EASTERN REGIONAL POWER COMMITTEE

ADDITIONAL AGENDA FOR 179th OCC MEETING TO BE HELD ON 21.05.2021(FRIDAY) AT 10:30 HRS

ITEM NO.1: Activation of Transient data record facility in the AVR, if available and sharing the information with RLDC whenever required.

Monitoring of response of all dynamic elements of the grid is extremely important for analyzing various events in the grid and validating dynamic models of the elements.

Modern AVR are having transient data recording facility and can record very high-resolution data. Therefore all generating station must activate the facility for understanding the dynamics of the grid in a much better way. Therefore all generators are requested to submit the following details:

Generator Name	AVR manufacturer	Transient Data recording facility available (Yes/No)	IS the data recording facility activated (Yes/No)

Members may discuss and update.

ITEM NO.2: Draft Technical specifications (TS) of 5/15 minutes IEM with AMR, MDP system

As per NPC, CEA letter dated 02.12.2020; a Joint Committee comprising of members from RPCs, CEA, PGCIL/CTU & POSOCO has been constituted to finalize the Technical Specification (TS) of the 5/15 minute IEMs (Interface Energy Meters) with AMR, MDP system. **(Annexure-2.1)**

Subsequently NPC, vide email dated 28.01.2021, has circulated a draft Technical specification (TS) in two parts **(Annexure-2.2).** The 1st meeting of the joint committee held on 05th February'2021, where it was decided for further deliberation at RPC level on Technical Specifications with states/Utilities for consolidated comments of RPCs. It is further informed that ERPC Secretariat vide email dated 04.02.2021, sought comments from States/Utilities, but till date no comments has been received. **(Annexure-2.3)**

Members may discuss & give comments on Draft Specifications.

सत्यमेव जयते

भारत सरकार/Government of India
विद्युत मंत्रालय/ Ministry of Power
केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority
राष्ट्रीय विद्युत समिति प्रभाग/ NPC Division
1st Floor, Wing-5, West Block-II, R.K. Puram, New Delhi-66, Mail: cenpc-cea@gov.in

No. 4/MTGS/NPC/CEA/2020/ 94-104 **Date: 02.12.2020**

To,
As per distribution list

Subject: Constitution of "Joint Committee on Technical Specification (TS) of the 5/15 minute IEMs with AMR, MDP system"-reg.

विषय: AMR, MDP प्रणाली के साथ 5/15 मिनट IEM की "तकनीकी विशिष्टता (टीएस) पर संयुक्त समिति का गठन। " -Reg

A meeting on the issue of Telemetry of Real-time Active Power (MW) data to SLDCs through IEMs was held on 19th November, 2020 chaired by Chairperson, CEA. In this meeting, it was decided that the Technical Specification (TS) of the 5/15 minute Interface Energy Meters (IEMs) with Automatic Meter Reading (AMR) and Meter Data Processing (MDP) for Interstate transmission system may be prepared at PAN India basis.

A joint committee comprising members from each RPCs, CEA, and CTU/PGCIL and POSOCO has been constituted to deliberate and finalise the above Technical Specifications.

The Constitution of the joint committee is as follows

1	Chief Engineer (GM), CEA	Member
2.	Chief Engineer, DP&T, CEA	Member
3	Member Secretary, WRPC	Member
4	Member Secretary, NRPC	Member
5	Member Secretary, ERPC	Member
6	Member Secretary, SRPC	Member
7	Member Secretary, NERPC	Member
8	Representative from PGCIL*(at the level of Sr.GM/GM)	Member
9	Representative from POSOCO**(at the level of Sr. GM/GM)	Member
10	Chief Engineer(NPC), CEA	Member & Convener of the committee

*To be nominated by PGCIL
**To be nominated by POSOCO

In this regard it is requested that PGCIL and POSOCO may send their nominations at the level of Sr.GM/GM.

Terms of Reference of the Committee is to "To prepare the Technical Specification (TS) of the 5/15 minute Interface Energy Meters (IEMs) with Automatic Meter Reading (AMR) and Meter Data Processing (MDP) for Interstate transmission system."

This letter is issued with the approval of the Competent Authority.

21/12/2020

(Rishika Sharan)
Chief Engineer (NPC)

Distribution List

1. CMD, PGCIL
2. CMD, POSOCO
3. Chief Engineer (GM), CEA
4. Chief Engineer (DP&T), CEA
5. Member Secretary, WRPC/ NRPC/ ERPC/SRPC/ NERPC

Copy for information to:

1. PS to Chairperson, CEA
2. SA to Member (GO&D)

Technical Specification for Interface Energy Meters, Automated Meter Reading System and Meter Data Processing for Inter State Transmission System

