification	MDM	Email/Messa ge Gateway	OTP
13.3	Consumer submits OTP	Portal/ App	MDM	
13.4	Consumer receives registration detail	MDM	Email Gateway	Login ID and default password
13.5	Consumer submits first login request	Portal/ App	MDM	
13.6	System seeks password change	MDM	Portal/ App	
13.7	Consumer changes default password	Portal/ App	MDM	
14.	Consumer Access to Consumption, Billing & Profile Data			
14.1	Consumer logs in to Portal/ App	Portal/ App	MDM	
14.2	Consumer Profile for Portal/ App	CIS-CRM	MDM →Portal/App	Name, Account, Address, Service Points, K Number
14.3	Consumption Data	MDM	Portal/ App →UI	Consumption profile
14.4	Billing (post-paid) / Credit Balance (prepaid)	Billing → MDM	Portal/ App	Post-paid Billing history/ Current Bill, Prepaid Recharge history
15.	Prepaid Consumer Recharge			
15.1	Consumer logs into Portal / Mobile App	Mob App / Portal	UI	Login
15.2	Consumer fills-in required detail in UI and requests recharge	UI→ Prepaid App	Payment Gateway	Consumer ID, Recharge amount
15.3	Consumer selects payment method	Payment Gateway	Net banking /Credit Card / Wallet etc.	
15.4	Consumer receives payment acknowledgement	Payment Gateway	Prepaid App→Portal →UI	
15.5	Calculate credit balance for prepaid consumer & update prepaid meter	Prepaid App	HES→Meter	Consumer credit balance (virtual token)

Sr.	Use Case Activity Description	Source	Destination	Info Exchanged
15.6	Notify credit balance to consumer	Prepaid App	Email/SMS Gateway	Credit Balance
16.	Post-Paid Consumer Bill Payment			
16.1	Consumer logs into Portal / Mobile App	Mob App / Portal	UI	Login
16.2	Consumer is presented with Billing history and current outstanding Bill	Billing → MDM	Portal/ App→UI	Outstanding Bill
16.3	Consumer requests bill payment. Option to download bill	UI Billing	Payment Gateway	
16.4	Consumer selects payment method	Payment Gateway	Net banking /Credit Card / Wallet etc.	
16.5	Consumer receives payment acknowledgement	Payment Gateway	Billing→ Portal/ App→UI	
16.6	Payment acknowledgement through email/SMS	Billing	Email/SMS Gateway	Payment acknowledgement
17.	Consumer Service Request			
17.1	Consumer logs in to Portal/ App	Portal/ App	MDM	
17.2	Consumer requests for service	UI	MDM	Service request
17.3	System assigns SRN & sends acknowledgement	MDM	Portal/ App→UI, Email/SMS Gateway	
17.4	System resolves request & updates consumer records	MDM	Portal/ App→UI, CIS/CRM	
17.5	System closes SRN	MDM	Email/SMS Gateway	
18.	Consumer Complaints			
18.1	Consumer logs into Portal/ App	Portal/ App	MDM	
18.2	Consumer registers complaint	UI	MDM	Specific complaint
18.3	System assigns CRN & sends acknowledgement	MDM	Portal/ App→UI, Email/SMS Gateway	
18.4	System assigns resolution based on nature of complaint	MDM	CIS / OMS / WFM	
18.5	Target system reports completion of complaint	OMS / WFM	MDM	
18.6	System updates records and closes CRN	MDM	CIS, Email/SMS Gateway	

Sr.	Use Case Activity Description	Source	Destination	Info Exchanged
19.	Demand read of meters from consumer premises			
19.1	Requesting instantaneous, interval, load profile & events data from meters	MDM	HES→Meter	Meter Number, Reading date & time, reading params (kWh, kVAh, Kw etc.)
19.2	Acquire instant, interval, load profile & events data from meters by HES which then reaches MDM system.	Meter→HES	MDM	Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.)
20.	Staff User Access to Utility Portal			
20.1	User logs in to Portal	Portal	MDM	Login with appropriate credentials
20.2	User selects available functions	MDM	Portal → UI	
20.3	User logs out	Portal → UI	MDM	

The AMISP shall specify and deliver an initial system that supports the collection and storage of data for meeting the performance level for [X no of consumers/ Smart Meters] with facility of future expansion.

The MDM shall have the ability to selectively choose which data to be maintained and which to be purged or archived [as per requirement of APDCL (user selectable)]

1.6.1 Asset Management

- a) The MDM shall maintain information and relationships between the current installed meter location (apartment, shop, industry/ address etc.), Consumer information (Name etc.), Consumer account no, Meter ID, Type of Meter (type of consumer, 1 phase/ 3phase, with or without relay, etc.), Meter configuration (Demand integration period, Load profile capture period etc.), GIS supplied information (longitude, latitude, connection with feeder/ transformer/ pole etc.) etc.
- b) The software should support tracking the status of meters and communication equipment from the date when they are installed in the field. The history of in-service asset location is maintained throughout the device life with start and end dates associated with each in-service location reference.
- c) Ability to report and log any damage / deterioration in the meter attributable to consumer /utility.

1.6.2 AMI Installation Support

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

communicating.

1.6.3 Meter Data

- a) The MDM shall accept input, process, store, and analyze Meter data from HES and meter data collected through handheld meter reading instruments and manual meter reads. In case of manual reads, provision should be there to insert associated notes such as assessed energy, etc. It would responsibility of AMISP for manual meter reading in case of any communication failure, etc. with seven (7) days of such failure.
- b) The MDM should accept input, process, store, and analyze non-billing meter data such voltage and power quality data (such as under/over voltage, out of band frequency, etc.) as they are available from HES. The MDM should also support schedule and on-demand meter reads and pinging of meter energized states by authorized users and by other utility systems.
- c) The MDM shall provide storage and retrieval of all collected Meter Data, events and alarm. It shall have capacity of storing 5 years data or more (as required by the utility) via archiving.
- d) The archiving of data should be done at a frequency of x and all data older than x days/hours should be archived. AMISP's solution should describe the process of archiving and restoration from the archive.
- e) Correctly track & resolve energy usage across meter changes with no loss of individual meter data.
- f) Provide complete history and audit trail for all data collected from meters including commands sent to meters and other devices for 30 days (configurable period).
- g) Execute on-demand read processes.
- h) Handle special metering configurations such as net metering/pre-paid metering/multiple meters at same premises.
- i) The MDM shall have the ability to manage at a minimum 5-minute interval data.
- j) The AMISP shall ensure data integrity checks on all metered data received from data collection systems.

1.6.4 Data Validation, Estimation, and Editing (VEE)

- a) The validation and estimation of metered data shall be based on standard estimation methods (such as max/avg. of past three days, max/avg. of past X number of similar weekdays, max/avg. of similar blocks of past X numbers of similar weekdays, etc.). The MDM should also support and maintain following data-
 - i. Registered Read Data including register reads, daily billing cycle, as well as derived billing determinants such as TOU
 - ii. Interval Data channels with variable intervals and variable units of measure
 - iii. Calculated Data that is derived or computed such as billing determinants and aggregated loads.
 - iv. Event data storage of all collected event and alarm data from meters, network equipment, and MDM itself
- b) 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

- i. CUM decrements within a billing cycle (except net-metering)
 - ii. CUM reads increments more than configurable threshold
 - iii. Future or old read dates
 - iv. Number of digits exceeds number of meter dials
- c) 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
 - i. Register decrements (except net-metering)
 - ii. Resets (to zero) (except net-metering)
 - iii. CUM reads increments more than configurable threshold
 - iv. Future or old read dates
 - v. Erratic compared to CUM read (sum of TOU reads minus CUM read)
- d) MDM shall detect, flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in Demand register reads
 - i. Do not reset on cycle
 - ii. Do not reset coincident with consumer move-out or move-in
 - iii. Reset off cycle inappropriately
 - iv. Too high
- e) All data shall be transferred to billing system after meter data validation and estimation including transformer / feeder station wise energy audit.
- f) MDM shall estimate usage for non-metered service points such as streetlights, farm lights, traffic signals, etc.
- g) The MDM shall maintain both the original received raw data in a non- manipulated state, in addition to VEE data.
- h) Notwithstanding the latency of data collection via the AMI system, once the MDM receives meter read data, the VEE process occurs in real-time and the post-VEE data is then immediately available to user or external systems.
- i) The MDM shall be able to automatically flag data changes from manual edits, VEE (Validating, Editing and Estimating) rules and data source corrections and electronically generate audit trail with timestamps and user-ids.

1.6.5 Billing Determinants

Calculations The MDM-

- a) Shall allow configuring multiple TOU options (e.g. the number and duration of TOU rate periods) by consumer type, tariffs and day type (weekend, weekdays, and holidays) and by season.
- b) Shall support the processing of interval data into billing determinants to include the following at a minimum:
 - i. Total Consumption

- ii. Consumption in different time blocks for ToU billing
- iii. Maximum Demand (in kW and kVA)
- iv. Number of tamper counts
- v. Average power factor
- c) Shall process interval data and frame it into the appropriate TOU periods for consumption and demand; for example, roll up 15/30-minute data intervals into hourly data.
- d) Shall have the ability to properly account for special metering situations such as check metering, sub metering, prepaid metering and net metering when calculating billing determinants and sending them to billing and other systems.
- e) Shall have the ability to properly account for special situations including, but not limited to, curtailment requests, demand response scenarios (based on use cases provided in Annexure F) when calculating billing determinants and sending them to billing software.
- f) Shall have the ability to facilitate implementation of automatic compensation payments by Utility to consumers for sustained outages when requested. Compensation calculations would require cross checking with billing and consumer balance information to ensure that disconnection is not construed as a no supply event.

1.6.6 Prepaid functionality

The MDM with the help of the corresponding HES, should be able to switch the Smart Meter between prepaid and post-paid modes by a simple change in configuration of the Smart Meter firmware remotely.

The following prepaid functionality shall apply

- a) MDM shall use consumer attributes from Consumer Care System (CCS) and/or Utility Billing system to,
 - i. enroll and setup new prepaid/ post-paid consumers
 - ii. migrate existing post-paid consumers to prepaid mode and vice versa
- b) The MDM should support pre-payment metering capability through interface with a pre-payment application engine.
- c) The prepayment system shall ensure that payment and connection parameters are stored centrally, and the details are updated to MDM and consumer portal/ app as defined in Section 1.7. Information required by consumer's Mobile App and web portal are shared in near real time.
- d) Prepaid consumers shall be provided facility to recharge their account by logging on to the consumer portal/app as defined in Section 1.7.
 - i. The user interface shall be integrated with the present online payment gateway of the utility.
Additional payment gateways shall be implemented if required
 - ii. The payment gateways shall facilitate payments through on-line banking, credit cards and payment wallets
- e) In addition, a prepaid mobile application functionality shall be provided as a recharge option for android OS and iOS. The consumer portal/ app, shall enable consumers to recharge as

well as view recharge history, existing balance, daily usage etc.

- f) In addition to billing determinants, the MDM shall share, consumer recharge and credit updates with the utility Billing system. Any re-conciliation shall be carried out in the Billing System and the same shall be shared with the MDM for use by the prepayment application.
- g) The system shall periodically monitor the energy consumption of prepaid consumer and decrease the available credit based on consumption. For this purpose, the MDM shall fetch billing data (kWh/kVAh consumption and MD) at configured intervals from the prepaid meter. The raw billing data shall be subjected to standard VEE rules before being used to update recharge balance with the help of applicable tariff slabs. The credit balance is updated into meter daily.
- h) The prepayment application shall use determinants such as minimum fixed charges, TOU tariffs, slab rates, duties & surcharge while calculating consumer credit/balance. Fixed charge shall be deducted on daily basis irrespective of the consumption, even after disconnection of supply and adjusted in the next transaction.
- i) The prepayment application should be able to automatically apply different TOU tariffs for future date lines, while calculating consumer credits.
- j) The system should send connect/disconnect command based on of available credit as per notified rules & regulations.
- k) The system should send low-credit notifications to the consumer when their balance approaches a pre-configured threshold. Alerts shall initiate on every recharge, low credit and load connection/disconnection. The alerts shall be posted on the consumer web Portal/ App in real time and sent through email. Consumer should also be alerted through other mechanisms such as one- time alarm / beep from the meter, LED blinking, message, etc.
- l) It shall be possible to configure an “emergency” credit limit in INR as well as day terms. This emergency credit shall be used as reserved amount that is consumed when consumer credit is exhausted. The credit amount shall be adjusted in next recharge transaction.
- m) It shall be possible to configure certain prepaid consumers where auto-disconnections shall not happen due to negative credit.
- n) MDM shall also have a facility to configure arrear recovery mechanism to recover arrears from a consumer. Some of the indicative mechanism to recover the same can be recovery of [X]% from every recharge amount while the rest goes as charging amount till all the arrears are recovered. Alternately the arrears may be settled in next [X] instalments as decided by utility such that not more than 50% of any instalment shall be adjusted towards arrear.

1.6.7 Net Metering

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

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

programmable threshold value

Like billing for post-paid meters, the billing for net-meters shall take place in the utility Billing server.

1.6.8 Exception Management

- a) Ability to capture and log data exceptions, problems and failures and to generate management reports, provide trend analysis, automate generation of service requests and track corrective actions.
- b) Ability to group, prioritize, filter and send system generated alarms and events to predetermined email addresses, cellular text messages to phone numbers/SMS/consumer care etc.
- c) Exception Generation - MDM shall generate exceptions based on configurable business rules including but not limited to the following:
 - i. Meter tamper alerts
 - ii. Communication module health alerts for meter/DCU
 - iii. If the consumption is less/more than pre-defined average consumption
 - iv. Negative Consumption (not for net-metering)
 - v. Power outage indications received from the Smart Meter

1.6.9 Service Orders

- a) The MDM shall generate service orders based on configurable rules for various events and alarms such as stop meter, tampers, problem in communication networks, etc.
- b) MDM shall send service orders via SMS, email, etc. with the email addresses / phone numbers being configurable. MDM shall receive feedback on action taken on the service order and track the status of service orders until resolution.
- c) Service order tickets could be generated by MDM but processed and closed under jurisdiction of the HES-NMS combine. If the utility already has a separate Workforce Management System (WFM), then the service order tickets can be routed from the MDM and the NMS to the WFM for completion of the tasks and reporting.

1.6.10 Revenue Protection Support

- a) Ability to analyze meter tampering flags, power outages, usage trends and usage profiles to identify potential energy diversion situations, and produce daily reports, monthly reports and service order requests for investigation.
- b) The business rules for revenue protection alerts shall be configurable via a user-friendly interface.
- c) The MDM shall filter out revenue protection alerts that may be caused by field activities if the field activity information is provided to the MDM.
- d) The MDM shall support the analytics/investigation (i.e. view current and historical usage patterns) to validate suspected revenue protection issues.

1.6.11 Analytics

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

- a) Display consumption/load profiles by configurable period (15/30 min, hour, day, month, year etc.) day type (weekday, weekend, holiday, festival wise etc.) and by tariff, consumer type (hospitals, schools, govt. offices, multiplexes, commercial, residential, industrial etc.), or any user specified collection of meters.
- b) Generate peak & off-peak load patterns by aggregating all loads of consumer group/consumer type/DT/Feeder over configurable period/day type.
- c) Perform DT/feeder wise energy audit for configurable period. These energy audit reports shall clearly bring out the technical losses at Feeder level and DT level through detailed analysis of supply side energy data and corresponding aggregated consumption data of connected consumers. In this analysis it must factor in data of energy export from net-metered consumers
- d) Perform load analysis for different groups and categories of consumers in different weather conditions.
- e) Ability to provide the data to load forecasting, load research or demand response applications (based on use cases provided in Annexure F) and perform error management such as missed reads and intermittent meter reads before sharing data with load forecasting, load research or demand response
- f) Ability to configure the system to effectively visualize consumption trends, identify unusual patterns, and visualize load analysis to understand which assets are being over utilized.
- g) Analyzing data to identify new patterns of usage, Setting fraud alert / transformer overload alerts / demand – supply gap alert etc.
- h) Ability to receive and store outage and restoration event data from Smart Meters and outage systems and to log all such events for analysis and also support calculation of compensation payments for sustained outages. Five reliability indices shall be calculated,
 - i. System Average Interruption Duration Index (SAIDI), which is sum of all consumer interruption durations in a given period over total number of consumers served.
 - ii. System Average Interruption Frequency Index (SAIFI), which is the total number of sustained interruptions in a given period over total number of consumers served.
 - iii. Consumer Average Interruption Duration Index (CAIDI), which is sum of all consumer interruption durations in a given period over the total number of sustained interruptions in that given period
 - iv. Consumer Average Interruption Frequency Index (CAIFI), which is the total number of sustained interruptions in a given period over the total number of distinct consumers interrupted in that given period
 - v. Momentary Average Interruption Frequency Index (MAIFI), which is the total number of consumer interruptions less than the defined time (1 or 5 minutes) over the total number of consumers served

These reliability indices shall be calculated for each month, for individual feeders and aggregated annually for the whole utility. The source data for outage shall be last gasp and the first breath messages from DT/Feeder level meters. These computations shall be independent of similar computations made by any OMS application.

- i) Ability to alerts on DT/ Feeder level overvoltage & back-to normal event and under-voltage and back-to-normal events. Based on these alerts the system should calculate the duration in which the DT/Feeder remained outside the nominal zone of defined voltage. Similar calculations should be allowed for power factor and current unbalance.
- j) Identify & visualize poor performing assets such as feeder/DT on multiple criteria such as energy losses, outage duration etc. through appropriate colour coding depending on severity thresholds.
- k) Analyze data of net-metering consumers to identify patterns of energy export to grid on hourly/weekly/monthly/yearly basis.

1.6.12 Reporting

The Report function shall enable the Utility to deliver reports in standard digital format such as PDF, Excel, etc. All queries for report generation shall be made through user driven drop down menu in GUI of Utility user interface (refer to section 1.7.1 for more details). The AMISP shall provide example queries to support internal report generation needs. The GUI shall have provisions to set up or change report delivery to configurable email addresses, network file directories, ftp sites or printer systems without modifying source program code and without any proprietary language skills.

1.6.13 Integration with other Systems

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

The aim of the above interface standards is to ensure generic two-way interfacing of the MDM with 3rd party applications. Towards this APDCL shall make arrangements to provide documented information on interface detail and specificity in implementation, of its existing systems, which need to interface with the MDM. This effort shall be guided by the methodology whose details are outlined in the approach paper set out in Project Implementation Plan.

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

- a) Utility Administration
- b) HES for data exchange with AMI solutions
- c) Billing system
- d) Existing Data Collection Systems
- e) Support of interface with HHU or manual reading system etc.
- f) Consumer Portal/ App

The supplied MDM shall be ready for integration with IVRS, CRM, GIS and CIS systems of the utility based on the standard interfaces as mentioned above. AMISP should provide suitable number of HHUs to read and update the data in MDM to meet contingency requirement in case of communication failure between meter and HES/MDM.

1.6.14 Integration with national level reporting platform

The AMI system put in place should provide a seamless exchange of data with a national level data portal without any manual interface. In this regard, the MDM shall have an out-bound interface to facilitate data transfer through API-based model/ service bus to a central platform as and when made

available. An indicative data list will be provided by the Utility for sharing with the national level reporting platform during contract period. The technical interface (such as web services, published APIs, DB table schemas etc.) for enabling this integration, will be defined accordingly. However, the AMISP needs to ensure the following:

- a) Any reports / analytics / graphics from system would provide opportunity to anonymize/ remove traceability to individual consumers to maintain privacy
- b) Reports/data made available in the public domain for public consumption should be always sufficiently aggregated/ anonymize so as to protect consumer privacy

1.7 Utility Interface and Consumer Portal/ App

1.7.1 Utility User Interface

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

- a) The interface is to be Payment Card Industry (PCI) compliant
- b) Compare total energy costs on one rate schedule vs. one or many alternative rates.
- c) Enable the user to see how different options within a rate affect costs.
- d) Enable the user to see how adjusting load or consumption levels or shifting them to different time periods influences costs.
- e) Display meter data at a user defined configurable cycle that allows authorized users to view energy usage patterns and the data behind them for selected consumers.
- f) Allow authorized users to view metered data, initiate and view reports, modify configurations, and initiate and update service requests.
- g) Display 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.
- h) Display the energy usage profile for a single meter or group of meters according to Time of Use (ToU) tariff.
- i) The UI shall support a configurable utility dashboard for Operations and Utility Management
- j) Access to a minimum of three (3) years of historical energy usage and meter reads through the UI.
- k) Clearly and visually distinguish between metered, estimated, allocated and substituted data.
- l) User management with roles and access rights
- m) GUI to provide role-based access based on user identity and user role. Shall have following types of users:
 - i. Administrator
 - ii. Operator
 - iii. Field staff
 - iv. Viewer/Guest
- n) 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.).