LIST OF TABLES

ABBREVIATIONS

S.No	Acronym	Definition
1	AMR	Automated Meter Reading
2	ATP	Acceptance Test Plan
3	CDCS	Central Data Collection System
4	CMRI	Common Meter Reading Instrument
5	C&R	Control & Relay
6	CTU	Central Transmission Utility
7	DCD	Data Collection Device
8	DCU	Data Concentrator Unit
9	DSM	Deviation Settlement Mechanism
10	EA	Energy Accounting
11	EHV	Extra High Voltage
12	FAT	Factory Acceptance Test
13	FTE	Full Time Equivalent
14	GPRS	General Packet Radio Service
15	GSM	Global System of Mobile
16	HHU	Hand Held Unit
17	IEC	International Electro-technical Commission
18	IEEE	Institute of Electrical and Electronics Engineers
19	IEM	Interface Energy Meter
20	IP	Ingress Protection
21	IS	Indian Standard
22	ISTS	Inter State Transmission System
23	LAN	Local Area Network
24	MDP	Meter Data Processing
25	NMS	Network Management System
26	OEM	Original Equipment Manufacturer
27	PCB	Printed Circuit Board
28	RDBMS	Relational Database Management System
29	RMS	Root Mean Square
30	SAT	Site Acceptance Test
31	SEM	Special Energy Meter
32	SRS	Software Requirements Specification
33	TOC	Taking Over Certificate
34	VPN	Virtual Private Network
35	WAN	Wide Area Network
36	RLDC	Regional Load Despatch Centre

37	RPC	Regional Power Committee
38	IEMDC	Interface Energy Meter Data Centre

I. BACKGROUND

Power system operation in India is under control of hierarchical regulatory system. Commercial settlements of energy generation and consumption are being computed through Availability Based Tariff (ABT) and Deviation Settlement Mechanism (DSM) which are in vogue for energy accounting. Availability Based Tariff was implemented in India in 2002/2003 considering the settlement period as 15-min. The Special Energy Meters (SEM) for Interface points i.e. Interface Energy Meters (IEM) are deployed throughout all the regions of India at identified locations which store electrical parameters having significance in Regional Energy Accounting (REA) and DSM. Suitable storage capacity was provided in meters keeping in view meagre data communication facilities which were available in the country about two decades ago. Block wise Energy data as recorded by the SEMs are down loaded offline monthly/weekly and forwarded (in encrypted format) by email to respective RLDCs for verification/validation. The processed meter data is forwarded by RLDCs to RPC secretariats for preparation of weekly/monthly energy accounts.

A large number of SEMs/IEMs installed at several ISTS points are more than 5 / 10 years old and are due for testing / replacement. Also Government of India (GoI) has set a Renewable Energy (RE) target of 175GW capacity by 2022. The need for implementing a 5-minute scheduling, accounting and settlement at the Inter State level is being felt considering the variability of load and renewables especially considering RE penetration in the coming years.

This issue was discussed in several CCM (Commercial Coordination Meeting) and TCC/RPC meetings and was decided to replace the entire fleet of existing SEMs (15-min Block) with Interface Energy Meters (5-min Block) and implement the Automated Meter Reading and Meter Data Processing System. The above is also in line with the recommendations of the Report on Scheduling, Accounting, Metering and Settlement of Transactions in Electricity (SAMAST) that was endorsed by the Forum of Regulators on 15th July 2016.

Moreover, in view of the new DSM regulation and its amendments, which are more stringent, there is a need to get streaming online instantaneous MW data at a user configurable rate (minimum 1 min) at SLDCs via IEMDCs. The Technical/basic performance of the meter (as envisaged in the CEA metering regulations/standards) should not get affected at any cost because of this streaming online instantaneous MW data functionality. This instantaneous MW data is only for the purpose of taking actions/decisions in real time for grid monitoring & discipline.

II. PROJECT SCOPE

…….. region comprises of the states of ……., ……., ……., ……., and …….. As on ……. there are …… Special energy meters (SEMs) installed at various interface points in the Inter State Transmission System (ISTS). The existing

distribution of energy meters in …… Region (State wise) is as below:

State	No. of SEMs installed

Table II-1 Distribution of Energy Meters in ……..

The present project envisages to replace the existing fleet of IEM (15 min, ABT meters) in the Inter State Transmission System (ISTS) in the …… region with Interface Energy Meters (5 min, IEM). The project also envisages to put in place a system of Main & Back-up Central Data Collection System (CDCS) for Automated Meter Reading (AMR)/Meter Data Processing (MDP) along with the associated hardware for meter data collection, validation and processing at Interface Energy Meter Data Centre (IEMDC)/ Regional Load Dispatch Centre (RLDC) before forwarding the meter data to RPC Secretariat for regional energy accounting. The Back-up IEMDC center to be established to take care of disaster management. A conceptual architecture of IEMDCs is shown in Fig.1

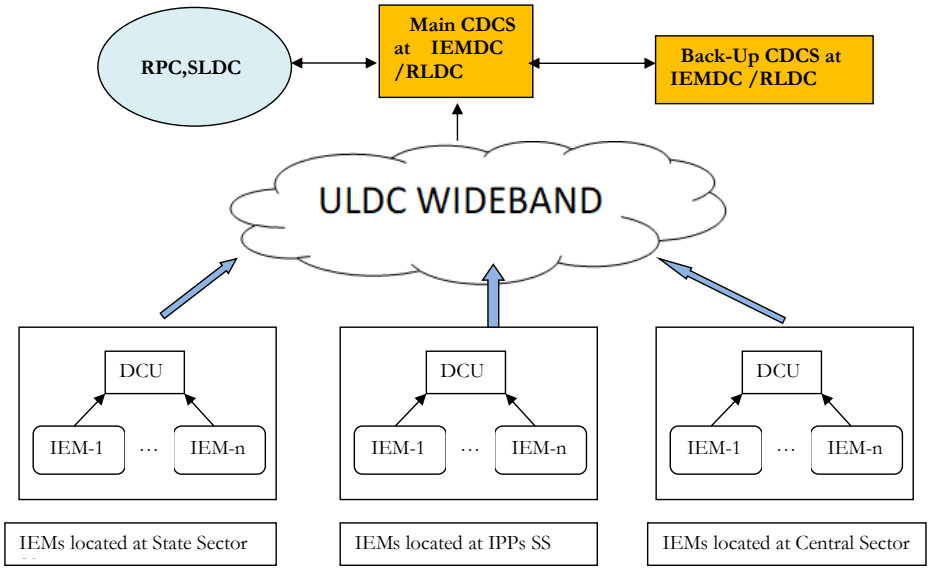


Fig.1

The main and back-up CDCS are to be provided with applications for fetching data from all IEMs via Data Collection Units (DCU), processing, validating meter data using Meter Data Processing (MDP) software, archiving data in appropriate storage, sharing data with

RLDC/RPC through secure web API. The DCU shall communicate with MDP System through CDCS at main and back-up IEMDCs/RLDCs as per the user defined schedule. The servers shall generate all the reports as configured as per defined time schedules and generate defined alarms for operators.

The successful bidders shall be responsible for site survey, planning, designing, engineering, testing, supply, transportation & insurance, delivery at site, storage, installation & commissioning, integration and training of IEM & CDCS system alongwith all hardware and software at respective locations

This project envisages delivering an end to end solution for energy metering at the interstate level. It shall involve capital as well as O&M expenditure by the successful bidder. During the warranty and O&M phase, the bidder shall provide web based system for complaint registration, support and maintenance along with one full time equivalent (FTE) competent resident engineer at IEMDCs/RLDCs to diagnose and address any software related issues in AMR/MDP/reporting system. The O&M/AMC charges payable to the successful bidder shall be calculated based on the CDCS system availability.

The technical specifications are broadly in two parts.

Part-1 - The first part of the specifications covers Interface Energy Meter (IEM) and Data Concentrator Unit (DCU) along with suitable switches for connection in between. The DCU shall be compatible to communicate with CDCS System at main and back-up IEMDCs/RLDCs as per the user defined schedule.

Part-2 -The second part covers CDCS system comprising all associated hardware & software for AMR-MDP system..

The execution of the project shall be planned in such a manner that there is no interruption in the prevailing regional energy accounting system. The IEMs shall record data at user configured time block of 5 minute/15 minute. This data shall be collected and archived atIEMDCs/RLDCs. However the settlement period for data processing and energy accounting shall be defined by the RLDCas per the prevailing CERC regulations. For instance, if the user chooses the settlement period to be 15 min, then the archived data of 5 min interval shall be converted to 15 min interval so as to be compatible with the existing software for meter data processing and energy accounting at RLDC and RPC. The format of the 5-min/15-min processed data reports shall be exactly same as that of the existing 15-min processed data reports in text files for compatibility at RPC end.

The installation of the IEM at the interface points shall involve shutdown of transmission elements. This shall be coordinated through the existing outage coordination procedure approved by the Regional OCC forum. Employer/RLDC shall coordinate the shutdown as per the OCC approved list subject to real time grid conditions.

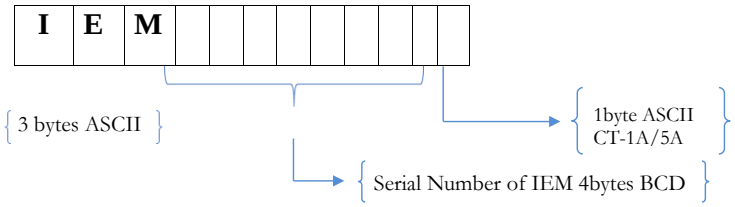
PART-I

III. INTERFACE ENERGY METERS

1. Basic Features of Interface Energy Meters

a. The energy metering system specified herein shall be used for tariff metering for bulk, inter-utility power flows, in different States of India. Projection mounted type, Static composite AC 3-ph 4 wire meter shall be installed at interface points as a self-contained device for measurement of Voltage (V), Frequency (f), Active (Wh) and Reactive (VArh) energy exchanged in each successive user defined (5 min/15 min) time block. Meter time block shall be re-configurable at site for change of time block as specified by the Central Commission. All meters shall be compliant to IS 15959 and its amendments.

b. Each meter shall have a unique identification code, which shall be marked permanently on its front, as well as in its memory. All meters supplied to as per this specification shall have their identification code starting with "IEM", which shall not be used for any other supplies. "IEM" shall be followed by an eight digit running serial number, further followed by a "A" and "B" for the use with CT secondary of 1A and 5A respectively. This shall be mutually agreed between the buyer and the vendor.



c. The meters shall be suitable for communication with external device like modem, DCU, etc. which shall be able to communicate with CDCS for remote data transfer.

d. Auxiliary Supply to IEM- The meters shall normally operate with the power drawn from the VT secondary circuit (line-to line voltage of 110V); provided that there shall be provision to operate the meters from AC and DC (Range 110V to 220V DC) auxiliary power supply. ~~The meters shall normally operate with the power drawn from DC auxiliary power supply (Range 110V to 220V DC)to reduce the Voltage Transformer (VT) burden. In addition, there shall be provision to operate the meter from the Voltage Transformer (VT) secondary circuit having a rated secondary line-to- line voltage of 110V.~~ Necessary isolation and/or suppression shall also be built-in as per IS 14697 and its amendments, for protecting the meters from surges and voltage spikes from extra high voltage switchyards. The reference frequency shall be 50Hz. Also, the meter shall have suitable of **±15%** tolerance for DC supply.