- o) Ability to set up alarm and event notifications that can be directed to a combination of configurable email addresses, cellular text messages.
- p) UI shall enable viewing of the credit amount updated in MDM for prepaid consumers.
- q) Option to send marketing messages and notification to select consumers or selected category of consumers
- r) Facility to enable or disable existing functionalities/sections of App/Portal for consumers use.
- s) Consumer views to be available to Utility consumer Service Executive also except payment card/bank information.
- t) Authorised representative to be enabled for consumer engagement analytics. The analytics to be configurable/ generated with minimal database skill and nil programming requirements.
- u) Representative to be able to generate various reports at different intervals the various reports as indicated in section 1.8. It shall be also possible to export the report data in multiple formats such as XLS, CSV format, etc.
- v) Provide consumer interactions history to enable efficient consumer complaints and queries resolution with consumer information in single screen.

1.7.2 Consumer Portal/ App

The consumer web portal and the mobile application (for smartphone and tablet devices using latest and commonly available browsers and operating systems and platforms) shall provide consumers, ready access to features extended by MDM. The Solution shall integrate via a user-friendly graphical interface. It shall provide for self service capabilities such as usage management, billing, service requests, participation in energy efficiency programs etc. Following features shall be supported by Portal / Mobile app:

- a) The mobile app and web portal shall support all device form factors such as mobile, tablet, desktop etc. by recognising the device details automatically.
- b) It shall be OS agnostic to operating system and devices (iOS, Android, etc.)
- c) The interface is to be Payment Card Industry (PCI) compliant
- d) It shall work on all standard browsers such as Internet Explorer (IE), Chrome, Safari, Firefox etc.
- e) The application should be modular and scalable a COTS product.
- f) The application should be native for better user experience.
- g) It shall support multiple languages viz Hindi, English and local language(s). Also, notifications should be sent to consumers in local languages.
- h) The user experience of the citizen on the Portal and App shall be similar in terms of look and feel, navigation, menu and access to preferences and other data.
- i) Menu should have navigation options, not limited to, Home, Settings, Recharge, notification preferences, usage rates, change password, terms and conditions, privacy policy, sign out.

- j) It shall have search functionality across all the pages.

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

1.7.2.1 Functional Requirements of Consumer Portal/ App

Web portal and Mobile app for consumers should have minimum following functionalities:

- a) The consumer portal/app shall have a landing Home page. This page shall provide a brief description about the Utility, any promotional features or advertisement for special programs can be placed in this page. Login Component is provided, and registered users may login using their username and password. New Users can also register by clicking on the First Time Users Register link. The Forgot Password link helps the user to retrieve their password. New users can register by providing their personal information and setting up of security answers. Forgot passwords can be retrieved or reset using OTP through registered mobile number or through email address. The registered users can change their password and account information as well as registered mobile number through OTP feature.
- b) The consumer portal/app shall provide consumers with access to consumer ID, meter ID, meter type and name plate details, besides other account information such as account name, address, balance, due, status etc. Any status message pertaining to the account/s viz. alerts/actions shall be displayed here. It shall also provide current and historical consumption in graphical formats for at least 12 months. A more detailed analysis can be provided in a tabular format listing meter reading date, reading, consumption, charges, selected period etc. Consumers shall be able to view interval data, outage flags, voltage, power quality indications, existing tariffs and incentives for selected period. Information about different consumer engagement programs shall also be displayed here.
- c) The portal/app shall have the ability to provide option for registering in online/paper billing to the consumer. There shall be a bill summary page that shall display bill information in summary and also option for detailed view and download in pdf format if required by consumer. The user shall be able to pay bill for single and multiple accounts.
- d) The portal/app shall be integrated with existing helpdesk of the utility and have the ability to provide option for recording service requests/complaints lodged by the consumer as new connection, disconnection, load change, category change, meter shifting etc. The user can view the service request status. The user can register complaints viz. power failure, faulty meter, streetlight outage etc. Option to track status of service requests and send the notification through SMS, online messaging platforms such as WhatsApp, Email and IVR and should support multiple languages – English / Hindi / regional languages.
- e) Mobile App and Web Portal shall facilitate Chat-bot functionality. The portal/ App shall support communication preferences for notification via email/ SMS/ message/ automated call (through utility IVRS), of configured alarms & events to selected users.
- f) The information on consumer identification no., meter ID, name plate details, make, type i.e. 1 Phase or 3 Phase, etc. (as per requirement of Utility) shall be updated in HES, MDM, and the consumer portal/app.
- g) The consumer Portal/ App shall have the ability to provide the consumer near real time online views of both usage and cost differentiating high energy usage periods, helping consumers to understand electricity usage and cost information, alerts and notifications and energy

savings tips with different levels of detail. The Portal/ App shall support the view for past electricity usage, last week's, yesterday's, current days or other period etc. as per selection as well as voltage and power quality indications. The portal/ app shall provide user friendly access to consumer for their data via graphs and charts and can download the data into a spreadsheet.

- h) The portal/app shall provide option to the consumer to view/download online bill. There shall be a bill summary page that shall display bill information in summary and option for detailed view and download in pdf format. The user shall be able to pay bill for single and multiple accounts.
- i) The portal/app shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc. The portal/app shall also can provide consumers with interval data, flags, voltage, power quality indications etc. Show outage information in map view.
- j) There should be different UI and landing pages for different type of consumers as per the need of utility.
- k) User interface to consumer Portal/ App to access consumer's data from MDM for all authorized consumers shall have ability for at least the following functionality:
 - i. View metered data, monthly average usage, current monthly consumption, maximum demand and other reports
 - ii. View data according to Time of Use (ToU), day, week, month, year and season etc.
 - iii. Update profile information such as mobile number/email etc.
 - iv. Guest user account/multi-user account access facility for consumer convenience
 - v. Initiate request for connection/disconnection
 - vi. Initiate request to switch between pre-paid and post-paid mode
 - vii. Initiate service requests for maximum demand updating, meter checking etc.
 - viii. Initiate complaints such as Meter not working, supply off etc.
 - ix. In case on net-metering consumers, user can view data for both import & export data
 - x. Can view recharge history, present balance, next possible recharge date and amount etc.
 - xi. Historical energy consumption and energy charges during the desired time period
 - xii. Facility to recharge their account through the payment gateway facilitated by the utility.

1.8 Report Generation

- a) The MDM should have an option to generate following reports (an indicative list only). Utility may request for additional reports as well during the contract period.
 - i. Daily data collection report
 - ii. Usage exceptions
 - iii. VEE validation failures
 - iv. Missing interval Read date and times (on hourly, daily, weekly & monthly basis) and their trends

- v. Physical meter events (install, remove, connect, disconnect) & meter reset report
 - vi. Meter flags
 - vii. Meter inventory
 - viii. Defective meters
 - ix. AMI performance measurements
 - x. Threshold exception
 - xi. MIS reports and analytical reports including but not limited to following reports:
 - 1) Payment collection summary and details in a day/week/month/year or as per user selectable period and trends
 - 2) Number / list of disconnected consumers due to inadequate prepaid account balance
 - 3) Prepaid consumers running low on account balance
 - 4) Connected consumers
 - 5) Critical notifications sent to consumers
 - 6) Revenue analytics as per consumption pattern of consumers (in terms of money and energy units). This shall also include automatic compensation payments by Utility to consumers for sustained outages, if implemented
- b) The utility interface should have ability to generate reports on critical and non-critical information directly from the HES as defined in section 1.5.3
 - c) The utility interface shall have feature to generate report related to SLAs being mentioned in section 5.6
 - d) Ability to generate various analytics reports as mentioned in section 1.6.11
 - e) AMISP shall submit a detailed report on data being shared as described in section 3.8 on a yearly basis. AMISP shall submit detailed report on any exception in general data sharing on monthly basis. Further, AMISP shall also submit a detailed report for any other time period as requested by utility

2. Hardware Requirements for AMI Network Operation & Monitoring Centre

The Network operation and monitoring centre shall be created in the utility premises by the AMISP, for which suitable built up space shall be provided by the utility. The built-up space to be arranged by the utility, shall be properly air conditioned, illuminated and adequate for at least five operator workstations and one cabin for a supervisor.

The AMISP is required to suggest a suitable architecture for the Network Operation & Monitoring Centre, taking care of the security requirements as described in this document. The network operation and monitoring centre shall be equipped with the following minimum hardware components:

- a) Six numbers Operator workstations including one for Supervisor
- b) A dual redundant 1 Gbps local area network
- c) Internet router supporting IPsec, and SSLVPN capability
- d) Firewall and intrusion protection system
- e) One video display system of at least 70-inch diagonal with laser light source HD cube (DLP technology) supported by,
 - i. Dual power supply
 - ii. IP based control options and
 - iii. Display Port, DVI, HDMI and Analog D-Sub signal interfaces
- f) One A3/A4 size laser jet B/W printer with LAN interface
- g) One A4 size ink jet colour printer with LAN interface
- h) Online UPS
- i) 2 Gbps internet connectivity

In addition, the AMISP has to be establish connectivity between the cloud-based MDM system with utility's existing Billing system. This will necessitate creation of a VPN tunnel between the two, unless it is decided to migrate the Billing system to the same cloud data centre.

This section describes the technical requirements of all the hardware envisaged in the AMI system. The AMISP has to submit the details of the supplied hardware along with the Bid. The AMISP shall asses the adequacy of hardware specified in the BOQ & if any additional hardware or higher end hardware configurations are required to meet all the requirements of the Technical Specifications, the same shall be included in the offer.

2.1 Technical Requirements for Hardware

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

All workstations and network equipment (routers, firewall etc.) shall be compatible for remote monitoring using secure Simple Network Management Protocol (SNMP) Ver. 3.0. All hardware shall support IPv6 simultaneously.

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

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

2.2 Technical Specification for Network Operation & Monitoring Centre

Workstations

S. No.	Description of the Features	Minimum Requirement of Features
1.	Spec	As per the base runtime requirement of CPU 2017 bench marking standards
2.	RAM	8GB
3.	Internal Auxiliary memory	500GB delivered, expandable up to 1TB
4.	Internal Optical Drive	Blu-ray (R+W)
5.	Speakers	Two external speakers
6.	Interfaces	1 Gb dual Ethernet ports Minimum Two nos. of USB Ports
7.	Power Supply	AC Power Supply
8.	User interface	Two 24" wide screen (16:9 aspect ratio), HD Resolution (1920x1080) TFT Colour monitors, keyboard & optical mouse
9	Mounting	Desktop Mounting

TFT Monitor for Work Stations

Sr. No.	Description of the Features	Minimum Requirement of Features
1.	Diagonal Viewable size	24"
2.	Colour support	16.7 million

3.	On screen control	Required
4.	Anti-glare & anti-static	Yes
5.	Tilt , Swivel	Yes
6.	Aspect ratio	16:9

Firewall

Sr. No.	Description of the Features	Minimum Requirement of Features
1.	Specification	8 Ethernet Ports (1gbps) and 4 Fiber Optic Ports
2.	Data encryption support	3DES (168 bits), AES 128-, 192-, 256- bit and hashing algorithm like MD5 , SHA-1, IKE, PKI (X.509) and IKEv2 with EAP
3.	Support Active-Active mode	Yes
4.	High Availability & Load balancing	Yes
5.	Support NAT, PAT & Policy based NAT/PAT, Mapped IP (MIP), Virtual IP(VIP) & MIP/VIP grouping	Yes
6.	IP address assignment features	PPPoE, DHCP
7.	Support VoIP protocols	H.323, SIP, MGCP, SCCP
8.	IPv6 features	Syn Cookie, Syn-proxy DoS attack detection, SIP, RSTP, Sun-RPC, ALG's, RIPng, BGP4, DHCPv6 Relay, IPv4 to IPv6 translations & Encapsulations.
9.	System management	Using web UI, Command Line interface (console/telnet/SSH).
10.	Filtering of packets based on Source address, destination address, protocol type, user, port number, URL.	Yes
11.	Filtering of protocols	FTP, SMTP, HTTP, HTTPS, SNMP, UDP, ICMP, RPC, DNS, DHCP, ARP, TCP, POP3
12.	Authentication protocols	RADIUS, LDAP and PKI methods
13.	Dynamic routing protocols	RIP v2, OSPF, & BGP

14.	DoS & DDoS prevention	Yes
15.	TCP reassemble for fragmented packet protection	Yes
16.	Brute Force attack mitigation	Yes

Sr. No.	Description of the Features	Minimum Requirement of Features
17.	SYN cookie protection	Yes
18.	Zone based IP spoofing	Yes
19.	Malformed packet protection	Yes
20.	DNS guard features	Yes
21.	Content filtering	JAVA & ActiveX blocking
22.	Antivirus, anti-worm, anti-spam and anti-spyware protection	Yes
23.	System Logging & monitoring	Syslog, Email, SNMPv2 and VPN Tunnel Monitor.
24.	Stateful packet inspection	Yes
25.	Assign zones to virtual & physical interfaces	Yes

Router

Sr. No.	Description of the Features	Minimum Requirement of Features
1.	Functions	High performance Routing for data exchange between data centers, remote WorkStation, DCU, Internet cloud.
2.	Routing Capability	Layer -2 & Layer-3 routing & Dynamic discovery of routing
3.	Processing capacity	Minimum 2 Mbps
4.	Features to support	QoS, MPLS, Security, Broadband, Multiservice, Voice, IP to IP Gateway
5.	Routing protocols	IS-IS, OSPF, BGP, ARP, IPCP, IP forwarding, VLAN & MPLS etc.
6.	Network protocols	TCP/IP, IPv6, IPv4, OSI, Telnet, UDP, DHCP
7.	Network management	Using SNMP Protocol

8.	Inbuilt security features	<p>a. Data encryption supported DES (56 BITS) 3des (168 bits) and hashing algorithm like MD5 and SHA-1</p> <p>b. Filtering of packets based on Source address, Destination address, Protocol type, User, Port number, URL</p> <p>c. Filtering of Protocols such as FTP, SMTP, HTTP, SNMP, UDP, ICMP, RPC, DNS, DHCP, ARP</p> <p>d. Minimum 100 IPSec VPN tunnels support e. Detailed system logging</p>
9.	Speed configurability at each port	All ports shall be configurable from 64kbps to 2Mbps
10.	Interface ports	Minimum 8 Ethernet ports (1Gbps) and 4 Fibre Optic Ports
11.	Mounting	Rack mountable

Colour Laser Printer

S. No	Description of the Features	Minimum Requirement of Features
1.	Functions	Print
2.	Paper size	A3, A4
3.	Print speed	30 Colour pages/minute of A4 size & 15 Colour pages/minute of A3 size.
4.	Print resolution	600X600 dpi
5.	Paper weight	75-200 GSM
6.	First page out time	8 sec for Black & White, 15 sec for Colour
7.	Duty cycle	100000 pages per month
8.	Paper handling capacity	Minimum 500 sheets for input tray & 500 sheets for output tray.
9.	Landscape and portrait orientation	Yes
10.	Interface	1GB LAN ports

Black & White Laser Printer (Multifunction Device)

S. No.	Description of the Features	Minimum Requirement of Features
1.	Functions	i. Print ii. Scan iii. Copy iv. Fax
2.	Paper size	A3, A4
3.	Print speed	30 pages/minute of A4 size & 15 pages/minute of A3 size.
4.	Print resolution	600X600 dpi
5.	Scan resolution	600x600 dpi
6.	Paper weight	75-200 GSM
7.	First page out time	8 sec
8.	Duty cycle	100000 pages per month
9.	Paper handling capacity	Minimum 500 sheets for input tray & 500 sheets for output tray.
10.	Automatic Duplex printing	Yes
11.	Landscape and portrait orientation	Yes
12.	Interface	1GB LAN ports

UPS

Specifications for 20KVA UPS Systems	
Sl. No. Component	Specifications
1. Capacity	20KVA
2. General	
Noise Level	Less than 50db
Operating temperature	0-45 degrees centigrade
Total Harmonic Distortion	<3% for 100% linear load
	<5% for 100% non-linear load
Crest Factor	Minimum 3:1 at full load
Output wave form	Sinusoidal
cold start feature	Required
Active input PF correction	>0.94
3. Input	
Input	20 KVA-- 3ph I/P and Single phase out put 3 Wire...
Input voltage range	415 V +10%, -20% Single phase...20kva... 230V +10%, -20%Single phase
Input frequency range	47 to 53 Hz
Input power at full load (At minimum rated power factor)	20KVA UPS : 17200/21500 watts without battery charging current @0.8/0.99pf
Input voltage at which mains fail is sensed at full load and battery takes over.	228V VAC and 478 VAC for 3ph phase 4 wire...
4. Out put	
Output voltage	230 VAC Single phase , +/- 1.5% at full load...230 VAC Single phase , +/- 1.5% at full load
Output frequency	50 Hz +/- 0.5% (free running)
5. Efficiency	
Overall efficiency	80% or better
Inverter efficiency	90% or better
6.Static Switch (Bi-directional) for all ratings	Should be provided and should take care of 100% load transfer without break
7.Load power factor	0.8 lagging
8.Overload capacity	130% overload for 60 seconds
	125% overload for 10 Minutes
9. UPS shut down	
UPS should shutdown with an alarm and indication on	
1. Output over voltage	250 VAC adjustable
2. Output under voltage	200 VAC adjustable
3. Battery low	1.75 v/cell
4. Inverter over load	130% for 1 minute
10. Isolation	
Isolation of power	Both input & output to have MCB's .Also battery connection to have MCB/MCCB/switch
Isolation transformer	Required at Input
Galvanic Isolation	Required
Manual service bypass	Required
11.Protection	

3. System Software Requirements

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

3.1 Software Standards

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

3.1.1 Design and Coding Standards for AMI Applications and Utilities

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

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

3.1.2 Applications

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

- a) **Expansion:** Software shall be dimensioned to accommodate the size of AMI application system as given in BOQ (as mentioned in this RFP) and Annexure D.
- b) **Modularity:** Software shall be modular i.e. functionally partitioned into discrete, scalable, reusable modules consisting of isolated self-contained functional elements and designed for ease of change. The system shall make maximum use of common industry standards for interfaces.
- c) **User-Directed Termination:** Functions taking long execution times shall recognize and process user requests to abort the processing.
- d) **Portability & Interoperability:** The system shall be designed for hardware independence and operation in a network environment that facilitates interoperability and integration of third-party applications. AMI applications should support multiple Relational Database Management Systems

(RDBMS) including Oracle, Microsoft SQL Server and MySQL.

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

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

3.1.3 Operating System

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

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

3.1.4 Time and Calendar Feature

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

3.1.5 Remote Diagnostic

Remote Diagnostic facility with necessary hardware as required shall be provided for communication between the AMI application system at the cloud data centre and the NOMC and the AMISP's & [utility's] support office for the diagnosis of hardware & software problems. The login shall be protected by a username & password entry. An automatic logging and intimation shall be provided to inform authorized person from AMISP/utility on such events of remote access and diagnosis.

3.1.6 Development System as a Test Bench

A Development system independent of the production environment shall be defined at the cloud data centre which shall provide testing facility for integration of changes/modifications of the AMI application and new field devices before putting it online with Real-time system. This Development system shall be on a VLAN separated from the production VLAN and shall be self- sufficient to carryout testing of changes/modifications. Network Software

3.2 Network Software

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

3.2.1 Network Communication

The network communications software shall use a standard network protocol such as TCP/IP, UDP etc. and shall support IPv6. The software shall link dissimilar hardware nodes such as local and remote workstations

and peripheral devices into a common data communication network allowing communications among these devices.