e. **Variation in CT/PT** The meters shall safely withstand the usual fluctuations arising during faults etc. In particular, VT secondary voltages 115% of Vref applied continuously and 190% of Vref for 3.0 seconds, and CT secondary current 150% of Iref applied continuously and 30 times of Iref applied for 0.5 seconds shall not cause any damage to or maloperation of the meters.

f. The meters shall continue to function for the remaining healthy phase(s), in case one or two phases of VT supply fails. In case of a complete VT supply failure, the computation of average values shall be calculated and recorded along with the time only for the period during which the VT supply was available in configured time block. However, the integrated parameters (active/reactive energy) shall not be affected and recorded as actuals

g. The total burden imposed by a meter for measurement and operation shall be defined as per IS 14697 and its amendments. An automatic backup for continued operation of the meter's calendar- clock, and for retaining all data stored in its memory, shall be provided through a long- life battery, which shall be capable of supplying the required power for at least 2 years. The meters shall be supplied duly fitted with the batteries, which shall not require to be changed for at least 10 years, as long as total VT supply interruption does not exceed two years.

h. The meters shall fully comply with all stipulations in IS 14697 and its amendments except those specifically modified by this specification. The reference ambient temperature shall be 27° C.

i. Each meter shall be provided with optical test output device (visual), as per IS 14697 and its amendments for checking the accuracy of active energy (Wh) measurement. The preferred pulsing rate is twenty (20) per Wh for CT sec-1A and four (4) per Wh for CT sec –5A.

j. **Exception Management**- The three line-to-neutral voltage shall be continuously monitored and in case any of these falls below defined threshold (80% of Vref), meter shall have suitable indication on LED/ LCD. The meter shall also have provision for low voltage event logging in meter memory in case of any phase voltage going below a defined threshold. The time blocks in which such a voltage failure occurs/persists shall also be recorded in the meter's memory with a symbol"*" if 3 Phase RMS voltage applied to the IEM is in between 25% to 80% of Vref and if Voltage is less than 25% of Vref, meter should record Zero voltage symbol "Z".

k. **Time Accuracy** - Each meter shall have a built-in calendar and clock, having an accuracy of 10 seconds per month or better. The calendar and clock shall be correctly set at the manufacturer's works. The date (year-month-day) and time (hour-min.-sec.) shall be displayed on the meter front on demand. Meter shall have the intelligence to synchronize the time locally from station control room or remotely from CDCS through software. All clock corrections shall be registered in the meter's memory-and suitably shown in the meter data report.

l. A touch key or push button shall be provided on the meter front for switching on the display and for changing from one indication to the next

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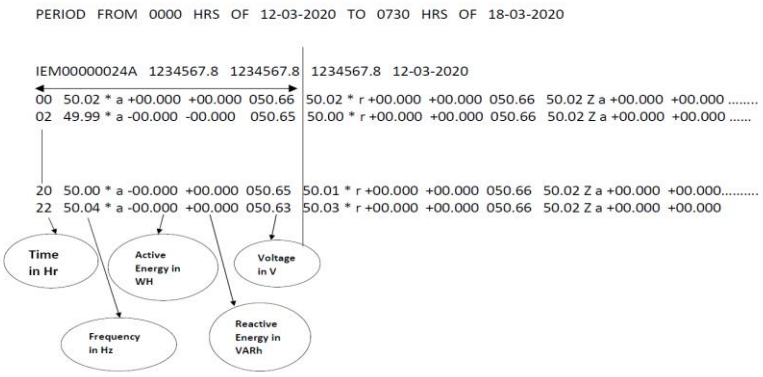

Fig 2 – Standard raw data format for IEM

There are 4 values in one 5 min time block. The first row shall contain the meter data for 2 hours, i.e. 24 time blocks, 00 hrs to 02:00 hrs. Similarly the 2nd row shall contain the data for the next 2 hours and henceforth.

m. Accuracy of IEMs under transients, frequency variations, voltage variations, unbalance, harmonics. Electromechanical influence and reverse phase rotation etc. shall be maintained as per IEC 62053-22 and its amendments.

n. Constructional Features

(i) The meters shall be supplied with compact and sturdy, metallic or moulded cases of non-rusting construction and/or finish. The cases shall be designed for simple mounting on a plane, vertical surface such as a control/relay panel front. Terminals shall have a suitable construction with barriers and cover, to provide a secure and safe connection of CTs and VTs leads through stranded copper conductors of 2.5 sq. mm. size.

(ii) All meters of the same model shall be totally identical in all respects except for their unique identification codes. They shall also be properly sealed and tamper evident, with no possibility of any adjustment at site as per IS 15959 (and its amendments) & CEA (Installation and Operation of meters) Regulations 2006 (and its amendments).

(iii) The meters shall safely withstand, without any damage or mal operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. in accordance with IS-14697(-and its amendments) & CEA (Installation and Operation of meters) Regulations 2006 (and its amendments).-

(iv) They shall have at least IP51 category dust tight construction, and shall be capable of satisfactory operation in an indoor, non-air conditioned installation & outdoor installation in a panel

(v) The meters shall have built-in facility (e.g. test links in their terminals) for in-site testing-

(vi) The meter shall be immune to external influences like magnetic induction, vibration, electrostatic discharge, switching transients, surge voltages, oblique suspension and harmonics and necessary tests shall be carried out in accordance with relevant standard.

o. **Data Security**: Data security shall be as per

i. IS 15959 (three layers of security) and its amendments,

ii. Cyber Security guidelines issued by the Central Government, time to time &

iii. The technical standards for communication system in Power Sector laid down by the Authority.

2. Measurement

a. The active energy (Wh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy as per class **0.2S** (IS 14697).

b. The meter shall compute the instantaneous active power (W) sent out from the substation busbars in each successive 1 min block, and store it in its memory up to two decimal place.

c. The meter shall compute the net active energy (Wh) sent out from the substation bus bars during each successive time block, and store it in its memory up to two decimal place. Further Wh data in .NPC/output report shall be rounded upto two decimal.

d. The meter shall count the number of cycles in VT output during each successive time block, and divide the same by time (in sec)to arrive at the average frequency. The least count of the frequency data shall be 0.01 Hz. The frequency data shall be stored in the meter's memory in Hertz up to two decimal. Further Wh data in .NPC/output report shall be rounded upto two decimal.

e. The meter shall continuously compute the average of the RMS values of the three line- to-neutral VT secondary voltages as a percentage of 63.51 V, and display the same on demand. The accuracy of the voltage measurement/computation shall be at least 0.5%,. The voltage data shall be stored in the meter's memory in volts up to second decimal. Further Wh data in .NPC/output report shall be rounded upto two decimal.

f. The Reactive energy (VARh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy of 0.5S as specified in IS 14697 and its amendments. The meter shall compute the net Reactive energy (Net VARh=(VARh Export- VARh Import)) sent out from the substation bus bars during each successive time block, and store it in its memory up to second decimal. It shall also display on demand the net VARh sent out during the previous time block. Further Wh data in .NPC/output report shall be rounded up to second decimal.

g. The meter shall also integrate the reactive energy (VARh) algebraically into two separate registers, one for the period for which the average RMS voltage is above 103.0%, and the other for the period for which the average RMS voltage is below 97.0%. The current reactive power (VAR), and cumulative reactive energy (VARh) readings of the two registers (>103% and <97%) shall be displayed on demand. The readings of the two registers at each midnight shall also be stored in the meter's memory. When reactive power is being sent out from substation bus bars,

VAR display shall have a plus sign or no sign and VARh registers shall move forward. When reactive power flow is in the reverse direction, VAR display shall have negative sign and VARh registers shall move backwards. Generally, the standard PT ratios are 132 kV/110 V, 220 kV /110 V, 400 kV /110 V and 765 kV / 110 V. However, at the time of commissioning the vendor may confirm the same from site (authorized sign) and configure the meter accordingly to ensure correct recording of reactive energy.

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h. For reactive power (VAR) and reactive energy (VARh) measurements, IS14697 shall be complied with. The accuracy of measurement of reactive energy shall be as per the standard.

i. Further, the meter shall continuously integrate and display on demand the net cumulative active energy sent out from the substation bus bars up to that time. The cumulative net Wh reading at each midnight shall be stored in the meter's memory. The register shall move backwards when active power flows back to substation bus bars.

j. Errors for different power factors shall be as defined in IS14697 and its amendments.

k. The harmonics shall be filtered out while measuring Wh, V and VARh, and only fundamental frequency quantities shall be measured/computed.

3. Memory/ Storage

a. Each meter shall have a non-volatile memory in which the following shall be automatically stored:

i. 1 min Instantaneous Active Power in MW up to second decimals.

ii. Average frequency for each successive time block, in Hertz up to second decimals.

iii. Net Wh transmittal during each successive time block, up to second decimal, with plus sign for active power sent out from station busbars and minus sign for active power received into the busbars.

iv. Net VARh transmittal during each successive time block, up to second decimal with plus sign for reactive power sent out from station busbars and minus sign for reactive power received into the busbars.

v. Cumulative Wh transmittal at each midnight, in eight digits including one decimal.

vi. Cumulative VARh transmittal for voltage high condition, at each midnight in eight digits including one decimal.

vii. Cumulative VARh transmittal for voltage low condition, at each midnight, in eight digits including one decimal.

viii. Average RMS voltage for each successive time block.

ix. Date and time blocks of failure of VT supply on any phase, as a star (*)/ (Z) mark.

b. The meters shall store all the above listed data in their memories for a period of minimum fifteen (15) days.

4. Display

Each meter shall have digital display for indication of the following (one at a time), on demand:

i) Meter serial no.: IEM12345678A or IEM12345678B

ii) Date (year month day /yyyy mm dd) : 20160311 d

iii) Time (hour min sec /hh mm ss) : 195527 t

iv) Cumulative Wh reading : 1234567.8 C

v) Average frequency of the previous block : 49.89 F

vi) Net Wh transmittal during the previous block with +/- sign: - 28.75 E

vii) Net VARh transmittal during the previous block with +/- sign : - 18.75 R

viii) Average % Voltage : 99.2 U

ix) Reactive power (VAR) : 106.5 r

x) Voltage - high VARh register reading : 1234567.5 H

xi) Voltage - low VARh registerl reading : 1234567.4 L

xii) Low battery indication

xiii) The three line-to-neutral voltages shall be continuously monitored and in case any of these falls below 80 %, then preferably, the corresponding flashing LED provided on meter's front shall become steady. They all shall go off if all three voltages fall below 80 %. The LED shall automatically resume flashing when all VT secondary voltages are healthy again.

xiv) The two VARh registers (x and xi) shall remain stay-put while VT supply is unhealthy.