3.2.2 Network Management System (NMS)

The proposed NMS shall facilitate following activities:

- a) Security Management to protect systems and network from unauthorized access, manage user access, authorizing rights and privileges.
- b) Viewing of all network elements deployed in the field and administer configuration changes of the network devices and nodes through toolkits to automate the following tasks:
 - i. Capture running configuration, capture start-up configuration, upload configuration
 - ii. Compare configuration
 - iii. Real-time or scheduled capture of device configurations
 - iv. Store historical device configurations captured and enable comparison of current device configuration against a previously captured configuration
- c) Security patch management of all applications shall be encrypted and signed.
- d) Performance Management to monitor network performance as specified.
- e) Fault Management to recognize, isolate, log and identify fault on network and connected nodes, devices.

The network management software shall be based on the latest secured version of SNMP v3. The NMS shall have a simple browser-based user interface to provide all the pertinent information about the system. The NMS shall not impact the availability and performance of AMI applications and shall load not more than 1% of network bandwidth and shall have secure communication.

The Network Management Software shall have following functionality:

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

3.2.3 System Protection & Security

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

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

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

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

The overall cyber security policy and implementation shall account for:

- a) Prevent unauthorized users from reading or writing data or files, executing programs or performing operations without appropriate privileges.
- b) Document all user sign on procedure
- c) Record all network traffic for detecting unauthorized activity, unusual activity and attempts to defeat system security (AMISP to propose and document what constitutes normal activity/traffic)
- d) A user authentication scheme consisting of at least a user identification and password shall be required for the user to request a connection to any network node.
- e) GUI to provide role-based access based on user identity and user role. Shall have following types of users:
 - i. Administrator
 - ii. Operator
 - iii. Field staff
 - iv. Viewer/Guest

3.3 Cloud Service Providers (CSP)

This section mentions key requirements from the Cloud Service Provider (CSP). AMISP shall be responsible to provide the services of CSP.

3.3.1 General Conditions

The cloud data centre shall have to comply with requirements of tier III category which applies to a concurrently maintainable site infrastructure with redundant capacity components and multiple independent distribution paths serving the critical environment. All IT equipment shall be dual powered. The following general conditions will apply:

- a) Only GI (MeghRaj) cloud services or Meity empanelled Cloud services should be used. The Cloud Service Provider (CSP), empanelled by MeitY, should be audited by STQC.
- b) One of the most critical issues in the Cloud Service implementation is the security of the data. It is the responsibility of the AMISP to define the security services that need to be implemented for their workloads depending on the nature of the applications / data hosted on the cloud.

- c) AMISP need to ensure that the CSPs facilities/services are compliant to various security standards (as mentioned in clause 4.3.4) and should be verified by third party auditors.
- d) CSP should suitably address all the potential risks and issues in cloud implementation including data security and privacy, increased complexity in integration with existing environments, vendor lock-in, application portability between different platforms, exit management / Transition-Out Services etc.
- e) The AMISP shall be responsible for providing the cloud data centre services. It shall be up to the AMISP, to identify the critical service agreements with the concerned cloud data centre provider in order that the AMISP can meet and sustain the SLA for the AMI project as described in section 5.6 of this schedule
- f) All Services including data should be hosted in India
- g) Exit Management / Transition-Out Services -The responsibilities of the CSP during the Exit Management Period need to be agreed upon with the Utility and they should assist the Utility in migrating the data etc.
- h) The responsibilities of CSP include migration of the data, content and any other assets to the new environment or on alternate cloud service provider's offerings and ensuring successful deployment and running of the Utility's Solution on the new infrastructure
- i) The ownership of the data generated upon usage of the system, at any point of time during the contract or expiry or termination of the contract, shall rest absolutely with the Utility.

The AMISP may also choose to procure the following Managed Services (O&M – Cloud Services) from a Managed Service Provider (MSP) in addition to the cloud services to handhold the department in managing the operations on the cloud. The scope of MSP may include:

- a) Migration of Existing Applications to Cloud / Deploying of new applications;
- b) Operations & Maintenance Services on Cloud (e.g., Resource Management, User Administration, Security Administration & Monitoring of Security Incidents, Monitoring Performance & Service Levels, Backup, Usage Reporting and Billing Management)
- c) Exit Management & Transition-out Services, etc.

3.3.2 MeitY's Guidelines

While the security, storage, data and compliance tools are provided by the **CSP**, it is the AMISP's responsibility to ensure that the CSPs facilities/services are certified to be compliant to standards.

In the MeitY's guidelines to Government Departments on Adoption / Procurement of Cloud Services, the following are included as essential certification by CSP. AMISP also needs to ensure that the CSPs facilities/services are certified to be compliant to the following standards (indicative list provided below):

- a) ISO 27001 - Data Center and the cloud services should be certified for the latest version of the standards towards information security management system
- b) ISO/IEC 27017:2015-Code of practice for information security controls based on ISO/IEC 27002 for cloud services and Information technology
- c) ISO 27018 - Code of practice for protection of personally identifiable information (PII) in public clouds.
- d) PCI DSS - compliant technology infrastructure for storing, processing, and transmitting credit card information in the cloud

3.3.3 Functional Requirements of the CSP

3.3.3.1 Operational Management

- a) CSP should provide access of cloud virtual machines either by SSH in case of Linux and RDP in case of Windows servers.
- b) CSP should enable Utility to get console access of cloud virtual machine from portal and perform operations.
- c) CSP should upgrade its hardware time to time to recent configuration to delivery expected performance for this Project.
- d) Investigate outages, perform appropriate corrective action to restore the hardware, operating system, and related tools.
- e) CSP should manage their cloud infrastructure as per standard ITIL framework in order to delivery right services to Project.
- f) The CSP should allow different users with different level of access on CSP portal. For example, billing user should not be able to provision resources or delete any resources
- g) The CSP should allow quota management for each department/ISV/Group. The resources to specific department/group/ISV should be as per allocated quota only. If there is any request for more than quota request, then it should be sent as request to admin.

3.3.3.2 Compatibility Requirements

- a) CSP must ensure that the Virtual Machine (VM) format is compatible with other cloud provider.
- b) CSP should give provision to import cloud VM template from other cloud providers.
- c) CSP should ensure connectivity to and from cloud resources used for this project is allowed to/from other cloud service providers if required.

3.3.3.3 Cloud Network Requirement

- a) CSP must ensure that cloud VM of project is into separate network tenant and virtual LAN.
- b) CSP must ensure that cloud VM are having private IP network assigned.
- c) CSP must ensure that all the cloud VMs are in same network segment (VLAN) even if they are spread across multi data centres of CSP.
- d) CSP should ensure that cloud VMs are having Internet and Service Network (internal) vNIC cards.
- e) CSP should ensure that Internet vNIC card is having minimum 1 Gbps network connectivity and service NIC card is on 10 Gbps for better internal communication.
- f) In case of scalability like horizontal scalability, the CSP should ensure that additional require network is provisioned automatically of same network segment.
- g) CSP must ensure that public IP address of cloud VMs remains same even if cloud VM gets migrated to another data centre due to any incident.
- h) CSP must ensure that public IP address of cloud VMs remains same even if cloud VM network is being served from multiple CSP data centres.

- i) CSP must ensure that the public network provisioned for cloud VMs is redundant at every point.
- j) CSP must ensure that cloud VMs are accessible from Utility private network if private links P2P/MPLS is used by Utility
- k) CSP must ensure that there is access to cloud VMs if Utility requires to access it using IPSEC/SSL or any other type of VPN.
- l) CSP should ensure that cloud VM network is IPV6 compatible.
- m) CSP should ensure use of appropriate load balancers for network request distribution across multiple cloud VMs.

3.3.3.4 Cloud data centre specifications

- a) All the physical servers, storage and other IT hardware from where cloud resources are provisioned for this project must be within Indian data centres only.
- b) The data centres of CSP should be spread across different geo location in different seismic zones.
- c) The CSP data centres should have adequate physical security in place.
- d) The Data Centre should conform to at least Tier III standard (preferably certified Uptime Institute certifications by a 3rd party) and implement tool-based processes based on ITIL standards.

3.3.3.5 Cloud Storage Service Requirements

- a) CSP should provide scalable, dynamic and redundant storage.
- b) CSP should offer provision from self-provisioning portal to add more storage as and when require by respective Utilities.
- c) CSP should clearly differentiate its storage offering based on IOPS. There should be standards IOPS offering per GB and high-performance disk offering for OLTP kind of workload.
- d) CSP should have block disk offering as well as file/object disk offering to address different kind of Project needs.

3.3.3.6 Cloud Security Requirements

- a) CSP should ensure there is multi-tenant environment and cloud virtual resources of this project are logically separated from others.
- b) CSP should ensure that any OS provisioned as part of cloud virtual machine should be patched with latest security patch.
- c) In case, the CSP provides some of the System Software as a Service for the project, CSP is responsible for securing, monitoring, and maintaining the System and any supporting software.
- d) CSP should implement industry standard storage strategies and controls for securing data in the Storage Area Network so that clients are restricted to their allocated storage
- e) CSP should deploy public facing services in a zone (DMZ) different from the application services. The Database nodes (RDBMS) should be in a separate zone with higher security layer.
- f) CSP should give ability to create non-production environments and segregate (in a different VLAN) non-production environments from the production environment such that the users of the environments are in separate networks.
- g) CSP should have built-in user-level controls and administrator logs for transparency and audit control.

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

3.3.3.7 Data Management

- a) CSP should clearly define policies to handle data in transit and at rest.
- b) CSP should not delete any data at the end of agreement without consent from Utility.
- c) In case of scalability like horizontal scalability, the CSP should ensure that additional generated data is modify/deleted with proper consent from Utility.

3.3.3.8 Managed Services

- a) Network and Security Management:
 - i. Monitoring & management of network link proposed as part of this Solution. Bandwidth utilization, latency, packet loss etc.
 - ii. Call logging and co-ordination with vendors for restoration of links, if need arises.
 - iii. Addressing the ongoing needs of security management including, but not limited to, monitoring of various devices / tools such as firewall, intrusion protection, content filtering and blocking, virus protection, and vulnerability protection through implementation of proper patches and rules.
 - iv. Ensuring that patches / workarounds for identified vulnerabilities are patched / blocked immediately
 - v. Ensure a well-designed access management process, ensuring security of physical and digital assets, data and network security, backup and recovery etc.
 - vi. Adding/ Changing network address translation rules of existing security policies on the firewall
 - vii. Diagnosis and resolving problems related to firewall, IDS/IPS.
 - viii. Managing configuration and security of Demilitarized Zone (DMZ) Alert / advise Utility(s) about any possible attack / hacking of services, unauthorized access / attempt by internal or external persons etc.
- b) Server Administration and Management:
 - i. Administrative support for user registration, User ID creation, maintaining user profiles, granting user access, authorization, user password support, and administrative support for print, file, and directory services.
 - ii. Installation/ re-installation of the server operating systems and operating system utilities
 - iii. OS Administration including troubleshooting, hardening, patch/ upgrades deployment, BIOS & firmware upgrade as and when required/ necessary for Windows, Linux or any other O.S proposed as part of this solution whether mentioned in the RFP or any new deployment in future.
 - iv. Ensure proper configuration of server parameters, operating systems administration, hardening and tuning
 - v. Regular backup of servers as per the backup & restoration

- vi. Managing uptime of servers as per SLAs.
- vii. Preparation/ update of the new and existing Standard Operating Procedure (SOP) documents on servers & applications deployment and hardening.

3.3.3.9 Business Continuity Plan & Backup Services

As part of a business continuity plan, the APDCL has made a business impact analysis in the event of loss of AMI applications running in the cloud and consequent loss of data to come up with a management plan for the associated risk to business operations. Central to this risk management strategy, the APDCL has defined the following target objectives:

- a) **Recovery Time Objective (RTO):** Duration of time and a service level within which a business process must be restored after a disruption in order to avoid unacceptable consequences associated with a break in continuity of service. The RTO of 12 hours shall be met by infrastructure redundancy and failover.
- b) **Recovery Point Objective (RPO):** Interval of time that may pass during a disruption before the quantity of lost data during that period exceeds the business continuity plan's maximum allowable threshold. The RPO of 4 hours shall be met by a suitable backup and replication strategy of operational data / application. The RPO shall define how fast the replicated data / application can be made available to the target system after a disruption strikes.

With these two objectives, the CSP shall provide the following:

- a) CSP must provide backup of cloud resources. The backup tool should be accessible
- b) To perform backup and restore management as per policy & procedures for backup and restore, including performance of daily, weekly, monthly, quarterly and annual backup functions (full volume and incremental) for data and software maintained on the servers and storage systems using Enterprise Backup Solution.
- c) Backup and restoration of Operating System, application, databases and file system etc. in accordance with defined process / procedure / policy. Monitoring and enhancement of the performance of scheduled backups, schedule regular testing of backups and ensure adherence to related retention policies
- d) Ensuring prompt execution of on-demand backups & restoration of volumes, files and database applications whenever required.
- e) Real-time monitoring, log maintenance and reporting of backup status on a regular basis. Prompt problem resolution in case of failures in the backup processes.
- f) Media management including, but not limited to, tagging, cross-referencing, storing (both on-site and off-site), logging, testing, and vaulting in fireproof cabinets if applicable.
- g) Generating and sharing backup reports periodically
- h) Coordinating to retrieve off-site media in the event of any disaster recovery
- i) Periodic Restoration Testing of the Backup
- j) Maintenance log of backup/ restoration
- k) CSP should provide network information of cloud virtual resources.
- l) CSP must offer provision to monitor network uptime of each cloud VM.
- m) The DR provided by the cloud service provider shall be a complete replica of the primary DC

provided by the cloud service provider.

3.3.3.10 Web Application Firewall (WAF) as Service

- a) Cloud platform should provide Web Application Filter for OWASP Top 10 protection
- b) CSP WAF should be able to support multiple website security.
- c) CSP WAF should be able to perform packet inspection on every request covering the 7th layers.
- d) CSP WAF should be able to block invalidated requests.
- e) CSP WAF should be able to block attacks before it is posted to website.
- f) CSP WAF should have manual control over IP/Subnet. i.e., Allow or Deny IP/Subnet from accessing website.
- g) The attackers should receive custom response once they are blocked.
- h) CSP must offer provision to customize response of vulnerable requests.
- i) CSP WAF should be able to monitor attack incidents and simultaneously control the attacker IP.
- j) CSP WAF should be able to Grey list or Backlist IP/Subnet.
- k) CSP WAF should be able to set a limit to maximum number of simultaneous requests to the web server & should drop requests if the number of requests exceed the threshold limit.
- l) The WAF should be able to set a limit to maximum number of simultaneous connections per IP. And should BAN the IP if the threshold is violated.
- m) CSP WAF should be able to set a limit to maximum length of path to URL.
- n) CSP WAF should be able to limit maximum size of request to Kilobytes.
- o) CSP WAF should be able to limit maximum time in seconds for a client to send its HTTP request.
- p) CSP WAF should be able to BAN an IP for a customizable specified amount of time if the HTTP request is too large.
- q) CSP WAF should be able to limit maximum size of PUT request entity in MB
- r) The WAF should be able to close all the sessions of an IP if it is ban.
- s) CSP WAF should be able to ban IP on every sort of attack detected and the time span for ban should be customizable. There should be a custom response for Ban IP.
- t) The Dashboard should show a graphical representation of
 - i. Top 5 Attacked Websites.
 - ii. Top 5 Attacking IP.
 - iii. Top 5 Attack types.
 - iv. Top 5 Attacked URLs.
- u) For analysis purpose the Dashboard should contain following information:
 - i. Number of requests to web server.
 - ii. Number of attacks.
 - iii. Number of Attackers.

- iv. Types of error messages and on. Of error messages sent to the users.
- v. Total Bytes sent during transaction

3.3.3.11 Database support service

- a) Installation, configuration, maintenance of the database (Cluster & Standalone).
- b) Regular health check-up of databases.
- c) Regular monitoring of CPU & Memory utilization of database server, Alert log monitoring & configuration of the alerts for errors.
- d) Space monitoring for database table space, Index fragmentation monitoring and rebuilding.
- e) Performance tuning of Databases.
- f) Partition creation & management of database objects, Archiving of database objects on need basis.
- g) Patching, upgrade & backup activity and restoring the database backup as per defined interval.
- h) Schedule/review the various backup and alert jobs.
- i) Configuration, installation and maintenance of Automatic Storage Management (ASM), capacity planning/sizing estimation of the Database setup have to be provided and taken care by the AMISP.
- j) Setup, maintain and monitor the 'Database replication' / Physical standby and Asses IT infrastructure up-gradation on need basis pertaining to databases

3.3.4 Security

Further, commercial CSPs offer cloud services to multiple consumers. In such an environment, the security controls and compliance to various standards (Including ISO 27001, ISO 27017, and ISO 27018) should be verified by third party auditors. Third-party certifications and evaluations provide assurance that effective physical and logical security controls are in place.

Although, the Cloud Service Providers (CSPs) offer assurances of effective physical and logical security controls through the third-party certifications such as ISO 27001, ISO 27017, ISO 27018, etc. and also may provide a host of security services such as encryption, web application firewall, etc., it is the responsibility of the AMISP to define the security services that need to be implemented for their workloads depending on the nature of the applications / data hosted on the cloud.

Now a days, CSPs offer tools and features to help consumers to meet their security objectives concerning visibility, auditability, controllability, and agility. These tools and features provide basic but important security measures such as Distributed Denial of Service (DDoS) protection and password brute-force detection on CSP's accounts.

However, the following basic security features should be ensured by any CSP-

- a) Strong encryption capabilities for data in transit or at rest
- b) Firewalls – instance and subnet levels
- c) Identity and Access Management (IAM): Control users' access to cloud services. Create and manage users and groups, and grant or deny access
- d) Managed Threat Detection: Managed threat detection service that provides you with a more accurate and easy way to continuously monitor and protect your cloud accounts and workloads
- e) Managed DDoS Protection: Managed Distributed Denial of Service (DDoS) protection service that safeguards web applications running on cloud.

- f) Web Application Firewall: Helps protect your web applications from common web exploits that could affect application availability, compromise security, or consume excessive resources.
- g) Key Management Service (KMS): Managed service that makes it easy for you to create and control the encryption keys used to encrypt your data
- h) Certificate Manager: Easily provision, manage, and deploy Secure Sockets Layer/Transport Layer Security (SSL/TLS) certificates.
- i) Cloud HSM: Meet regulatory compliance requirements for data security by using dedicated Hardware Security Module (HSM) appliances within the Cloud.
- j) Inspector: Automated security assessment service that helps improve the security and compliance of applications deployed on cloud
- k) Organizations: Policy-based management for multiple consumer accounts. With Organizations, you can create groups of accounts and then apply policies to those groups.

CSPs also offers access to additional third-party security tools (e.g., IDS / IPS, SIEM) to complement and enhance the consumers' operations in the Cloud. The third-party security tools complement existing Cloud services to enable consumers to deploy a comprehensive security architecture. These security tools on cloud are equivalent and identical to the existing controls in an on-premises environment.

The AMISP needs to review and validate the security configurations, review the notifications and patches released by the CSP and validate that the same is being taken into consideration during operations, confirm that the audit trails (e.g., who is accessing the services, changes to the configurations, etc.) are captured for supporting any downstream audits of the projects by the finance or audit organization such as STQC.

3.3.5 Reporting

Further, the AMISP should insist on the following regular reporting by CSP during the contract:

- a) Availability of the cloud services being used
- b) Summary of alerts that are automatically triggered by changes in the health of those services.
- c) Summary of event-based alerts, providing proactive notifications of scheduled activities, such as any changes to the infrastructure powering the cloud resources
- d) Reports providing system-wide visibility into resource utilization, application performance, and operational health through proactive monitoring (collect and track metrics, collect and monitor log files, and set alarms) of the cloud resources
- e) Auto-scaling rules and limits
- f) In case of any un-authorized access, the Agency should provide logs of all user activity within an account , with details including the identity of the API caller, the time of the API call, the source IP address of the API caller, the request parameters, and the response elements returned by the cloud service. This is required to enable security analysis, resource change tracking, and compliance auditing
- g) Report of all the provisioned resources and view the configuration of each.
- h) Summary of notifications, triggered each time a configuration changes
- i) Incident Analysis in case of any un-authorized configuration changes.
- j) Summary of alerts with respect to security configuration gaps such as overly permissive access to certain compute instance ports and storage buckets, minimal use of role segregation using Identity

and Access Management (IAM), and weak password policies

- k) Summary of security assessment report that identifies the possible improvements (prioritized by the severity) to the security and compliance of applications deployed on cloud
- l) Report on upcoming planned changes to provisioning, either possible optimizations, if any, indicating how the underutilized services can be reduced to optimize the overall spend, or required enhancements (e.g., upgrade to additional storage) to meet the service levels defined in the RFP.