Navigation keys to be provided at the meter front plate to navigate the display menu.

5. Communication Port

a. All the meters shall have at least three ports. . One of these ports shall be compatible for Ethernet traffic through which all the data stored in the meter's memory shall be transferred to DCU. The data between Meter and DCU is exchanged using Ethernet standard frame structures defined in IS15959.

The second port shall be front Optical port suitable for admin access / meter configuration/ local data downloading. The admin port is password protected for access and the meter configuration is to be done through admin port using Laptop and optical to USB convertor. Optical to USB convertor cable of suitable length to be supplied at every location. (Third port shall be Rs485 as spare and shall be used for meter data access in case of any eventuality. One number RS485 to USB convertor cable of suitable length to be supplied at every location.

b. The galvanic isolation of these ports is such that no external electrical induction on cable degrades the performance of the meter. Meter data shall be tamper-proof.

c. Data collection on any local laptop/PC shall be possible by installing data collection software. It shall be ensured that data transfer through Optical to USB interface shall be unidirectional only i.e. from Meter to external storage device in an authentication process.

6. Quality Assurance

All equipment, after final assembly and before dispatch from manufacturer's works, shall be duly tested to verify that is suitable for supply to the Owner. Type, Routine & Factory Acceptance Tests (FAT) shall be carried out on the meters in line with relevant standards.

i. Type Test-

b. The meters shall be subjected to the complete range of type tests as per IS14697 and IS15959 and their -amendments and other applicable standards, after final assembly. At least three samples shall be offered to employer for choosing any one meter for Type Testing. In case of any failure to pass all specified tests, the bidder shall arrange to carry out the requisite modifications/replacements in the entire lot of meters at his own cost. After any such modifications and final assembly, again three samples shall be offered to employer and two (2) meters selected out of the lot by the Owner's representative shall be subjected to the full range of type tests. The lot shall be accepted by the Owner only after successful type testing.

c. The type tested meters shall not be supplied/installed. The Bidder shall arrange all type testing specified above, and bear all expenses for the same.

d. Type Tests shall be certified or performed by reputed laboratories using data sheets and test procedures that have been approved by the Employer. Type test conducted once shall be valid for 5 years for the same model. Copy of Test certificate shall be submitted to Employer/OWNER

ii. Routine Test-

All Routine Test shall be carried out as per IS 14697 and its amendments.

iii. **FAT-**

During the FAT IEMs after final assembly and before dispatch from Bidder's/Manufacturer's works shall be duly tested to verify that they are suitable for downloading data using meter communication ports shall be subjected to the following acceptance test.

i) Downloading Meter Data from the Meter(s) to PC via admin Optical port.

ii) Downloading meter data to DCU through Ethernet port. IEMs along with convertor, Optical Switch, DCU shall be integrated with the PC for demonstration.

iii) Downloading Meter Data from the Meter(s) to PC via RS 485 port.

iv) Functioning of Time synchronization.

e. A procedure/schedule for the above demonstrations shall be submitted to the employer for approval. Copy of Test certificate shall be submitted to Employer/OWNER

iii. SAT-

Integration of DCU to CDCS shall be demonstrated at site incoordination with IEMDC/RLDC. Employer shall ensure FO connectivity upto IEMDC/RLDC.

7. Installation and Commissioning

The static energy meters specified above shall be installed at various EHV substations owned by the Owner, ISTS licensee, Inter State Generating Stations, DISCOMs and other agencies, throughout India. The tentative list of substations along with the existing number of meters is enclosed as Annex-I. The exact location for installation shall be provided in consultation with site in-charge.. In case of replacement of old meters during the transition, the new meters will be connected in series of the existing meter subject to space availability..

a. The Bidder shall be responsible for total installation and commissioning of the meters (along with test blocks, if supplied separately) as per Owner's advice, including unpacking and inspection on receipt at site, mounting the meters on existing control and relay panels at suggested height, connection of CT and VT circuits including any required rewiring, functional testing, commissioning and handing over. The Bidder's personnel shall procure/carry the necessary tools, equipment, materials and consumables (including insulated wires, lugs, ferrules, hardware etc.)

b. As part of commissioning of DCUs the Bidder shall load the required software in the Laptop/PC at the respective substations, and fully commission the total meter reading

scheme.

c. Operating manual (.pdf as well as hard copy) of the meter containing all details of the meter, various data downloading features, etc. shall be made available at site.

d. Following technical information shall be furnished by the Bidders in their offers:

   i) Foreseen dimensions of proposed meter.

   ii) Expected weight of proposed meter.

   iii) Dimensions and weight of the test block, if supplied separately.

e. Every meter installed shall be time synchronized through SNTP server from IEMDCs/RLDC.

8. Training

Hands on training program for personnel at Generating Stations/Transmission substation shall cover the following:

- Features of IEM, DCU, Communication Interface.
- IS/IEC protocols.
- Extension of Auxiliary Supply, CT/PT connection.
- Time synchronization through station GPS, Time correction through software.
- Data downloading from IEM.
- Data uploading through web interface.
- Installation of software in local PC/Laptop.

System Diagnostics Minimum duration of training program is Two Hours.

9. General

a. The IEMs shall be supplied with version of firmware.

b. The meter shall be supplied with software (compatible with old & new meters data download handling).

c. Software for windows/office/antivirus to be supplied for DCUs at substation.. Antivirus should not slow down processes and same will be demonstrated during technical demonstration.

d. .

e. Meter shall be accommodated in existing C&R panel in door closed condition. If required before bidding, bidder may collect necessary data by visiting the site..

f. Step by Step procedure (on screen shot type and desktop video capture) shall be provided for

   i. Installation/Re-installation of Database handling software in to Laptop / PC

   ii. Meter maintenance/site-testing procedure as per relevant IS/IEC standard.

   iii. Procedure for data downloading from Meter by Laptop/Desktop PC.

10. .Dismantling / Buy-Back of Existing IEM

Bidder is responsible for dismantling of old special energy meters and to purchase on buy back basis on successful installation of new IEMs in case of replacement of old meters.

IV. DATA CONCENTRATOR UNIT (DCU) & OPTICAL SWITCH

1. Basic Features of DCU

A Data Concentrator Unit (DCU) installed at each location will act as interface between IEMs and Central Data Collection System (CDCS) at IEMDCs/RLDCs. DCU shall collect data from energy meters (upto 35 IEMs/DCU) and send the same to CDCS at IEMDCs/RLDCs. DCU shall also report diagnostic information of the energy meters to CDCS.

a. Acquiring energy and status data from energy meters

DCUs shall be connected with local energy meters through Ethernet to Optical convertors & Optical Switches in between. Connection to the local energy meters shall be firm and secure from any unintended disconnection. DCU should implement IEM protocols.

b. Providing Energy Data and Status to CDCS

DCU shall accept following commands from CDCS/GPS Clock and shall function as per the command:

- **Energy data collection from energy meters**- . DCUs shall query meter data and transfer the same to CDCS based on the command received from CDCS. Command may be for one time demand of data or it may be on cyclic basis. CDCS takes the updated Database from these DCUs and create suitable Database in its memory. DCU shall be able to query data from all or selected energy meters for the selected period based on the command from CDCS. DCUs shall be able to read meter data from all make of energy meters supplied as per this Technical Specification.

  Each meter has a unique identification number and each meter location has unique identification code. DCU shall collect data from a single or group of meters based on meter number or meter location code. DCUs shall collect data from IEMs and transfer the same to CDCS. As DCU functions on read and forward philosophy for IEM data, no storage is envisaged in the DCUs for meter data.

- **Acquiring status and alarm from energy meters**- DCUs shall acquire connected IEM details like meter identification number, make etc. periodically as well as whenever it's powered on. Any meter change activity like meter number etc. shall be reported to CDCS immediately.

  DCUs shall be self-monitoring for alarm like power failure, communication disconnection,

and disconnection from energy meters and report the same to CDCS immediately.

DCUs shall have non-volatile memory for storing status data of IEMs duly time stamped, details of connected meters like make, meter number, status change. Non-volatile memory should be able to store such data for at least one month in round FIFO buffer.

- **IEM clock synchronization with GPS clock-** DCU shall have the intelligence to synchronize the IEM clock time. Input signal to DCU shall be from CDCS (at IEMDC/RLDC) GPS clock. If CDCS clock synch signal is not available to DCU, DCU will get GPS clock reference from station GPS. DCU shall function as SNTP servers to the IEMs and SNTP clients to CDCS SNTP servers.

c. **Providing Energy Data to Local PC/Laptop-**DCU shall provide meter status, alarm etc. and data to local personal computer, if required. Local PC shall be able to query meter data from selected or all IEMs by using basic meter downloading software. All communication with local computer shall be password protected. PC for data downloading at each DCU location shall be arranged by respective site/ utility.

d. **Displays**- Each DCU shall be provided with indicative LEDs for monitoring of- Power supply status, health of DCU, LAN ports for link/activity.

e. The DCU shall be powered from the station battery supply rated at 220V/110V DC supply.

f. DCUs shall accept only digitally signed files for Firmware updates, Package updates, License updates.

g. Only root user shall have rights to modify/delete DCU logs.

h. The data exchange is controlled as per the IS 15959 :2011 standard and its amendments.

i. **Constructional Features**

- DCU shall be a self-contained, stand-alone, tamper proof sealed box with necessary ports for external connection.
- DCU shall not have any removable parts such as a hard disk, to ensure smooth and reliable operation for long term.
- All external connections to DCU should be secure so as to avoid accidental disconnection.
- DCU shall be able to operate in environment with temperature up to 50ºC and humidity up to 90% without any significant effect on its performance.
- The mechanical design and construction of each unit sub-assembly shall be inherently robust and rigid under various conditions of operation, adjustment, replacement, storage and transport.
- DCUs shall also withstand, without any damage or mal-operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. They shall have at least IP-51 category dust-tight construction and shall be capable of satisfactory operation in an indoor, non-air conditioned installation.

j. **Communication Ports**

- 6 Ethernet ports for data communication.
- DCU shall be capable of sending data simultaneously through two discrete ports to Main and Back-up CDCSs through separate physical FO channels.
- DCUs shall be provided with a RS-485 as Spare

Annexure - A

Technical Specification for Interface Energy Meters, Automated Meter Reading System and Meter Data Processing for Inter State Transmission System