3.4 Database

3.4.1 Initial Database Generation

The AMISP shall be responsible for the initial database generation using data available at NOMC in association with the APDCL.

3.4.2 Development Tools

The AMISP shall provide all necessary software tools for the development and maintenance of the databases required for AMI application at Network Operation cum Monitoring Centre.

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

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

3.4.3 Management

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

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

The database manager shall include the mechanisms, in both interactive and batch processing modes, to perform the following functions:

- a) Add, modify and delete database items and data sources such as data links, and local I/O.
- b) Add, modify and delete application program data
- c) Create a new database attribute or new database object
- d) Resize the entire database or a subset of the database
- e) Redefine the structure of any portion of the database.

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

3.4.4 Tracking Changes

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

3.4.5 Integration

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

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

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

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

Displays shall be generated in an interactive mode. The user shall be able to interactively:

- a) Develop display elements
- b) Link display elements to the database via symbolic point names
- c) Establish display element dynamics via database linkages
- d) Define linkages to other displays and programs
- e) Combine elements and linkages into display layers
- f) Combine display layers into single displays.

All workstation features and all user interface features defined in this specification shall be supported by the display generator software.

The display generator shall support the addition, deletion and modification of segments, including the merging of one segment with another to create a new segment.

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

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

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

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

The system shall generate reports for all the modules in user-defined formats. The system will have a graphical

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

3.6 Software Utilities

AMISP shall supply all software utilities used to develop and maintain these softwares, whether or not specifically described by this Specification. The software utilities shall operate on-line (in background mode) without jeopardizing other application functions running concurrently. Utility software shall be accessible from workstations, processor terminals and servers.

3.6.1 Auxiliary Memory Backup Utility

Software utility, to take back-up of auxiliary memory files of server and workstation onto a user- selected archival device such as SAN, shall be installed. Backup shall be maintained for the entire duration of contract period. The backup utility shall allow for user selection of the files to be saved based on:

- a) Server and workstation
- b) File names (including directory and wildcard designations)
- c) File creation or modification date and time
- d) Whether or not the file was modified since the last backup.

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

3.6.2 On-Line Monitoring Diagnostics Utility

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

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

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

3.6.3 Data Exchange Utilities

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

3.6.4 Other Utility Services

AMI Application management shall include the following utility services:

- a) Loading and storage of information from labelled portable media storage units as dictated by the requirements of this specification.
- b) Preparation of .pdf output for the displays/reports available in the AMI Application system. It should

also be possible to export all the reports to any MS-Office format.

- c) Displays and Reports for Web server -The AMISP shall provide utilities for preparing displays and reports suitable for Web publishing. These utilities shall be used to generate, all required displays and reports from the system displays and reports, automatically (without requiring rebuilding).
- d) Online access to user and system manuals for all software products (e.g., Operating System and Relational Database Software) and AMI applications shall be provided with computer system
- e) Antivirus Software - All computers and firewalls shall be provided with the latest antivirus software as on date of supply. The antivirus software shall have the capability of having its virus definitions updated from time to time. The AMISP shall be responsible for the maintenance & update of the antivirus software during the contract period.
- f) Software Upgrade-The AMISP shall be responsible for the maintenance & update of the patches and signatures of operating system, applications (AMI Applications) system and Web based System up to the contract period.
- g) Automated patch management and anti-virus tools shall be provided to expedite the distributions of patches and virus definitions to the system using an orchestration facility.

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

3.7 Cyber Security

Cyber security governance problems are unique as well as evolving therefore, they cannot be dealt with a traditional approach. For establishing secure and resilient Smart Meter systems, a standardized cybersecurity framework should be adopted by the AMISP in consultation with the Utility and relevant stakeholders. The key elements of the cyber security framework must include:

- a) Differentiation of stakeholders into broad categories to aid in proper distribution of responsibilities among stakeholders and avoid overlapping
- b) Defined set of responsibilities for each stakeholder group. As a result, the decision-making process is streamlined, and proper management hierarchy is established for handling the reported cyber-attacks. The roles and responsibilities are divided into two groups:
 - i. **Cyber – strategy and governance:** The responsibilities under this group relates to the policy and decision-making aspects of cyber security framework
 - ii. **Cyber security – risk, operations and compliance:** This group comprises of responsibilities relating to the operational parts of implementing cyber security policies
- c) Standardization of security practices and abundant guidance from knowledge bodies while implementing security controls and processes. There are multiple global security standards and Indian standards that are relevant in context of underlying technologies used in smart meters:
 - i. National Institute of Standards and Technology (NIST) has developed a framework for Cyber Physical Systems (CPS). The Framework provides a taxonomy and organization of analysis that allow the complex process of studying, designing, and evolving CPS to be orderly and sufficiently encompassing.
 - ii. Department of Electronics and Information Technology (DeitY), Government of India has developed a National Cyber Security Policy. It aims at protecting the public and private infrastructure from cyber- attacks. The policy also intends to safeguard "information, such as personal information (of web users), financial and banking information and sovereign data".
- d) Cyber security incident management: The ISO/IEC Standard 27035 outlines a five-step process for security incident management, including:

- i. Prepare for handling incidents.
- ii. Identify potential security incidents through monitoring and report all incidents.
- iii. Assess identified incidents to determine the appropriate next steps for mitigating the risk.
- iv. Respond to the incident by containing, investigating, and resolving it
- v. Learn and document key takeaways from every incident

Notwithstanding the measures suggested above, the following guidelines/strategies shall be taken care of by the AMISP for making the entire AMI system including the NOMC immune to Cyber Attacks.

- a) All the Hardware, OS and application software shall be hardened.
- b) Application, scanning and hardware scanning tools shall be provided to identify vulnerability & security threats.
- c) Data shall be encrypted at system/device/technology level.
- d) Network Zoning shall be implemented as per the proposed architecture. However, the AMISP may suggest other methods of network architecture without compromising the security of the System.
- e) Internal user shall be allowed to access all adjacent zones. However, they will not have access to remote network zone.
- f) While procuring cyber security items testing must be done and the system must be secure by design.
- g) Residual information risk shall be calculated by AMISP and same shall be submitted to APDCL for approval.
- h) All default user id & passwords shall be changed.
- i) All log in/out and cable plugs in/ out shall also be logged in Central Syslog server.
- j) Penetration & Vulnerability assessment test from certified auditors during FAT, SAT & Operations and Maintenance period.
- k) Auditing by third party during FAT, SAT and annually during operations and maintenance period shall be in the scope of AMISP.
- l) As the computer system in NOMC has access to external environment the AMISP shall document and implement Cyber Security Policy/Plan in association with the APDCL to secure the system.
- m) Latest Cyber Security Guidelines issued by CERT-In specified at <http://www.cert-in.org.in/>, Ministry of Power (including “Testing of all equipment, components, and parts imported for use in the power Supply System and Network in the country to check for any kind of embedded malware /trojans/ cyber threat and for adherence to Indian Standards – Regarding” vide Order No. No.9/16/2016-Trans-Part(2) published by Ministry of Power, Government of India dated 18 November 2020 and amended from time to time) or any other competent authority shall be followed.

3.8 Data Privacy

AMISP should describe ensure that the system is compliant with the applicable provisions of the “Reasonable security practices and procedures and sensitive personal data or information Rules, 2011 (IT Act)” as well as shall be committed to work with Utility for compliance to Personal Data Protection requirements. In this regard, the general elements of the data privacy framework may include:

- a) The Utility shall be the sole custodian of the Smart Meter data. The AMISP and its contracted vendors will have limited need basis access to the data. In case of pre-mature termination or at the end of contract, the AMISP and the contracted vendors should relinquish all access to the data and transfer the same to the Utility.
- b) AMISP is required to prepare and submit a “Privacy by Design” document to the Utility which details out all the policies, practices, processes and technologies employed to manage, and process the Smart Meter data in a secure manner. This should also include the details on methods of anonymization applied to the personal Smart Meter data based on data types defined below:

- i. Aggregated Data: No identification individually and at neighbourhood level unless explicitly required to report
 - ii. Anonymised Data: A data set which has individual Smart Meter data but without any personally identifiable information like consumer name, account number, address etc.
 - iii. Personal Data: A data set with Smart Meter data tagged with personally identifiable information.
- c) AMI system should enable the Utility to get the consumer consent on sharing and processing of Smart Meter data based on following criteria
 - i. Consumer consent not required
 - 1) If any type of Smart Meter data is processed by the Utility or a third party on behalf of Utility for the purpose of generating bills, identifying theft, network planning, load forecasting or any related activities that can enable the Utility to fulfil its duty as a licensee.
 - 2) If any type of Smart Meter data is requested by the law enforcement agencies.
 - 3) If aggregated or anonymised data is shared with not-for-profit academics, policy research, civil society entities for research that can benefit the sector in general.
 - ii. Opt-out consumer consent
 - 1) If any type of smart meter data is shared with or processed by any third-party commercial entity to provide services other than as enabled by regulation. In this case, the AMI system should enable the Utility to conduct the following consumer consent process
 - Consumer should be notified and given a time to opt-out
 - Consumer should have the right to change his/her option through the app/web account/direct communication to Utility.
- d) AMI system should enable following Data sharing protocol
 - i. Data should be shared by providing finite and secure access to the system. The access can be modified or terminated as need be.
 - ii. Sharing of part/full database shall be subject to review and consent of Utility.
- e) All data sharing shall be recorded and periodically submitted to utility for review / regulatory requirement
- f) AMISP should have a data breach response plan and should communicate to the utility and consumers in case of any data breach from AMI system
- g) AMISP is responsible to conduct 3rd party data privacy audit at least once every year based on evaluation criteria pre-identified by the Utility in consultation with data experts. The audit report should be made available to Utility. AMISP to take necessary actions on audit observations in consultation with the utility.

4. Tests and Inspections

Test and inspections are in the complete purview of the AMISP and its sub-vendors. It shall be ensured that there are no conflicts in roles played between AMISP personnel carrying out tests / inspections, and those assigned responsibilities of quality assurance (QA) and quality control (QC). The QA/QC Manager designate for the project shall be the custodian of all inspection and test records/certificates. QA/QC Manager either directly or through its authorised representative shall be responsible for all witness testing, approval of test records and in general, management of the QA/QC program of the project.

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

4.1 In-Process Inspection

4.1.1 Type Testing

Type Tests shall be defined as those tests which are to be carried out to prove the design, process of manufacture and general conformity of the product to this specification. Type Testing shall comply with the following.

- a) The AMISP shall document, within scheduled period as per project plan, copies of test reports and certificates for all the Type Tests that are specified in the specifications and that have previously been performed. These certificates shall apply to items and equipment that are essentially identical to those due to be delivered under the Contract and test procedures and parameter values shall be identical to those specified in this specification. The type tests shall be carried out at nationally/Internationally accredited labs.
- b) Type Tests shall be performed for all equipment types for which certification is not provided as required above. If any of the type tests are required to be carried out, the same shall be carried out by the AMISP.
- c) For pluggable NIC modules, the type tests shall be carried out with the NIC module integrated in the field device, that is meters and DCUs being supplied under the project.
- d) Type Tests shall be certified or performed by nationally/internationally reputed laboratories using material and equipment data sheets and test procedures that have been developed for the project. The test procedures shall be formatted as in the specifications and shall include a complete list of the applicable reference standards before commencement of test (s).
- e) The AMISP shall prepare a detailed schedule for performing all specified type tests.
- f) The AMISP shall ensure that all type tests can be completed within the time schedule offered in its Technical Proposal.
- g) In case of failure during any type test, the AMISP is either required to manufacture a fresh sample lot and repeat all type tests successfully or repeat that particular type tests at least three times successfully on the samples selected from the already manufactured lot at its own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.
- h) Documentation for all factory, field, and availability tests that apply to the AMI system shall be provided in accordance with the requirements defined in this section of specification

4.1.2 Quality Assurance and Quality Control Program

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

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

Instructions and records for quality assurance shall be controlled and maintained at the system levels. The AMISP shall describe its QA/QC program in the Technical Proposal and shall submit its QA/QC Manual for review.

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

- a) The organization structure for the management and implementation of the proposed Quality Assurance Program
- b) Documentation control system
- c) Qualification data for key personnel
- d) The procedure for purchase of materials, parts/components and selection of Sub-contractors' services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases, etc.
- e) System for shop manufacturing including process controls
- f) Control of non-conforming items and system for corrective action
- g) Control of calibration and testing of measuring and testing equipment
- h) Inspection and test procedure for manufacture
- i) System for indication and appraisal of inspection status
- j) System for quality audits
- k) System for authorizing release of manufactured product
- l) System for maintenance of records
- m) System for handling, storage and delivery
- n) A Quality Plan detailing out the specific quality control procedure adopted for controlling the quality characteristics of the product.

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

The personnel performing QA/QC functions shall have well-defined responsibility, authority, and organizational freedom to identify and evaluate quality problems and to initiate, recommend, or provide solutions during all phases of the Contract.

The QA/QC organization of the AMISP shall be an independent administrative and functional structure reporting via its manager to the AMISP's top management. The QA/QC manager(s) shall have the authority within the delegated areas of responsibility to resolve all matters pertaining to quality when actual quality

deviates from that stated in the Work Statement.

The AMISP shall be required to make available all the Quality Assurance Documents as stipulated in the Quality Plan at the time of inspection of equipment/materials.

4.1.3 Scope of QA/QC Program for the AMI Project

The QA/QC Manager of the AMI Project shall have the right to carry out Quality Audit and Quality Surveillance of the systems and procedures of the AMISP's/his vendor's Quality Management and Control Activities. The scope of the duties of the QA/QC Manager, pursuant to the Contract, will include but not be limited to the following:

- a) Review of all the AMISP's drawings, engineering data etc.
- b) Witness or authorize its representative to witness tests at the manufacturer's works or at site, or at any place where work is performed under the Contract.
- c) Inspect, accept or reject any equipment, material and work under the Contract in accordance with the specifications.
- d) Issue certificate of acceptance
- e) Review and suggest modification and improvement in completion schedules from time to time; and
- f) Monitor the Quality Assurance program implementation at all stages of the works.

4.1.4 Inspection and Test

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

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

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

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

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

4.1.4.1 Test Plans & Procedures

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

The AMISP shall prepare detail testing procedure in line with specification. The procedure shall be modular to the extent possible, which shall facilitate the completion of the testing in the least possible time.

During the development of test plans and test procedures for the system, emphasis shall be placed on

testing each conditional logic statement, checking error conditions, and documenting the simulation techniques used. The test plans and test procedures shall be modular to allow individual test segments to be repeated as necessary.

4.1.4.1.1 Test Plans

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

- a) Test schedule on a day-by-day basis
- b) Responsibilities of test engineer and QA/QC personnel
- c) Record-keeping assignments, procedures, and forms
- d) Procedures for monitoring, correcting, and retesting variances
- e) Procedures for controlling and documenting all changes made to the hardware and software after the start of testing
- f) Block diagrams of the hardware test configuration, the external communication channels, and any test or simulation hardware.

4.1.4.1.2 Test Procedures

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

- a) Name of function to be tested;
- b) References to the functional, design, user, and any other documents describing the function;
- c) List of test segments to be performed and the purpose of each test segment;
- d) Set-up conditions for each test segment, including descriptions of the test equipment;
- e) Descriptions, listings, and instructions for test software tools and displays if any;
- f) Step-by-step descriptions of each test segment, including user actions for each test step;
- g) Expected results for each test segment, including pass/fail criteria;
- h) Descriptions of the techniques and scenarios to be used to simulate system field inputs and controlled equipment;
- i) Copies of any certified test data to be used in lieu of testing.

4.1.4.1.3 Test Records

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

- a) Reference to appropriate test procedure
- b) Date of test
- c) Description of any test conditions, input data, or user actions differing from that described in

the test procedure

- d) Test results for each test segment including a pass/fail indication
- e) Identification of AMISP's test engineer and QA/QC representative.
- f) Provision for comments by test engineer and QA/QC representative
- g) Copies of any variance reports generated
- h) Copies of reports, display copies, and any other hardcopy generated as part of the test.

4.1.4.1.4 Reporting of variances

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

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

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

- a) Sequential identifying number assigned to the variance
- b) Date and time the variance was detected
- c) Appropriate references to the test procedures and this Specification
- d) Description of test conditions at the time the variance was detected
- e) Identification of testing and QA/QC representatives
- f) Estimated date and time when variance is expected to be fixed
- g) Description of the corrective actions taken (to be completed as part of the variance resolution process)
- h) Dated signature lines for the QA/QC and test representatives to signify reporting and correction of the variance.

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

- a) Class 1: Testing will immediately stop and the AMISP will evaluate and correct the variance before testing is resumed
- b) Class 2: Testing will continue, and the variance will be evaluated and corrected by the AMISP at the end of the current session but prior to further testing
- c) Class 3: Testing will continue, and the variance will be evaluated and corrected at a mutually agreed upon time.

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

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

All actions taken to correct variances shall be documented on the variance report by the AMISP. Sufficient information shall be recorded to enable QA/QC representative to determine the need for

and extent of retesting, the need for testing interactions of the correlation with any previously tested hardware or software, and the need for updating appropriate documentation. A variance shall be deemed resolved after retesting has been performed satisfactorily and the test engineer and QA/QC representatives have acknowledged correction of the variance on the variance report.

4.1.4.2 Test Initiation

The following conditions must be satisfied before starting any test

- a) All test plans and procedures for the test shall be available.
- b) All hardware and software engineering design change orders shall be incorporated into the system under test.
- c) All relevant documentation including drawings, lists of deliverables, and software functional and design documents, and user manuals shall be available.
- d) A complete regeneration of the software under test shall be performed immediately prior to the start of factory testing.
- e) All operating system parameters, files, and configuration information shall be saved to archive media so that the AMI systems operating environment can be recreated starting with an uninitialized system. The existence and completeness of this data shall be demonstrable.
- f) All database, display, and report definitions shall be saved to archive media so that the databases, displays, and reports can be recreated if necessary.
- g) The image backup of all applications of AMI Systems shall be taken on the archive media so that AMI systems software can be regenerated if necessary.
- h) A complete dry run of each factory test (excluding the integrated system test) shall be conducted by the AMISP using the test plans and test procedures.

4.1.4.3 Test Completion

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

- a) All variances have been resolved
- b) All test records have been documented and issued
- c) QA/QC acknowledges, in writing, successful completion of the test.

4.1.5 Factory Acceptance Test (FAT)

The factory tests shall be conducted on all the equipment to be supplied under the project. FAT⁴ shall include, but not be limited to the following, appropriate to the equipment being tested:

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

Arrangements shall be made to carry out the tests for pluggable NIC modules integrated into three different meter makes, including the make(s) of meter being supplied by the AMISP. The slot for plugging the NIC

⁴ It is expected that the FAT for equipment supplies shall happen in phases of delivery. For this a test cum development system environment shall have to be created for the AMI system, with the HES, MDM and Database application servers installed in the target cloud data centre. This test / development system environment shall be separate from the production environment and shall continue to serve the purpose of development system beyond the FAT phase, for the total duration of the project

modules in the meter shall conform to this specification. The FAT shall be carried out on the meter and/or DCU integrated with the NIC modules. If any on-line communication failover has been agreed between the APDCL and the AMISP, tests shall be carried out to check a seamless failover of communication. The three makes of meters shall be checked with NIC modules for all type of communication technologies selected for the project.

Before the start of factory testing, the AMISP shall verify that all changes applicable to the equipment have been implemented. As a part of the factory tests, unstructured testing shall be performed to enable proper verification of operation of the equipment under conditions not specifically tested in the above structured performance test. All special test facilities used during the structured performance test shall be made available for use during unstructured testing. AMISP to inform the schedule of FAT to Utility as soon as finalised, with changes, if any, and Utility may choose to be associated with the FAT.

4.1.5.1 Factory Test Requirements

- a) The database displays and the report formats developed for the central system by the AMISP shall be demonstrated and verified at the start of factory testing.
- b) All Field Device, AMI functions, communication & networking systems as well as performance shall be tested and demonstrated.
- c) The AMISP shall also carry out testing of the standard protocol implementation for successful integration before the FAT starts.
- d) All hardware and software associated with AMI Systems shall be staged and completely tested with simulated data at the AMISP's facility.
- e) The AMISP is responsible for conducting all factory tests.
- f) 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.

4.1.5.2 Hardware Integration Test

The hardware integration test shall confirm that the computer hardware conforms to this Specification and the AMISP-supplied hardware documentation. The hardware integration test shall be performed when the computer hardware has been installed in the AMISP's factory. The operation of each item shall be verified as an integral part of the system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. Equipment expansion capability shall also be verified during the hardware integration test.

4.1.5.3 Functional Performance Test

The functional performance test shall completely verify all features of the AMI Systems hardware and software. This shall mean the suit of application software shall be made to run on the actual CSP infrastructure integrated with the field level hardware components, using selected communication paths. As a minimum, the following items shall be included in the functional performance test:

- a) Inspection of all equipment for conformance to drawings/document and satisfactory construction and appearance
- b) Testing of the proper functioning of all software, including test cases with normal and exception user-entered inputs and responses

- c) Simulation of local error and failure conditions
- d) Verification that ultimate expansion requirements are met
- e) Verification of data link interfaces with other Central systems
- f) Verification of Field Device communication interfaces (with failover if any) and data link interfaces with other central systems. This shall include the tests of three makes of meters with different types of NIC modules.
- g) Simulation of Field Device and data link communication errors and channel failures, including incorrect check codes and random channel noise bursts
- h) Testing of all user interface functions, including random tests to verify correct database linkages
- i) Simulation of hardware failures and input power failures to verify the reaction of the system to server and device failure
- j) Demonstration of all features of the database, display, and report generators and all other software maintenance features
- k) Demonstration of the software utilities, libraries, and development tools
- l) Verification that the computer system meets or exceeds performance requirements
- m) Verification of the accuracy of hardware and software documentation via random tests
- n) Sample check of meter calibration accuracy and testing of spare parts.

4.1.5.4 Integrated System Test

The integrated system test shall verify the stability of the system hardware and software after the functional performance test has been successfully completed. During the integrated system test, all functions shall run concurrently and all AMISP-supplied equipment shall operate for a continuous 100-hour period. This minimum level of activity may be augmented, by other activities that represent normal day-to-day operation of the system as long as these activities are conducted in accordance with the documentation provided with the system. These other activities may include, but shall not be limited to, database, display, and report modifications, software development activities, configuration changes (including user-commanded server and device failovers), and the execution of any function described in this Specification.

The integrated system test shall ensure that the computer system is free of improper interactions between software and hardware while the system is operating as an integrated unit. In case during the 100-hour period testing, un-commanded functional restart or server or device fail occurs the test shall be extended by 24 hours each time such a fail over occurs. Further the test shall not be conducted with the failed device.

4.1.5.5 Unstructured Testing

Periods of unstructured testing shall be allocated to allow AMISP to verify proper operation of the systems under conditions not specifically included in the test procedures. Unstructured testing shall be conducted in compliance with the following conditions:

- a) A minimum of 25 percent of the actual test period shall be reserved for unstructured test of the system
- b) The AMISP's test and QA/QC representative shall be present during unstructured test periods
- c) All simulation software, test cases, and other test facilities used during the structured portions of

the factory tests shall be available for use during unstructured testing

- d) Unstructured testing shall not begin prior to the start of the functional performance test
- e) Unstructured testing shall be allowed at the discretion of QA/QC both at the end of a structured test segment and after completion of the functional performance test.

4.1.5.6 Despatch of Material to Site

The Material Inspection Clearance Certificate (MICC) for all hardware shall be issued only after successful completion of FAT as per specification. At least 10 Field Devices for each protocol shall relate to each central system and the remaining Field devices shall be simulated in the factory test environment. The data exchange between central systems shall also be simulated in the factory test environment.

All Equipment Suppliers/OEMs to the project shall make use of categorised Interim Inspection Reports (CIP Clearance) from AMISP to ship materials to site after completion of FAT. Interim Inspection Report with the lowest category would mean a complete failure of FAT and hence rejection of material. Interim Inspection Reports issued with a category between the lowest and the highest, shall mean pending actionable points of minor nature, but material deemed fit for dispatch to site. In case where CIP is issued with the highest category (with no pending actionable points in FAT), a Material Inspection Clearance Certificate (MICC) shall be issued

4.2 Field Installation and Integration Test (FIIT)

Before the start of the FIIT, the following steps have to be completed:

- a) All field level hardware which have undergone FAT shall be installed at the site and the installation report signed off.
- b) Before the delivery of the first lot of field devices (meters/DCUs etc.),
 - a. The production hardware (servers, WS, LAN/Routers, FW, etc.) and software shall be provisioned at the cloud data centre.
 - b. The IT hardware shall be installed and made functional at the NOMC with requisite connectivity to the cloud data centre.
- c) The installed field hardware shall be configured and registered in the production environment of the cloud data centre.

It shall be the responsibility of the AMISP/Utility to devise the FIIT tests regime. At the minimum the following tests shall be performed.

- a) Proper registration of the incoming population of field devices
- b) Checking of user interface linkages with database
- c) Remote configuration downloads and reading of profiles
- d) If required checking of new meter readings with existing meter readings.
- e) Forced event creation and communication of such events
- f) Performance tests of device communication links
- g) Device communication link failover
- h) Integration tests with the MDM in line with a use case table to be drawn up by the AMISP. A use case table is provided in Section 1.6 of this schedule for reference purpose

4.3 Site Acceptance Test (SAT)

SAT shall be carried out with Smart Meters/DCUs in lots as these are delivered and passes through the Field Installation and Integration tests. The first lot to be subjected to SAT shall consist of the complete cloud data centre and its hardware and software components along with supply, installation & integration of a minimum

of [5%] Smart Meters/ DCUs (along with its related hardware and software equipment). The SAT for remaining meter population shall be staged on monthly basis based on the total supply, installation and integration of Smart Meters (along with its related hardware and software equipment).

The AMISP shall start up and check the performance of the equipment of field locations. All hardware shall be aligned and adjusted, interfaces to all inputs and outputs installed, operation verified, and all test readings recorded in accordance with the AMISP's recommended procedures. The SAT shall exhibit generally all functions of the equipment and duplicate factory test. All variances must be corrected prior to the start of the SAT. The list of final tests to be carried out in the field shall be listed in the site-testing document by the AMISP. Among others, the site testing document shall include the following minimum performance tests:

Data Type	Performance Requirement
1. Load Profile Data Read⁵	
One-month block load profile for installed meters	From 99% of the meters in 12 hours after the midnight
2. Billing Profile Data Read⁶	
Billing profile data for installed meters	From 99% of the meters in 12 hours after the midnight
3. On-Demand Remote reads of meters	
Collection of 7 days of interval energy data and the current total accumulated energy from a selected individual meter	From 99% of the meters in 2 minutes
4. Remote connect / disconnect	
Action to response for individual meter	Less than 3 mins
5. Updating of data on consumer portal/ app	
Updating of individual consumer data on portal/ app after receiving the data in MDM	Action performed for active on portal consumers within 5 minutes after receiving the data in MDM
6. Ping Response with acknowledgement/ response for selected meters	
For installed meters	Action performed at 99.9% of meters within [1] minute; and
For an individual meter	Action performed within 3 seconds
7. Meter loss and restoration of supply	
Receiving of alert for all affected AMI meters	Alert to be received within 3 minutes for 60% of meters
8. Meter Tamper Alerts	
Receiving of alert for an individual meter	Alert to be received within 3 minutes
9. Power Quality Alerts	
Receiving of alert for an individual meter	Alert to be received within 5 minutes

⁵ This performance test shall be done during SAT, from second lot of meters onwards

⁶ This performance test shall be done during SAT, from second lot of meters onwards

10. Firmware upgrade with acknowledgement/ response for selected meters	
For installed AMI meters	Action performed at 99% of meters within [1] hour; and
	Action performed at 99.9% of meters within [2] hours

Data Type	Performance Requirement
11. Remotely altering settings in meter	
For installed AMI meters	Action performed at 99% of meters within [30] minutes; and
	Action performed at 99.9% of meters within [1] hour
12. Remotely read events logs	
For reading the full event log for installed AMI meter	Action performed at 99% of meters within [30] minutes; and
	Action performed at 99% of meters within 1 hour; and
	Action performed at 99.9% of meters within [6] hours.
13. VEE processing	
For all installed meters	Action performed in [15] mins
14. Computation of Billing Determinants	
For all installed meters	Action performed in [2] hours
15. Prepaid Recharge	
Payment success to consumer acknowledgement	Within 5 mins
Payment success to meter update	Within one hour
16. Utility User Interface	
Manual data entry of new value appears on screen	Less than 6 secs
Acknowledgement of any action request	Within 3 secs
Display update rate	2 secs
17. Disaster Recovery Capability (Refer to Section 3.3.3.9 for details)	
Recovery Time Objective (RTO)	12 hours
Recovery Point Objective (RPO)	4 hours
18. On-Demand Remote reads of meters	
Collection of 7 days interval energy data and the current total accumulated energy from a group of 10% of installed base of meters (configurable)	Action performed within 2 hours

Interim inspection reports shall be generated if the SAT is unsuccessful at any stage and all variances shall have to be corrected and recorded. On successful completion of each lot of SAT a clear MICC shall be issued.

4.4 Operational Go Live

The Operational Go Live of the AMI system shall be considered as completion of the SAT for [5%] of Smart Meters (along with its related hardware and software equipment) supplied installed and integrated. AMISP's obligations for Operational Go Live of the system shall be deemed to be met when the following milestones are achieved:

- a) Completion of training obligations (training documentation plus training) for APDCL staff, as defined in the RFP;
- b) Supply, installation & integration of [5%] of Smart Meters (along with its related hardware and software equipment);
- c) Successful completion of SAT for [5%] of Smart Meters;
- d) Successful completion of system availability test.

As part of the Operational Go Live, the AMI system must undergo a [120 (one hundred twenty) hours] system availability test. This shall be conducted on supplied systems under normal day-to-day operating conditions. The test shall verify the reliability and integrity of the Field devices, Central Systems, Communication & networking systems, database, displays, report and all communication interfaces.

4.4.1 Test Responsibilities

QA/QC will be responsible for oversight of the conduct of the availability test. The test shall consist of normal AMI Systems operations without special test equipment or procedures.

Test records defined in the availability test plan and procedures will be maintained. AMISP will operate and maintain the system according to procedures described in the AMISP documentation. QA/QC shall raise incident reports for every incident that is encountered and closed with response time, resolution time and hold times.

AMI systems maintenance on an on-call basis shall be provided by the AMISP during the availability test period. When on-site maintenance support is needed, qualified AMISP personnel shall arrive at the site within maximum four (4) hours of notification and shall keep records of the progress in problem resolution. For availability purposes, this service response time and the associated on-site maintenance time shall be taken into account as defined in sections of "Downtime" and "Hold time".

The AMISP shall maintain an inventory of spare parts, which may be required to achieve the specified availability. These spares shall be in addition to the mandatory spares. All spare parts used during the availability test shall be drawn from AMISP's inventory.

4.4.2 Downtime

Downtime occurs whenever the criteria for successful operation defined in section 5 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.

4.4.3 Hold time

During the availability test, certain contingencies may occur that are beyond the control of any stake holder. These contingencies may prevent successful operation of the system but are not necessarily valid for the purpose of measuring AMI systems availability. Such periods of unsuccessful operation may be declared "hold time". Specific instances of hold time contingencies are:

- a) **Scheduled Shutdown:** During scheduled shutdowns, or if an equipment failure occurs while its backup device is scheduled out-of-service, the resulting system outage shall be hold time, provided that service can be restored according to AMISP-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 AMISP is engaged in remedial action and normal functions can be restored by AMISP-defined procedures whenever the failure occurs. Instead of accounting for the actual intermittent downtime, one hour of downtime shall be counted for each 24 hours of otherwise successful operation while the problem persists.
- d) **Service Response Time:** A maximum four (4) hours of hold time will be allowed for the AMISP to respond to each call for maintenance support.
- e) **Corrected Design Defect:** Hold time may be declared to ensure against similar future occurrences if a failure occurs due to a defect in system design for which the AMISP defines and implements corrective measures. In such a case, hold time shall be allowed in increments of 24 hours to allow verification of the corrective action.

4.4.4 Test Duration and Criteria for Acceptance

After the elapse of [120 hours] of cumulative test time, the availability shall be calculated. Should availability falls short of specified percentage as defined in section 4.4.4.1, the AMISP may either (a) Continue the test by moving the starting time of the test forward and continuing the test until the consecutive hours have been accumulated and the specified availability has been achieved subject to maximum of 5 days, Or (b) the AMISP may restart the test for 120 hours, .

To establish that all failures have been satisfactorily repaired prior to the end of the availability test, no downtime, intermittent (hold time) failures, or more than one un-commanded fail over shall have occurred within 48 hours of the test's conclusion.

4.4.4.1 Criteria for successful operation

The AMI system shall be designed to meet the system availability as defined below:

S.No.	System	Minimum System Availability Requirements
1.	Smart Meters	99%
2.	DCU/ AP	99%
3.	MDM	99.5%

4.	HES	99.5%
5.	NOMC Hardware such as UPS, Router, etc.	99%
6.	Utility and Consumer User Interface	99.5%

The total operational time shall not include the hold time. The system shall be considered available as long as all the requirements defined under section 2 are available.

4.5 Meter Accuracy Test

In case a Consumer complaints of the meter accuracy post operational go-live and same isn't reasonably resolved through past consumption trend, Transformer Energy Audit, Check Meter (by Utility), etc. AMISP will be obliged to facilitate the meter testing. In this regard, AMISP shall handover the meter for testing to Utility Lab and install a temporary meter till the period of removal and replacing meter, if found inaccurate or reinstall if found accurate.

5. Operation and Maintenance

5.1 Scope and period

The operation, maintenance, and support services start after the successful completion of the operational go-live of the system as defined section 4. Operation, maintenance and support services shall extend up to end of 27540000 meter-months from operational go-live. The scope of work under operation and maintenance services shall include,

- a) Comprehensive maintenance of all the software (including licensing and annual technical support cost)
- b) Comprehensive maintenance of all hardware at the Operation and Monitoring Centre, along with field devices (like Smart Meters, DCUs etc.) provided by AMISP under the project
- c) All equipment under leased service like cloud data centre, MPLS band width etc.
- d) NAN / WAN communication infra between field devices and the cloud data centre
- e) Future integration and support services for meeting the future expansion requirement envisaged under this project and
- f) Day to day operations of the AMI system under supervision and authority of the APDCL. These shall include among others,
 - i. New meter installation
 - ii. Changeover of consumer meters from post-paid to prepaid mode and vice versa
 - iii. Firmware update of remote devices (Meters and DCUs) as required
 - iv. Update of tariff slabs
 - v. Ensuring completion of recharge cycle of prepaid consumer meters
 - vi. Connecting, disconnecting or reducing consumer's licensed load under approval from APDCL
 - vii. Initiating resolution of consumer trouble tickets raised by utility CCS
 - viii. Ensuring availability of BP, LP, interval data and event notifications from meters in time schedules as agreed with the utility
 - ix. Ensuring scheduled completion of billing determinant calculations
 - x. Ensuring daily reports from the AMI system as per agreed list, are made available to utility
 - xi. Ensuring Consumer Portal is kept updated
 - xii. Ensuring smooth data traffic between the MDM and utility systems
 - xiii. Patch management of AMI applications at cloud data centre
 - xiv. Provide backup data to support SLA and AMISP invoicing
 - xv. Carry out performance checks of various functions as per agreed schedule or on demand

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

5.2 AMISP's Responsibilities under Operation & Maintenance Services

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

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

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

5.3 Maintenance Practices

For all third-party equipment (Hardware & Software) AMISP shall have back to back support along with supply of spare with appropriate response time from OEM/OEM Authorized representatives. AMISP shall be responsible for coordination with the OEM for all matter related to equipment.

The maintenance practice followed by AMISP shall be in accordance with best industry practices and must include the following:

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

5.3.1 Preventative Maintenance Activity

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

- a) Repair / replacement of defective equipment
- b) Configuration of the replaced hardware and software, periodic routine checking as part of a preventive maintenance program
- c) Monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components
- d) Providing all necessary assistance to APDCL for addition and modification of utility user interface, consumer Portal/ App displays, and Database
- e) Ensure Backup of the system at regular interval which is mutually decided during system design
- f) Restoration of the systems upon its failure and to restore the functioning of the various application / systems at the cloud data centre. Towards this, the RPO and RTO shall have to be measured no less than once a month.

5.3.2 Integration of Equipment

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

5.3.3 Spares inventory

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

5.4 Monitoring

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

- a) MDM / HES system error history logs or selected day

- b) Field & Network device failure – rate and trends
- c) Availability of various communication links
- d) Missing meter data – rate and trend
- e) Reviewing resource information

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

5.4.1 System Cyber Security Monitoring

The AMISP shall also be responsible for monitoring of the system from cyber security prospective. The logs of the system shall be analyzed for exceptions and the possible incident of intrusion/trespass shall be informed to the APDCL and analysed to discover root cause. The monitoring shall encompass all cyber security devices installed at the cloud data centre as well as at the NOMC such as firewalls, all types of Intrusion prevention system, routers etc.

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

5.5 Physical Maintenance

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

5.6 Service Level Agreement (SLA)

Service Level Agreement (SLA) shall be monitored as mentioned in the following table. It is expected that the AMI system shall meet the minimum threshold of service defined against each lever. Any degradation below this minimum threshold will attract penalties as per bands of service level met. The idea is that it triggers a proper review of any defect / failure / performance that had been agreed upon for the project, and to find resolutions in keeping with the highest standards of service excellence. The total penalties under SLA categories is capped at [20%] of AMISP Monthly Fee. AMISP shall ensure that the data collection and computation for the purpose of SLA penalties (as mentioned in the following table) should be automated and visualised in Utility Interface as mentioned in section 1.8.

For this purpose, each of the designated scheduled tasks in the following table, shall signal⁷ the SLA computation application to record the start time. The same designated tasks shall generate mile-stone signals⁸ in order that the SLA application is able to record times when various thresholds (as indicated in the table) of meter population have responded. For system level availability, the SLA computation application shall offer a ticketing system which shall be used by the Utility &/or AMISP to raise an incident against any line item at corresponding severity level. The incident originator shall select the severity level followed by selecting the incident description (as per Annexure G) available as a drop-down list within the SLA application. The ticketing system shall follow a process flow such that,

- a) The AMISP’s response along with time of response are recorded. This ‘response’ may be a simple acknowledgement of the incident or a rejection of the incident as not being part of its ‘scope of work’

⁷ This signal shall be always automated, and the SLA Application would know precise number of meters involved.

⁸ Alternate provision may be kept for manual entry of time for such mile-stone signals but with proper backup monitoring report made available.

with adequate explanation.

- b) Utility's acknowledgement or rejection of AMISP 'response' along with time are recorded. If utility acknowledges the incident to be irrelevant to AMISP's scope of work, then the incident is immediately closed, and no further records are maintained for this incident⁹.
- c) Resolution &/or workarounds are recorded and submitted by AMISP along with time
- d) In case of enhancements and change requests, AMISP's Plan of Action (POA) and schedule are recorded
- e) AMISP's POA and schedule (for enhancements and change requests) are approved by utility
- f) Resolution as submitted by AMSIP is approved by utility and the incident closed. In case of rejection of resolution, the incident shall remain live and shall have to be re-worked by the AMISP.
- g) All submittals, acknowledgements, approvals/agreements shall have system generated time stamps by default. There shall be also provision for a separate manual entry of time stamps.

⁹ The first two process steps in the ticketing system of the SLA App shall ensure complete agreement between Utility and AMSIP, before an incident is accepted for resolution.

Data Type	Performance Requirement (Averaged over a month) ¹⁰	Penalty	SLA Penalty Calculation (For understanding purpose only)
A. Scheduled Tasks			
1. Scheduled Interval data readings			
Periodic collection of the interval load profile data for the day ¹¹	From 99% of meters within 8 hours	Deduction of 0.2% of AMISP Monthly Fee for every 1% or part there of capped at 1% penalty	Maximum Penalty of 1% if action takes place for <=94% of meters
2. Scheduled Interval data readings			
Periodic collection of the interval load profile data for the day ¹²	From 99% of meters within 12 hours	Deduction of 0.2% of AMISP Monthly Fee for every 1% or part there of capped at 1% penalty	Maximum Penalty of 1% if action takes place for <=94% of meters
3. Scheduled daily meter readings			
Previous days ¹³ intervalenergy and total accumulated energy	From 99.9% of meters within 24 hours after midnight	Deduction of 0.2% of AMISP Monthly Fee for every 1% or part there of capped at 2% penalty	Maximum Penalty of 2% if action takes place for <90.9% of meters
4. Scheduled billing profile data for the bill period			
Collection of billing data for the bill period	From 99.9% of meters before the next periodic collection is scheduled. Please refer to Annexure H for the billing schedule	Deduction of 0.5% of AMISP Monthly Fee for every 0.5% or part there of capped at 3% penalty	Maximum Penalty of 3% if action takes place for <97.4% of meters
B. Remote Actions / tasks performed by AMI System			
5. For remote connect/disconnect with acknowledgement/ response for selected meters			
Remote connect / disconnect of the AMI meters	Action performed at 99% of meters within 15 minutes	Deduction of 0.5% of AMISP Monthly Fee for every 0.5% or part there of capped at 2.0% penalty	Maximum Penalty of 2.0% if within 15 minutes, delivery takes place for <=95% of meters
6. For remote connect/disconnect with acknowledgement/ response for selected meters			

¹⁰ Local intervention allowed to achieve SLAs

¹¹ Assuming interval of 30 minutes.

¹² Assuming interval of 30 minutes.

¹³ All previous days from the last billing cycle

Data Type	Performance Requirement (Averaged over a month) ¹⁴	Penalty	SLA Penalty Calculation (For understanding purpose only)
Remote connect / disconnect of the AMI meters	Action performed 99.9% of meters within 6 hours	Deduction of 0.5% of AMISP Monthly Fee for every 0.5% or part there of capped at 2.0% penalty	Maximum Penalty of 2.0% if within 6 hours, delivery takes place for <98.4% of meters
C. System Availability			
7. Availability of AMI System per month			
Availability of AMI System per month	≥ 99.5%	Deduction of 0.6% of AMISP Monthly Fee for every 0.5% or part there of reduction in availability capped at 6.0% penalty	Maximum penalty of 6% shall be deducted when system availability is <95.0%

Notes:

- Maximum Penalty out of the above shall be restricted at 20% of AMISP Monthly Fee. The deduction shall be computed as AMISP Monthly Fee X penalty % as computed in above table
- The penalty, as mentioned above, shall be computed as per the performance deviated from the performance requirement.
- Averaged over a month means weighted average performance from meter population over a predefined time interval. For instance,
 - Assuming on i^{th} day or event, action was done on $y_i\%$ of total meters and within stipulated time, data was received from $z_i\%$ of $y_i\%$ meters. So, the average^{10%}SLA over the month shall be computed as $\frac{\sum y_i \times z_i}{\sum y_i}$
 - For system availability, the availability is computed as $\frac{\text{THM} - S1/S2/S3}{\text{THM}}$; Where THM is total hours in the month when power supply to AMI system is available, S1/S2/S3 is the total non-available hours in Severity Level-1/Level-2/ Level-3. Please refer to Annexure-G for more details on the same.
- Exclusions: Power Outages, Meter bypass by consumers, Local Temporary/ Permanent disconnection by Utilities, Meter burnt shall be excluded from above SLA calculations.

5. AMISP shall submit AMI generated reports for cases mentioned above based on data available in HES/MDM. For the balance cases, joint visit of AMISP and Utility officials shall be carried out and field inspection report shall be submitted by AMISP to Utility for suitable action.
6. For the purpose of joint visit, AMISP shall put a request to Utility who should allocate manpower for joint visit within 1 working day. In case of non-allocation/ non-availability of manpower from Utility, the report submitted by AMISP shall be final and actionable by Utility.
7. The penalties would be computed on the basis of performance of AMISP for a calendar month.
8. AMISP shall be responsible for collection of billing data for all Smart Meters which could not be remotely accessed.

5.7 Responsibility Matrix

The table in this section provides a summary definition of the roles and responsibilities of the AMISP and APDCL.

Legend:

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

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

4.3	Identify failed component, replace failed components in the system using parts from spares inventory	F	•
Item	Task	APDCL	AMISP
4.4	Restore operation of repaired/replaced equipment	A	•
5.0.	Hardware Spare Parts		
5.1	Manage local spares inventory	F	•
5.2	Replenish local spares inventory	F	•
6.0.	Integration and Database Work At NOMC End		
6.1	Field Device Integration	A	•
6.2	Other System Integration	A	•
7.0.	Cyber Security Monitoring		
7.1	Patch Updates	F	•
7.2	Cyber Security Monitoring	F	•
7.3	Annual Audits	F	•
7.4	Implementation of Recommendations during Audit	F	•
8.0.	Manual Meter Read Through HHU In Case of Non- Communication Of Smart Meters	A	•

6. Training Requirements

6.1 General

General requirement for training to be imparted is as follows:

- a) Training shall be conducted by AMISP personnel who are experienced instructors and speak understandable English/Hindi.
- b) The AMISP shall provide training to various user groups nominated by APDCL. The AMISP shall provide the Training Approach in the response
- c) All necessary training material shall be provided by the AMISP. Each trainee shall receive individual copies of documents used for training. Training material shall be organized by functional process that will serve as the training documentation for a particular functional area.
- d) Training materials, including the documents provided to the trainees as well as handouts, shall become the property of APDCL. APDCL reserves the right to copy such materials, but for in-house use only.
- e) For all trainings the travel expenses of the APDCL will be borne by the APDCL.
- f) The schedule, location, detailed contents, for each course shall be finalized during detail engineering. The number of participants in the training program may undergo change. However, all the training courses shall preferably be conducted in single batch. Training shall be done in batches comprising of Introduction, Basic and Advanced categories.
- g) The training will consist of a curriculum of courses to address the issues of system operation, system troubleshooting, business-wide application, changed business processes and general use of the new system.
- h) Representatives from the AMISP, [utility's] project management teams will be involved throughout in the development of training strategy, training material design and development, standards and training delivery to ensure that change management issues are incorporated, and that training strategies and materials are aligned to the requirements of the project and as business-specific as possible.

The AMISP shall be required to organize following training for the APDCL personnel:

- a) **Professional Training** - This is the training for the core group of implementation team of the APDCL. This team will comprise of members from all the Business Functions and IT sections. Each member would be trained in the relevant function/ module. This Training would be required to be given to approximately 10 personnel. It is the responsibility of AMISP to deliver this training. Standard curriculum designed and agreed by the APDCL for hardware, software and network preferably shall be arranged by the AMISP for each group. The APDCL will prefer if a portion of the training is conducted on-site.
- b) **End User Training** - The AMISP will provide training to the owner's team on a "Train the Trainer" basis. The [utility's] team so trained will then train all of the [utility's] end users. It is estimated that this training will require around 10 groups, with each group comprising of around 10 persons. These training sessions will be required to be conducted at any of the sites. The recommended training material can be in paper / electronic media with courses on Business Process Automation software fundamentals, business process overview, job activity training, and delivery options being on-line, CBTs, instructor led classrooms, etc.

In addition, two Engineer's from APDCL shall be stationed at the AMISP's works during development/customization of solution as per the RFP. The deputed utility engineers shall be involved with the

project till its completion.

6.2 Training modules

The training modules shall include but not limited to:

- a) AMI Administration & Configuration
- b) AMI Installation and troubleshooting
- c) Application Management
- d) Application Data Analysis

An indicative list of training is as provided below.

Item No.	Description	No. of Trainees	Duration in weeks		Total Man-weeks	
			At Utility's facility	At AMISP's facility	At Utility's facility	At AMISP' facility
1.	Smart Grid components Hardware and Software Course	30	1	1	30	30
2.	Database, Report and Analytic Building Course	20	1	1	20	20
3.	Application Software	25	2	2	10	10
4.	Operator training	40	1	0	8	0
5.	Network and Cyber Security Training course	5	0	1	0	5
Total		120	5	5	68	65

7. Project Management

7.1 Project Management

The AMISP shall appoint at least the following personnel dedicated for the AMI Project

- a) **Project Manager:** She / he shall have the authority to make commitments and decisions that are binding on the AMISP. APDCL will designate a Nodal officer to coordinate all project activities. All communications between APDCL and the AMISP shall be coordinated through the project manager and nodal officer. The project manager should be an expert in AMI Implementation including metering and related aspects, installation and management of Smart Meters, communication network, last mile connectivity, HES and MDM. The project managers shall be responsible for all communications between other members of the project staffs including sub-contractors, if any.
- b) **System Integration Expert:** An expert in System Integration covering application software, hardware and network installation, integration design and ability to manage multiple partners with different skill sets in different technology domains.
- c) **Cyber Security Expert:** An expert in cyber security related aspects covering planning and implementing high level system security requirements, managing data privacy and confidentiality, information flow through adequate authorizations, threat modelling and security testing
- d) **Communication Protocol Expert:** An expert in communication protocols and in implementing applications using different communication technologies and ensuring communication inter-operability across applications/functionality

The project manager shall be responsible for bringing in the Cyber Security expert and Communication Protocols expert at the appropriate stage in the project as and when required.

7.2 Progress Report

A progress report shall be prepared by the AMISP for each month against the activities listed in the project schedule. The report shall be made available to APDCL on a monthly basis on a mutually agreed schedule, 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. The progress report will also highlight the risks to the project and plan for risk mitigation.

7.3 Transmittals

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

7.4 Review Meeting

Progress meetings shall be scheduled by the APDCL and attended by the AMISP each reporting period to review progress of the project. Progress meetings shall be used to review the progress report, written correspondence exchanged since the last meeting, and open action items. The review meeting will also be used to discuss upcoming milestones, support needed from APDCL, risk identified by the Program team, risk mitigation strategies and to make decisions for path forward.

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

7.5 Document Review and Approval Rights

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

The APDCL will respond with written comments to the AMISP within Fifteen (15) calendar days after receipt of the documents. Documents requiring correction must be resubmitted by the AMISP to the APDCL within fifteen (15) calendar days. The APDCL will respond to resubmitted documents within seven (7) calendar days after receipt of the document. No Project Implementation Schedule relief is to be implied for documents requiring correction and resubmission to the APDCL.

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

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

To help the APDCL manage the review and approval of documents during any given period, the AMISP 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.

8. Document Requirements

8.1 General

To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the AMISP shall submit documentation to APDCL describing the systems for review and approval. Further the AMISP 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 AMISP shall obtain approval of APDCL for the relevant document at each stage before proceeding for purchase, manufacturing, system deployment, factory testing, erection, site testing, training etc.

8.2 Instructions

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

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

8.3 Hardware Documentation Requirements

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

- a) System description documents (Overview)
- b) Data requirement sheets for all items
- c) Functional description document
- d) Database documents
- e) Drawings/Documents for installation of the equipment/system at site
- f) Installation Progress Document: Including documentation of date of installation, make and meter ID of existing replaced meter, meter ID of new meter, consumer account number, GPS coordinates, unmetered connection, existing meter status (OK, failed, meter tampering), line theft, etc. Where applicable AMISP may, for recordkeeping, take photographs/ videos of installation site on approval from APDCL
- g) Software description/design documents for each module
- h) Factory test procedure and report
- i) Manuals for each equipment
- j) System configuration parameter
- k) Site testing procedure and report
- l) Training documents
- m) System administrator documents
- n) User guide
- o) Software licenses

- p) Type test reports
- q) Cable sizing calculations
- r) Inventory of the hardware
- s) General and internal arrangement drawing of panels indicating modules, components location etc.
- t) Installation drawing
- u) Schematic drawing

8.4 Software Documentation Requirements

The documents to be submitted shall include the following information:

8.4.1 Software Inventory

An inventory of all software shall be maintained by the AMISP. The AMISP 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 AMISP documents, language and libraries used, and an indication of whether the program is to be standard, modified, or custom.

8.4.2 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.

8.4.3 Software Design

Software design documentation shall be provided for each function before the FAT (subsequent changes to be incorporated in as-built documentation). 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.

8.4.4 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.

8.4.5 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.

8.4.6 System Administration Documentation

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

- a) Network communications management
- b) Processor configuration
- c) System performance monitoring
- d) System restart/failover management and diagnostic procedures
- e) System generation and management

- f) Database generation and management
- g) Display generation and management
- h) Report generation and management
- i) Diagnostic programs
- j) Software utilities
- k) Software maintenance
- l) Application software parameters and tuning guides
- m) Web administration
- n) Other AMISP supplied system software not included above.

8.5 Test Documentation

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

8.6 Training Documentation

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

9. Annexures

Annexure A: Technical Specifications for Whole Current A.C. Single Phase Smart Energy Meter

Basic Features

The Smart Meter would have the following minimum basic features-

- Measurement of electrical energy parameters
- Bidirectional Communication
- Integrated Load limiting /connect/disconnect switch
- Tamper event detection, recording and reporting
- Power event alarms as per IS 16444 Part 1
- Remote firmware upgrade
- Pre-paid features at MDM end (as per IS 15959 Part 2)
- TOD features
- Net Metering(kWh) features (optional as per requirement of utility)
- On demand reading

General standards applicable for meters

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

Communication

Meter shall have the ability to communicate with Head End System (HES) on any one of the communication technologies mentioned in IS16444 Part 1 (RF/PLCC /Cellular) in a secure manner. The selection of communication technology should be as per the site conditions and as per design consideration of AMI Implementing agency to meet the performance as per agreed Service Level Agreements (SLAs). In case of Cellular based meter, the meter shall accommodate SIM card/ e-SIM of any service provider. The meter shall log the removal of the plug-in type communication module removal /nonresponsive event with snapshot.

Remote connect/disconnect/load limiting: Remote Connect/disconnect/Load control facilities would be as per IS 16444 part 1.

Other Specifications

Features	Minimum Requirement of Features
Applicable Standards	The meters shall comply with IS 16444 Part 1 for all requirements.
Reference Voltage	As per relevant IS (240 V)
Current Rating	5-30 A
Category	UC1
Starting Current	As per IS 16444 Part 1
Accuracy	Class 1.0 as per IS 16444 Part 1
Limits of error	As per IS 16444 Part 1
Operating Temperature range	As per IS 13779
Humidity	As per IS 13779
Frequency	As per IS 16444 Part 1
Influence Quantities	As per IS 16444 Part 1
Power Consumption of meter	As per IS 16444 Part 1
Current and Voltage Circuit	As per IS 16444 Part 1
Running at No Load	As per IS 16444 Part 1
Test output device	As per IS 16444 Part 1
Meter Display	As per IS 16444 Part 1
Name Plate & marking Meter Display	As per IS 16444 Part 1
Parameters to be measured	As per IS 16444 Part 1 / As per IS 15959 Part-2
Maximum Demand resetting	As per IS 15959 Part 2

Features	Minimum Requirement of Features
Time of Use registers	As per IS 15959 part 2
Power Quality Information	As per IS 15959 part 2
LED/LCD Indicators	As per IS 16444 Part 1
Load Survey/Interval Data	As per IS 15959 part 2
Tamper/ Event Recording	As per IS 15959 part 2
Measuring Elements	As per IS 16444 part 1
Alarm	As per IS 16444 Part 1/ 15959 Part 2
Load Control	As per IS 16444 Part 1
Connect/Disconnect switch	UC1 (As per IS 16444 part 1)
Status of load switch	As per IS 16444 Part 1
Programmability	As per IS 16444 Part 1
Communication	As per IS 16444. Part 1
Data Exchange Protocol	As per IS 16444 Part 1
Remote Firmware upgrade	As per IS 15959 part 2
Real Time Clock (RTC)	As per IS 16444 Part 1/ IS 15959 Part1 & Part 2
Data Retention	As per IS 16444 Part 1
Battery Backup	Meter shall be supplied with separate battery backup for RTC.
First Breath (power on) and Last gasp (power off) condition detection and communication to HES	As per IS 16444 Part 1
Plug-in Communication Module	The Smart Meters shall be have a dedicated sealable slot for accommodating plug-in type bi -directional communication module which shall integrate the respective communication technology (RF/PLCC/ Cellular) with the Smart Meters, leading to easy adaptability for network interfaces (WAN/NAN).The Plug-In module shall be field swappable/ replaceable.

Data display facility (auto/manual)

As per IS 16444. However minimum requirement should include the following:

Data Display shall be in two modes-

1. Auto Scroll
2. Scroll with Push Button

The display parameters shall be:

- Auto Scroll
 - Display Check
 - Date and Time
 - Last Recharge Amount
 - Last Recharge Time
 - Current Balance Amount
 - Current Balance time
 - Cumulative Active Energy kWh with legend.
 - Current calendar month MD in kW with legend.
 - Instantaneous voltage
 - Instantaneous Phase current
 - Instantaneous Load kW
 - Instantaneous average Power Factor

These parameters should be displayed on the Meter Display continuously for a period of 10 seconds on Auto scroll.

- Scroll with Push-button

All Parameters mentioned under Auto-Scroll mode should be displayed. Additionally, the following Parameters shall also be displayed:

 - Internal diagnostics (display check)
 - Meter Serial No.
 - Last month cumulative kWh with legends
 - Last month MD in kW with legends
 - Current month Average Power Factor
 - Last month Average Power Factor

Further, the Meter should display high resolution energy values with resolution of 3 digits before decimal and 4 digits after decimal in push button mode.

The meter's display should return to default display mode (continues auto scroll) if push button is not operated for more than 10 seconds. (The order of display may be revised as per requirement of the utility). Meter display should go in to the sleep mode during Power-On condition in case the push button is not operated for more than 10 minutes.

Anti-tamper features

The meter shall continue working under tamper conditions as defined in IS 15959 Part 2 and would log the event and send alarm at Head End System after detection of the defined tamper features as per IS 15959 Part2.

Type Tests & Test Certificates

Smart Meter shall be type tested for all the tests as per relevant parts of IS 16444 (latest versions), and certified by Indian Standard wise list of BIS recognized labs as available at <https://bis.gov.in/index.php/laboratorys/list-of-bis-recognized-lab/>. The number of sampling for testing of meters and criteria for conformity would be as per IS 16444 (as amended up to date). Necessary copies of test certificates shall be submitted as per agreement with the utility.

Routine & Acceptance Tests

The Factory Acceptance and Routine tests shall be carried out as per IS 16444 Part 1.

General & Constructional requirements

Meter shall be BIS marked as per IS 16444 Part 1. General & construction requirement shall be as per IS 16444/IS 13779

Meter base & cover - Meter base & cover shall be as per IS 16444 Part1 / IS 13779. The meter Base & cover shall be 'Break to open' design. The material for meter base and cover shall be made of high-grade polycarbonate.

The meter Base & cover shall be ultrasonically welded / Chemically welded or other suitable bonding technology and it will not be possible to remove the cover from the base without evidence of damage

Terminal block & cover - As per IS 16444 Part 1/IS 13779

Design

Voltage circuit, sealing arrangement, terminal block, terminal cover and nameplate etc. shall be in accordance with IS-16444 Part 1(latest version).

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

Name plate and marking

The name plate on the meter should be clearly visible, effectively secured against removal and indelibly/distinctly marked in accordance with relevant IS. In addition, "Assam Power Distribution Company Limited", purchase order no. & year/month of manufacturing shall be provided on the name plate. The rating plate information shall be as per relevant IS.

Connection diagram: As per IS 16444 Part 1

Fixing arrangements

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

Sealing arrangement:

Arrangements shall be provided for proper sealing of the meter cover so that access to the working parts shall not be possible without breaking the seal. The sealing arrangement and number of seals shall be as per relevant IS/ requirement of utility.

Meter box:

The Meter Box if required by utility/purchaser, would be provided as per requirement of the utility/ purchaser and the material of the Meter Box should be such that it does not hamper communications.

Technical Specifications for Meter Boxes:

Both single and three phase smart energy meters are to be fitted into meter cabinets which are to be supplied along with the meters. The minimum technical specification of meter boxes are given below-

The meter box shall be intended to house one number Single Phase/Three-phase whole current smart energy meter as per specification desired in this volume of the bid document. The meter box complies with relevant Indian standard IS:14772:2000 / IS: 13410 / other applicable standard with latest amendment.

MATERIAL:

The meter box shall be made SMC (Thermosetting Plastic) / Engineering Plastic material which compiles following properties:

Meter box shall be weather proof, capable to withstanding temperatures of Glow wire test at 650 degree C as per IS:11000. HDT of meter box material shall be minimum 85 degree C.

CONSTRUCTION:

The meter box shall have roof tapering down to both the sides for easy flow of rainwater. The thickness of the box shall be minimum 2.0 mm +(-) 0.2 mm on all sides. The overall dimensions of the box shall be such that a minimum 10 mm clearance from left and right and top, 10 mm from front and 10mm from back side of the meter box surface and 60 mm from meter terminals and bottom side shall be maintained in between meter and box surface.

- a. The box cover shall be fixed with concealed hinge. It would be open by at least 120 degrees.
- b. Soft rubber gasket shall be provided all around the periphery of box for protection against ingress of dust and water inside the box.
- c. Meter Box shall comply with IP protection class with IP - 54.
- d. Handle shall be provided on the box door for ease of door opening.
- e. For holding and sealing the door, 2 Nos. of U-shaped clamps shall be provided. These clamps/latches would hold the box cover with the base.
- f. All metallic parts would be well protected against corrosion.
- g. Offered Meter box's top cover shall be transparent to view the meter display
- h. Box shall have 4 nos. holes of 6 mm diameter for fixing the meter box on wall /wooden board.

i. Cable Entry:

Suitable provision shall be provide at the bottom side of the meter box bottom for cable inlet & outlet and the same shall be capable of accommodating cable of 22-26 mm diameter; engineering plastic cable gland shall be provided.

j. Name plate:

Printed metallic/Laser engraved name plate shall have details of Purchase order No. & Date. It shall be fixed with rivet such that it cannot be removed easily. In addition to this the plate should have following engraving:

- Manufacturer's name and/or trade mark and the place (with country) of manufacture;
- Marking as per BEE guidelines
- Designation of type;
- The no. of phases and no. of wires for which the meter is suitable for;
- The manufacturer's serial number and year of manufacture;
- Reference voltage;
- The basic current and the maximum current;
- The principal unit in which the meter reads;
- Meter constant
- Class index of the meter;
- Reference Frequency;

TESTS FOR BOXES:

The following tests are to be conducted on the box at any independent NABL accredited laboratory and test reports shall be carried out as per relevant Indian Standard.

- Test of HDT minimum 85 degree C
- Test for mechanical strength
- Glow wire test at 650 degree C as per IS: I1000

ACCEPTANCE TEST:

- a. Physical verification of dimensions of the box.
- b. Compatibility oi the box for housing the meter and ensuring ease of connecting and reading the meter.

Packing

The meters shall be suitably packed for vertical/horizontal support to withstand handling during transportation. The meter shall be packed appropriately to ensure safe transportation, handling, identification and storage. All packing materials shall be as per environment law in force. The primary packing shall ensure protection against humidity, dust, grease and safeguard the meter's performance until its installation. The secondary packing shall provide protection during transportation. The packing case shall indicate "Fragile in nature" and direction of placement of box. The packing shall indicate marking details like Manufacturer's name, Sl. No. of meters, quantity etc.

Transportation

- The meter shall be compact in design. The meter block unit shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation.
- The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.
- The meter should not be exposed to undue shock and mishandling during transportation.
- The stacking of box inside transport media should be such as to avoid their free movement.
- The packing should also be protected from rain and dust by transport media.
- The AMISP shall be responsible for any damage during transit due to inadequate or improper packing.

Testing and Manufacturing Facilities at Manufacturer's Place

The manufacturer shall have facilities of conducting Acceptance Testing as per IS 16444 Part 1.

Inspection

- The meters shall be sealed as per the mutual agreement of the supplier and the purchaser
- The utility/ purchaser may inspect the meter randomly as per sampling plan for acceptance test as per IS 16444 Part 1. The meters shall be tested for acceptance test as per IS 16444 Part 1

Annexure B: Technical Specifications for Whole Current A.C. Three Phase Smart Energy Meter

Scope

The specification covers the design, manufacturing, testing, supply and delivery of AC whole current 3 phase 4 wires Smart Energy Meter with bidirectional communication facility suitable for Advanced Metering Infrastructure (AMI) with connect/disconnect switch. The meter shall communicate with Head End System (HES) on any one of the communication technologies mentioned in IS16444 Part 1, as per the requirement of the utility / authorized system integrator.

Basic Features

The Smart Meter would have the following minimum basic features-

- Measurement of electrical energy parameters
- Bidirectional Communication
- Integrated Load limiting switch/relay
- Tamper event detection, recording and reporting
- Power event alarms as per IS 16444 Part 1
- Remote firmware upgrade
- Pre-Paid features at MDM end (as per 15959 part 2)
- TOD feature
- Net Metering(kWh) features (optional as per requirement of utility)
- On demand reading

General standards applicable for meters

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

Communication

Meter shall have the ability to communicate with Head End System (HES) on any one of the communication technologies mentioned in IS16444 Part 1 (RF/PLC/ Cellular) in a secure manner. The selection of communication technology should be as per the site conditions and as per design requirement of AMI Implementing agency to meet the performance as per agreed Service Level Agreements (SLAs). In case of Cellular based meter, the meter

shall accommodate SIM card/ e-SIM of any service provider. The meter shall log the removal of the plug-in type communication module removal /nonresponsive event with snapshot.

Remote connect/disconnect/load limiting: Remote Connect/disconnect/Load control facilities would be as per IS 16444 part 1.

Other Specifications

Features	Minimum requirement of features
Applicable Standards	The meters shall comply with IS 16444 Part 1 for all requirements.
Reference Voltage	As per relevant IS
Current Rating	10-60 A
Category	UC1
Starting Current	As per IS 16444 Part 1
Accuracy	Class 1.0 as per IS 16444 Part 1
Limits of error	As per IS 16444 Part 1
Operating Temperature range	As per IS 13779
Humidity	As per IS 13779
Frequency	As per IS 16444 Part 1
Influence Quantities	As per IS 16444 Part 1
Power Consumption of meter	As per IS 16444 Part 1
Current and Voltage Circuit	As per IS 16444 Part 1
Running at No Load	As per IS 16444 Part 1
Test output device	As per IS 16444 Part 1
Meter Display	As per IS 16444 Part 1
Name Plate & marking Meter Display	As per IS 16444 Part 1
Parameters to be measured	As per IS 16444 Part 1 / As per IS 15959 Part-2
Maximum Demand resetting	As per IS 15959 Part-2

Features	Minimum requirement of features
Time of Use registers	As per IS 15959 Part-2
Power Quality Information	As per IS 15959 Part-2
LED/LCD Indicators	As per IS 16444 Part 1
Load Survey/Interval Data	As per IS 15959 Part-2
Tamper/ Event Recording	As per IS 15959 Part-2
Measuring Elements	As per Is 16444 Part 1
Alarm	As per IS 16444 Part 1 / As per IS 15959 Part-2
Load Control	As per IS 16444 Part 1
Connect/Disconnect switch	UC1 as per IS 16444 Part 1
Status of Load switch	As per IS 16444 Part 1
Programmability	As per IS 16444 Part 1
Communication	As per IS 16444 Part 1
Communication Protocol	As per IS 16444 Part 1
Remote Firmware upgrade	As per IS 15959 Part-2
Real Time Clock (RTC)	As per IS 16444 Part 1 / IS 15959 Part 1 & Part 2
Data Retention	As per IS 16444 Part 1

Features	Minimum requirement of features
Battery Backup	Meter shall be supplied with adequate separate battery backup for RTC.
First Breath (Power on) and Last gasp (Power off) condition detection and communication to HES	As per IS 16444 Part 1
Plug-in Communication Module	The Smart Meters shall be have a dedicated sealable slot for accommodating plug-in type bi -directional communication module which shall integrate the respective communication technology (RF/PLC/ Cellular) with the Smart Meters, leading to easy adaptability for network interfaces (WAN/NAN).The Plug-In module shall be field swappable/ replaceable.

Data display facility (auto/manual)

As per IS 16444. However minimum requirement should include the following:

Data Display shall be in two modes-

1. Auto Scroll
2. Scroll with Push Button

The display parameters shall be:

- Auto Scroll
 - Display Check
 - Date and Time
 - Last Recharge Amount
 - Last Recharge Time
 - Current Balance Amount
 - Current Balance time
 - Cumulative Active Energy kWh with legend.
 - Cumulative Apparent Energy kVAh with legend.
 - Current month MD in kW with legend.
 - Current month average Power Factor
 - Instantaneous voltage VRN
 - Instantaneous voltage VYN
 - Instantaneous voltage VBN
 - Instantaneous current IR
 - Instantaneous current IY
 - Instantaneous current IB
 - Instantaneous current IN

- Instantaneous Load kW and kVA
- Instantaneous average Power Factor

These parameters should be displayed on the LCD/LED continuously for a period of 10 seconds on Auto scroll.

- Scroll with Push-button

All Parameters mentioned under Auto-Scroll mode should be displayed. Additionally, the following Parameters shall also be displayed:

- Internal diagnostics (display check)
- Meter Serial No
- Cumulative Energy in kVAh Lag/ Lead with legend
- Cumulative Active Energy kWh ToD wise with legends.
- Cumulative Apparent Energy kVAh ToD wise with legends.
- Current month MD in kVAh with legends
- Last month cumulative kWh with legends
- Last month cumulative kVAh with legends
- Last month MD in kW with legends
- Last month Average Power Factor

Further, the Meter should display high resolution energy values with resolution of 3 digits before decimal and 4 digits after decimal in push button mode.

The meter's display should return to default display mode (continues auto scroll) if push button is not operated for more than 10 seconds. (The order of display may be as per the requirement of utility). Meter display should go in to sleep mode during Power-On condition in case the push button is not operated for more than 10 minutes.

Anti-tamper features

The meter shall continue working under tamper conditions as defined in IS 15959 Part 2 and would log the event and send alarm at Head End System after detection of the defined tamper features as per IS 15959 Part2.

Type Tests & Test Certificates

Smart Meter shall be type tested for tests as per relevant parts of IS 16444 (latest versions), and certified by Indian Standard wise list of BIS recognized labs as available at <https://bis.gov.in/index.php/laboratorys/list-of-bis-recognized-lab/>. The number of sampling for testing of meters and criteria for conformity would be as per IS 16444(as amended up to date). Necessary copies of test certificates shall be submitted as per agreement with the utility.

Routine & Acceptance Tests

The Factory Acceptance and Routine tests shall be carried out as per IS 16444 Part 1.

General & Constructional requirements

Meter shall be BIS marked as per IS 16444 Part 1. General & construction requirement shall be as per IS 16444/IS 13779

Meter base & cover - Meter base & cover shall be as per IS 16444 Part1 / IS 13779. The meter Base & cover shall be 'Break to open' design. The material for meter base and cover shall be made of high-grade polycarbonate.

The meter Base & cover shall be ultrasonically welded / Chemically welded or other suitable bonding technology and it will not be possible to remove the cover from the base without evidence of damage

Terminal block & cover - As per IS 16444 Part 1/IS 13779

Design

Voltage circuit, sealing arrangement, terminal block, terminal cover and nameplate etc. shall be in accordance with IS-16444 Part 1 (latest version). The meter shall be compact and reliable in design, easy to transport and immune to vibration and shock involved in transportation and handling

Name plate and marking

The meter should bear a name plate clearly visible, effectively secured against removal and indelibly/distinctly marked in accordance with relevant IS. In addition, "Assam Power Distribution Company Limited", purchase order no. & year/month of manufacturing shall be provided on the meter name plate. The rating plate information shall be as per relevant IS.

Connection diagram: As per IS 16444 Part 1

Fixing arrangements:

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

Sealing arrangement:

Arrangements shall be provided for proper sealing of the meter cover so that access to the working parts shall not be possible without breaking the seal. The sealing arrangement and number of seals shall be as per relevant IS/ requirement of utility.

Meter box:

The Meter Box if required, would be provided as per requirement of the utility/ purchaser and the material of the Meter Box should be such that it does not hamper communications.

Packing

- The meters shall be suitably packed for vertical/horizontal support to withstand handling during

transportation.

- The meter shall be packed appropriately to ensure safe transportation, handling, identification and storage.
- All packing materials shall be as per environment law in force. The primary packing shall ensure protection against humidity, dust, grease and safeguard the meter's performance until its installation.
- The secondary packing shall provide protection during transportation.
- The packing case shall indicate "Fragile in nature" and direction of placement of box.
- The packing shall indicate marking details like Manufacturer's name, meters #s, quantity, etc.

Transportation

- The meter shall be compact in design. The meter block unit shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation.
- The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.
- The meter should not be exposed to undue shock and mishandling during transportation.
- The stacking of box inside transport media should be such as to avoid their free movement.
- The packing should also be protected from rain and dust by transport media.
- The AMISP shall be responsible for any damage during transit due to inadequate or improper packing.

Testing and Manufacturing Facilities at Manufacturer's Place

The manufacturer shall have facilities of conducting Acceptance Testing as per IS 16444 Part 1.

Inspection

- The meters shall be sealed as per the mutual agreement of the supplier and the purchaser
- The Utility/ purchaser may inspect the meter randomly as per sampling plan for acceptance test as per IS 16444 Part 1. The meters shall be tested for acceptance test as per IS 16444 Part 1

Annexure D: System Sizing Requirement

G.1 Sizing Parameter

The system shall be designed as per the technical parameters defined in this specification and as specified in this Annexure.

The system (MDM, Historian, NMS etc.) shall be suitably sized based on data to be captured from X nodes with 100% expansion.

The auxiliary memory utilization of any of the Servers shall not exceed 30% of its delivered capacity at any time even under peak loading conditions involving a combination of the following -

- 400 alarms per minute for 5 minutes.
- 10 concurrent display requests from 5 users. Including graphical trends
- Restoration of 100%-meter data after system failure.
- VEE and billing determinant calculations involving 10,000 consumer meters
- System activity alarms.

This memory utilization includes the memory used for storage of data (including expansion requirement defined in above para) for the defined duration as specified in the Technical Specification. The system architecture and the network design shall have the ability to handle the growth with respect to functions, user and geographic sites. Also, applications must evolve to support new business requirements and make use of new technologies.

G.2 Configuration requirement for Hardware & Software

S. No.	Description	No of Nodes	Future requirement
1.	HES*	X	X% Expansion
2.	MDM*	X	X% Expansion

*In future, APDCL may use same HES / MDM for entire area. Provision should be there to cover such area through procurement of additional licenses.

Annexure E: General requirement for common pluggable communication module for Smart Meters

Considering that the new Smart Meters may use different types of communication technologies (RF/PLCC/Cellular, etc.), thus in order to enable different communication modules to be used in the same meter, it is necessary to use a universal interface and a particular size irrespective of the choice of communication technology that defines the dimensions of the communication slot as well as physical placement and location of connectors. The following example recommendations will go a long way in assuring interoperability whilst still complying with the provisions of IS 16444 and IS 15959 standards:

Part I

1. Recommended Module Placement location

In order to improve the Radio Performances of any of the wireless technologies encompassing but not limited to Cellular, RF and / or RF mesh, it is recommended to place the communication module anywhere on the accessible part of the meter. This will also enable an easy approach to improve antennae performances.

2. Meter shall have the means of tamper detection to record the event(s) of the removal of the communication module set from the meter, irrespective of whether the meter is in power on (has supply) or powered off (no supply) condition.
3. The Module shall be hot swappable and shall fit snugly inside the meter box, so that the same IP class of the meter is maintained.
4. A transparent cover may be used for the purpose,
 - a. To have a sealing arrangement with the meter body as well as
 - b. For easy viewing of LED indicators and antenna assembly without having to open the cover.

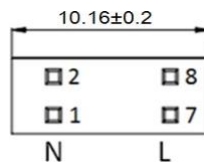
Part II

AC power interface:

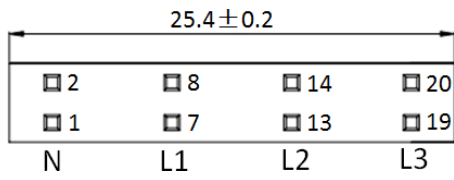
In the event of PLC communication being chosen as the only or one of the choices, the following arrangement of connector and pinouts need to be provisioned on the communication module.

Female connector

1. Front View:

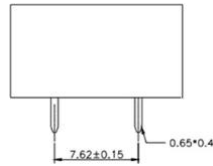


Single phase meter

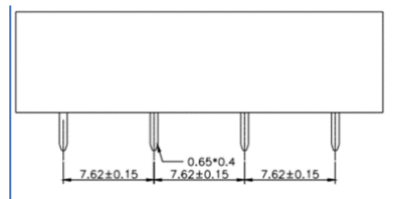


2. Top View:

Poly phase meter

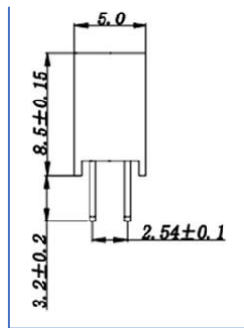


Single phase meter



Poly phase meter

3. Side View:



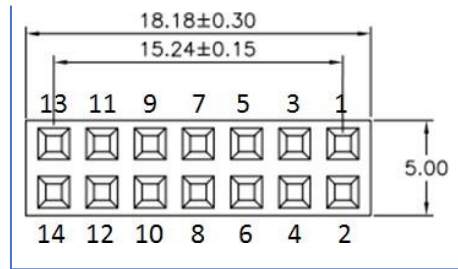
Pin to Pin distance should be: 7.62mm (Standard Pin connector)

Communication interface:

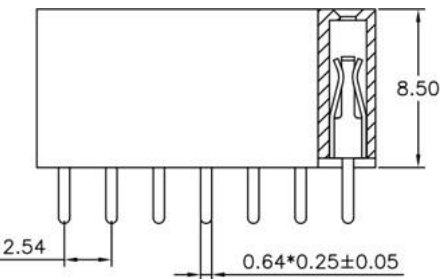
The meter shall have a slot of an appropriate size to allow for the pluggable communication module (such as but not limited to NAN /WAN, dual mode RF, Dual Technology, cellular etc.) to be fit in to the meter. The meter shall provide a 14-pins Female socket connector (2*7pin, 2.54mm). The socket shall be selected and positioned to ensure that the male pins on the communication module can connect reliably and easily connect with the female contactors on the meter.

Female connector

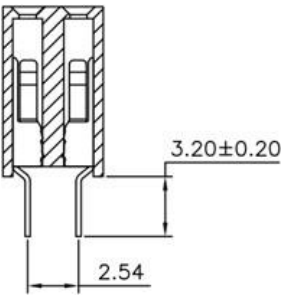
1. Front View :



2. Top View :



3. Side View :



PIN Outs may be provided as per below details

Pin No	Name	Input/output	Description
1.	Reserved	/	/
2.	Reserved	/	/
3.	Power EN	Output	Control the module's power supply
4.	Reserved	/	/
5.	Reserved	/	/
6.	Meter TXD	Output	To Module UART port RXD, Min.38400
7.	Meter RXD	Input	From Module UART port TXD, Min.38400
8.	Reserved	/	/
9.	RTS	Input	Input digital signal from module

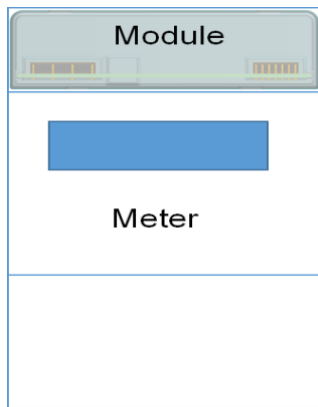
Pin No	Name	Input/output	Description
10.	RST	Output	Reset signal for module
11.	CTS	Output	Output digital signal to module
12.	+Vdc	Power	As per IS16444
13.	GND	Common	Ground Reference Potential
14.	GND	Common	Ground Reference Potential

Part III

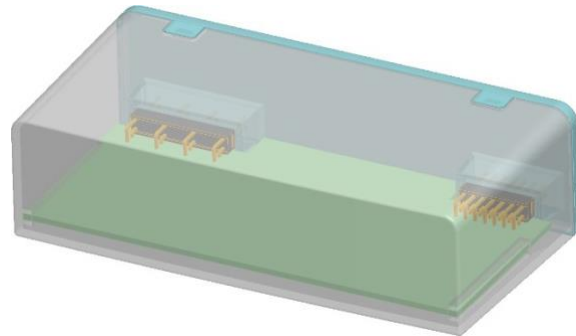
The following reference size may be adhered to irrespective of a single or multiple communication options provisioned on the same module. This standard form factor and dimensions will enable physical and functional interoperability with different makes of meters.

A. Module 3-D views (For Representational Purpose Only)

1. Module in meter (Top View)



2. 3D View



3. Front View



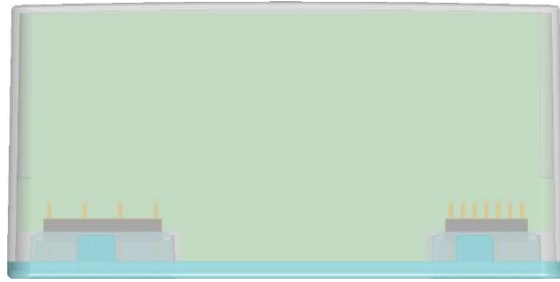
4. Back View



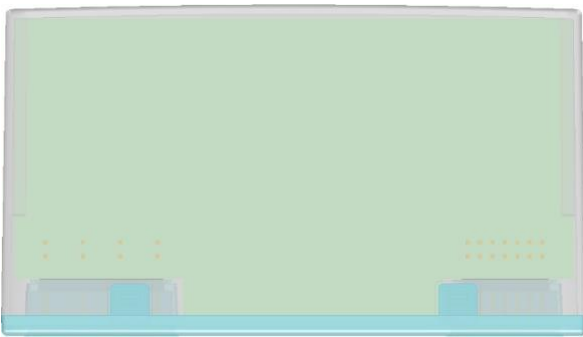
5. Side View



6. Top View

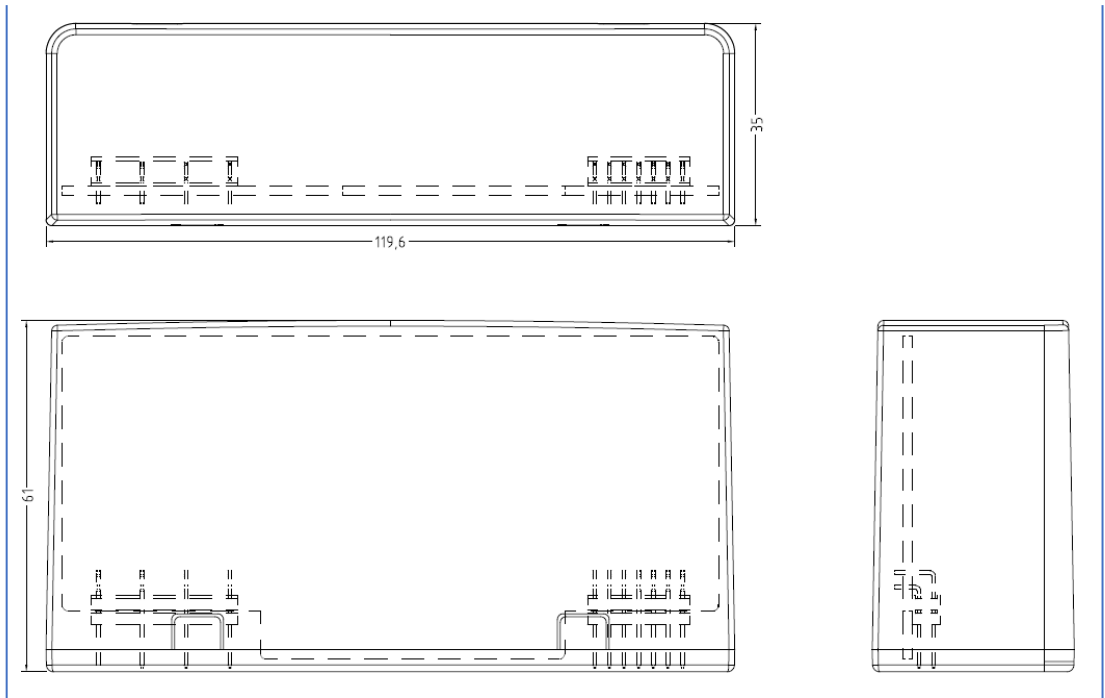


7. Bottom View

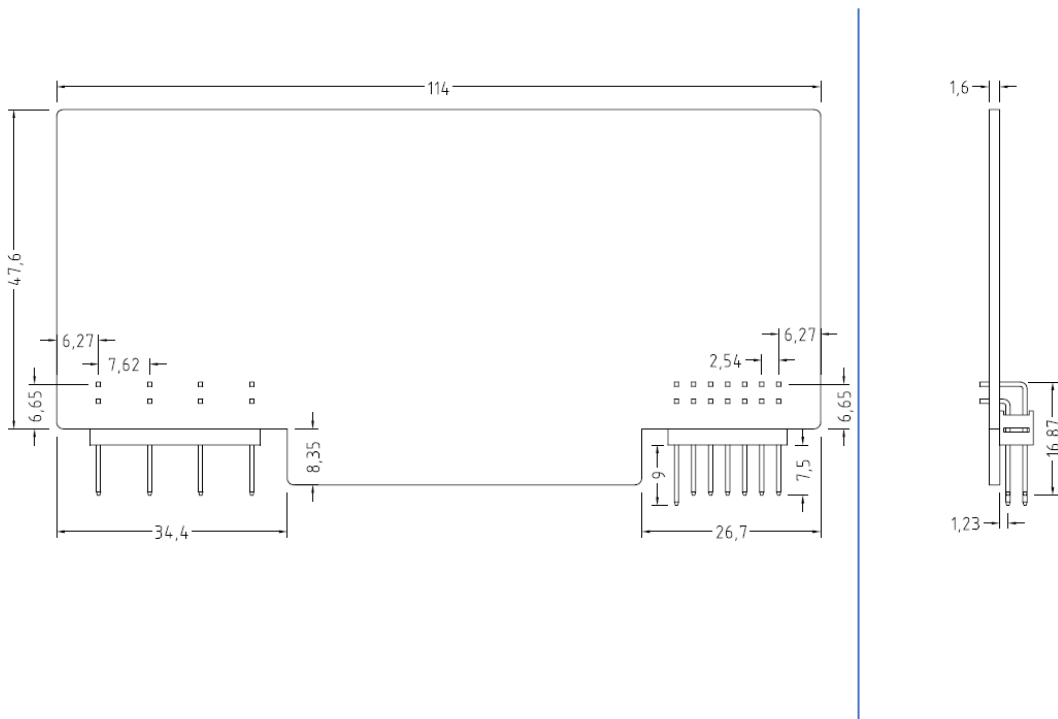
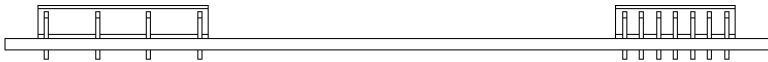


B. Module Dimensions

Overall view of the module:



Overall view of the module's PCBA:



Notes: Module Reference Sizes: unit mm.

Annexure F: Demand Response Use Cases

The objective of the Demand Response iterated in the RFP is to optimal utilization of energy resources by uniform distribution of load across the day, to save additional investment in capacity addition within the utility, improved access of power to rural areas, reduction in technical losses, enhanced consumer satisfaction by load curtailment in place of load shedding.

S.No	Functional requirement	Description of Functional requirement
1.	Load Curtailment event in place of Load Shedding	System will determine based on day ahead schedule for available generation capacity and load forecasting the load curtailment events. Advance notice will be sent to a group of consumers affected by this load curtailment. DR system will send the load curtailment command to the MDM. The MDM will forward this command to the appropriate AMI Head-End.
2.	DR Program Commencement	Once the consumer is set up with all the devices necessary, the consumer details will be sent to DR system. Premium charges for assured power supply with SLA and/or Rebates and incentives can be given to consumers who participate in DR programs.
3.	Real time Pricing	Utility shall be able to send real-time pricing signals to end consumers/ AMI system
4.	Curtailment due to Contract Violation	Utility limits consumer's load due to reasons like exceeding contract load
		Alarms (visual and audio) shall be provided in case of load violation (in home device, Email, SMS etc.). The billing system shall be notified of the load violation, and the corresponding charges shall be applied to consumer (based on tariff rules).
5.	Demand side Management	In every 15-minute interval Meter data should be captured, Confirmation of action taken for demand response should be mentioned as well as monitoring of historical Consumer Load Profile should be done.
6.	Load Monitoring at Demand side	Daily Meter Reading, Status and associated details capturing for records of consumer consumption data, TOU details, real time trends and Load profile Details. Along with this whenever there is a load violation event recorded in the meter, the information is sent to the control center
7.	Initiate Direct Load Control Event	Utility calls a Direct Load Control Event using the Peak Load Management (PLM) Application and executes through head-end by sending a load control signal to Smart Appliances thru HAN/Smart Meter or other means
8.	Energy accounting system	Register and Interval based accounting: Register based

S.No	Functional requirement	Description of Functional requirement
		<p>Register based accounting supports requirements for prepaid energy accounting based on register reads.</p> <p>It includes billing cycle data services that deliver billing determinants via an interface to CIS/Billing on the billing cycle date and on request when special reads are required. A Billing Determinant Calculator provides the flexibility to compute the billing determinant values based on utility defined formulas. Formulas are built around logical and arithmetic operators, and can contain other billing determinants, constants, and consumer functions.</p> <p>Bi-directional</p> <p>MDM should support bi-directional metering by processing the delivered and received channels for a given meter in two separate channels.</p> <p>Net Metering (using Virtual channel)</p> <p>MDM should support net metering by processing the delivered and received channels from the meter/recorder and calculating a net amount. The calculated net will be stored onto a virtual channel. MDM should provide full tracking, management, and storage of usage data related to each data channel. This allows summation of usage data separately for each data channel.</p> <p>Usage Calculated from Register Reads</p> <p>MDM can create usage data from register reads received from AMI systems or gathered manually through HHUs. MDM will calculate the difference between the current bill period register read and the previous bill period register read, applying the ratio required converting to the correct kWh usage. Rollover conditions are also considered when computing usage. The calculated usage is stored in the billing table and accessible to all applications that require the data.</p> <p>Interval Billing:</p> <p>The Interval Billing should include all of the functionality offered in the Register Billing in addition to support Advanced Billing Determinants (ABD) calculated from interval reads.</p> <p>As interval data is retrieved by the AMI systems, the Advanced Billing Determinant (ABD) engine should process the interval reads into daily and billing cycle usage-based billing determinants (as compared to register-based billing).</p>

S.No	Functional requirement	Description of Functional requirement
		<p>For example, if 15 min interval data is retrieved by the system, MDM calculates the proper billing determinant which is based on RTP/ Time-of-Use (TOU) tariff, then ABD engine will make this computation based on tariff configuration data in the database. Then it stores this daily data set (RTP/TOU values with usage details for each), along with the interval data in the Metered Usage Data Repository (MUDR). On each billing cycle, the ABD engine will summarize the RTP/TOU and demand data for each period over the requested billing span and deliver these billing determinants to the billing system. By performing the billing determinant summations daily, MDM support end-user presentation of "month-to-date" information as well as spread computational loads over time (including weekends).</p>

Annexure G: AMI system availability

AMI system issues and availability are flagged at three different severity levels.

- a) Severity 1 is the most critical being a complete system level failure or breach of IT policies and requiring urgent and immediate attention.
- b) Coverage under severity 2 are outages that do not cause any immediate disruption but subsequently may result into severity 1 outage.
- c) Severity 3 are those issues / problems / outages which are neither of an emergency nor priority level as grouped under severity level 1 or 2.

The AMISP shall implement an appropriate online SLA Application (as elaborated in section 5.6 of Schedule F) for problem/defect reporting and tracking system. This would enable logging and tracking of outages / defects/non-conformances of all severity levels and get the approval of the same from APDCL towards desired resolution. The incidents (15 in number) are categorized as mentioned in below table.

Category	Definition
Severity 1 Urgent	<ul style="list-style-type: none"> a) Complete loss of AMI system functions²¹ b) Partial outage of AMI functions <ul style="list-style-type: none"> i. Utility user interface ii. Consumer portal c) Stoppage of data backup at DC/DR (refer section '5.3.1 e' of Schedule F) d) Cyber Security issues leading to unauthorized access to systems/applications
Severity 2 Serious	<ul style="list-style-type: none"> a) Outage at Network Operation cum Monitoring Centre <ul style="list-style-type: none"> i. Complete outage of communication connectivity ii. Failure of UPS system iii. Failure of Battery / other auxiliary system) b) Interruption of data exchange with utility enterprise systems c) Partial outage of AMI functions <ul style="list-style-type: none"> i. Outage of VEE ii. Billing Determinants iii. Reports d) Breach of data privacy e) Adherence to RPO / RTO²² as defined in Section 3.3.3.9 of Schedule F and as mentioned in Section 5.3.1 of Schedule F
Severity 3 Minor	<ul style="list-style-type: none"> a) Non-availability of reports as defined in section 1.8 of Schedule F during the Operation Phase b) Resolution of complaint ticket raised and passed on by CCS [These complaints shall be registered within the SLA Application and hence shall have to undergo mutual agreement checks between Utility/AMISP before being registered for resolution] c) Non-availability of required inventory of spares specified in Section 5.3.3 of Schedule F

	d) Failure of workstation, printers, LAN etc. at the NOMC e) Non-availability of designated AMISP’s Manpower at the NOMC
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G.1.Response & Resolution Time

The target times within which the AMISP should respond to support requests for each category of severity is described in the following table.

- a) The Initial Response Time is defined as the period from the initial logging of the support request (through established systems and/or communications channels) and the acknowledgment of the AMISP subject to the maximum time defined in the following table. In case, AMISP doesn’t respond within initial response time, the support shall be deemed acknowledged by the AMISP.
- b) The Action Resolution Time is the period from the acknowledgement of support request to the AMISP delivering a solution subject to the Maximum time defined in following table.
- c) The Action Resolution Time includes investigation time and consideration of alternative courses of action to remedy the situation.

Severity	Initial Response Time	Maximum Action Resolution Time	Action
1	[15 minutes]	[2 hours]	An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored.
2	[30 minutes]	[24 Hours]	Attempt to find a solution acceptable to APDCL (dependent on reproducibility), as quickly as practical.
3	[2 hours]	[10 days]	Evaluation and action plan. Resolution time is dependent on reproducibility, ability to gather data, and [Utility’s] prioritization.

G.2.Service Response Requirements

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 to. Severity 1 issues shall be reported by telephone for rapid response; the key objective is to restore the system to an operational state as quickly as possible.

G.3. System Availability Calculations

System level issues / availability calculation methodology shall be as below:

- a) For Severity-1 and 2 level incidents, the non-availability hours for availability calculation shall be counted from the end of the allowed Action Resolution time for their first instance in a given month. If any incident, repeats in the same month, the non-availability hours for availability calculation shall be counted from the end of allowed Initial Response Time.
- b) For Severity-3 events, the non-availability hours for availability calculation shall be counted from the end of the allowed Action Resolution time

A standardized online ticket register shall be maintained, that shall be made available to utility online, containing the following:

Details of each issue reported:

- a) Actions taken by AMISP to correct the issue
- b) Applicable Severity level
- c) Time of reporting to the AMISP support engineer/support
- d) Actual vs Allowed response & resolution time as defined in this annexure
- e) Review of utility's Engineer-in-charge as well as the AMISP's support engineer of the site.

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

Availability computation shall be done on monthly basis in selected area(s) of operation. The formula to be used for availability computation shall be as under:

$$\text{Availability per month} = \frac{\text{THM} - (S1 \times 1 + S2 \times 0.8 + S3 \times 0.5)}{\text{THM}}$$

- Where THM is total hours in the month when power supply to AMI system is available
- S1/ S2/ S3 is the total non-available hours in Severity Level-1 /2/3

S1/ S2/ S3 are computed for each event. For instance, S3 for each Severity-3 event would be number of hours passed beyond the maximum resolution time for which the event is not resolved. Some examples for the same are provided below:

Category	Example of computing non-available hours
Severity 1 – Urgent	<p>For incidents happening for the first time in the month, Number of hours beyond the allowed maximum resolution time for which:</p> <ul style="list-style-type: none"> a) Complete loss of AMI system functions b) Partial outage of AMI functions <ul style="list-style-type: none"> i. Utility user interface ii. Consumer portal c) Cyber security issues remain unresolved d) Data backup at DC/DR remains stopped <p>For incidents happening for the second or more times in the month, Number of hours beyond the allowed initial response time for which:</p> <ul style="list-style-type: none"> a) Complete loss of AMI system functions b) Partial outage of AMI functions <ul style="list-style-type: none"> i. Utility user interface ii. Consumer portal c) Cyber security issues remain unresolved d) Data backup at DC/DR remains stopped

<p>Severity 2 – Serious</p>	<p>For incidents happening for the first time in the month, Number of hours beyond the allowed maximum resolution time for which:</p> <ul style="list-style-type: none"> a) Outage at Network Operation cum Monitoring Centre <ul style="list-style-type: none"> i. Complete outage of communication connectivity ii. Failure of UPS system iii. Failure of Battery / other auxiliary system) b) Partial outage of AMI functions <ul style="list-style-type: none"> i. Outage of VEE ii. Billing Determinants iii. Reports etc. c) Any single event on data privacy breach is not resolved d) Interruption of data exchange with utility enterprise systems remains unresolved e) Adherence to RPO / RTO is not ensured <p>For incidents happening for the second or more times in the month, Number of working hours beyond the allowed initial response time for which</p> <ul style="list-style-type: none"> a) Outage at Network Operation cum Monitoring Centre <ul style="list-style-type: none"> i. Complete outage of communication connectivity ii. Failure of UPS system iii. Failure of Battery / other auxiliary system) b) Partial outage of AMI functions <ul style="list-style-type: none"> i. Outage of VEE ii. Billing Determinants iii. Reports etc.
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Category	Example of computing non-available hours
	<ul style="list-style-type: none"> c) Any single event on data privacy breach is not resolved d) Interruption of data exchange with utility enterprise systems remains unresolved e) Adherence to RPO / RTO is not ensured
Severity 3 – Minor	<p>Number of days beyond 10 days for which (Number of days shall be converted to number of hours by multiplying it with 24)</p> <ul style="list-style-type: none"> a) Non-availability of reports as defined in section 1.8 of Schedule F during the Operation Phase b) Resolution of complaint ticket raised and passed on by CCS [These complaints shall be registered within the SLA Application and hence shall have to undergo mutual agreement checks between Utility/AMISP before being registered for resolution] c) Non-availability of required inventory of spares specified in Section 5.3.3 of Schedule F d) Failure of workstation, printers, LAN etc. at the NOMC e) Non-availability of designated AMISP's Manpower at the NOMC

Annexure H: Schedule of billing data collection for different consumer category

The schedule for billing for all categories of consumers are given below:

- 1) The billing cycle is monthly
- 2) Meter readings are to be made available to APDCL's billing system by 5th day of every month.