ABBREVIATIONS

S.No	Acronym	Definition
1	AMR	Automated Meter Reading
2	ATP	Acceptance Test Plan
3	CDCS	Central Data Collection System
4	CMRI	Common Meter Reading Instrument
5	C&R	Control & Relay
6	CTU	Central Transmission Utility
7	DCD	Data Collection Device
8	DCU	Data Concentrator Unit
9	DSM	Deviation Settlement Mechanism
10	EA	Energy Accounting
11	EHV	Extra High Voltage
12	FAT	Factory Acceptance Test
13	FTE	Full Time Equivalent
14	GPRS	General Packet Radio Service
15	GSM	Global System of Mobile
16	HHU	Hand Held Unit
17	IEC	International Electro-technical Commission
18	IEEE	Institute of Electrical and Electronics Engineers
19	IEM	Interface Energy Meter
20	IP	Ingress Protection
21	IS	Indian Standard
22	ISTS	Inter State Transmission System
23	LAN	Local Area Network
24	MDP	Meter Data Processing
25	NMS	Network Management System
26	OEM	Original Equipment Manufacturer
27	PCB	Printed Circuit Board
28	RDBMS	Relational Database Management System
29	RMS	Root Mean Square
30	SAT	Site Acceptance Test
31	SEM	Special Energy Meter
32	SRS	Software Requirements Specification
33	TOC	Taking Over Certificate
34	VPN	Virtual Private Network
35	WAN	Wide Area Network
36	RLDC	Regional Load Despatch Centre
37	RPC	Regional Power Committee
38	IEMDC	Interface Energy Meter Data Centre

Part-II

I. CENTRAL DATA COLLECTION SYSTEM (CDCS)

1. Intent of CDCS

The intent of CDCS proposed in this document is collection of meter data at a user configurable rate including 1 minute instantaneous MW data from each meter/location to IEMDCs/RLDC followed by validation, processing and generation of customized reports.

The data shall be stored in Standard RDBMS and archived in Historian at CDCS. Finally the processed data shall be integrated to RLDC Energy Accounting software for Deviation Settlement calculation .

2. Basic of Central Data Collection System

CDCS are heart of the system. In this project two CDCS are envisaged one main and other back-up, located at different locations. A Central Data Collecting System provided at IEMDC/RLDC will manage all functionalities of collection of data through DCUs, validation and verification of the data, storage of the data in ORACLE/ Standard RDBMS such as SQL/ORACLE database and management of the complete AMR system.

CDCS at IEMDC/RLDC shall have a scheduler for scheduling the task of collection of data periodically as per the selected time block interval. It has server class machines networked along with Historian. Main IEMDC and Back-up IEMDC shall communicate with each other in ICCP protocol. Both are always engaged in health monitoring of each other. In case main IEMDC fails, failover process brings the backup in less than 1 minute. Firewall must be proposed at all vulnerable points.

Architecture for ISTS Metering with AMR-CDCS system is attached as Appendix-A

The Bidder shall provide the necessary software which would enable CDCS to

i) Have polling feature along with a task scheduler to run the data downloading software at a pre-designated date and time repeatedly or by manually selecting a meter. A detailed activity log shall also be available for each downloading operation.

ii) Fetch the meter data from all metering points and process the same in its server in user defined formats (text, csv, xls, etc.) in a user-defined file name (file name format must be dd-mm-yy substation name-utility name).

iii) Fetch 1 min instantaneous Active Power (MW) data from all connected IEMs

iv) There should be provision to select multiple meter data files based on filename, and convert all selected files with single key-stroke and store the text files in the same location where binary files are stored.

v) Display the collected data on PC's screen in text format, with forward/backward rolling.

vi) Print out in text format the data collected from one or more meters, starting from a certain date and time, as per operator's instructions.

vii) Providing access to RLDC for Energy Accounting software to download all meter related data from CDCS system in standard formats such as .csv, xlsx, text etc. through authenticated login on Web Portal. The CDCS system should provide standard API features (preferably RESTful APIs such JSON etc) to enable data exchange between IEMDC/RLDC and existing Energy Accounting software at RLDCs.

viii) Access to SLDCs to provide user based access to view instantaneous MW data through WEB portal.

The above software shall further ensure that absolutely no tampering (except erasing of complete data with password protection) of the collected metering data is possible during its handling by the PC.

The software shall be suitable for the commonly available PCs, (Windows) and shall be supplied to Employer in a compatible form to enable its easy loading into the PCs available (or to be installed by the Employer) at the various substations.

3. Scope of Work

Commented [HSK{क1]: To be shifted under Project Scope

This section provides detailed scope of work included in the bidder's scope, and facilities to be provided by station owner/employer.

2.1 Bidder's Scope of Work

The scope of work in complete conformity with subsequent sections of the specification shall include site survey, planning, design, engineering, manufacturing/integration, testing, supply, transportation & insurance, delivery at site, storage, installation, commissioning, demonstration for acceptance, training and documentation of AMR-MDP system including:

a. Design Document for complete AMR -MDP System including software specifications.
b. All hardware including application Servers, Database and RDBMS etc at IEMDCs/RLDC.
c. Making data available up to CDCS system at IEMDCs/RLDC.
d. Standard database (RDBMS) for storage of data at IEMDCs/RLDC.
e. All cabling, wiring, terminations and interconnections of the equipment.
f. Database development, Displays and Reports.
g. Archival and retrieval of data through Standard RDBMS such as SQL/ORACLE database at IEMDC/RLDC
h. Interconnection of main CDCS with Back-up CDCS on ICCP
i. The complete system shall be in line with established cyber security standards.
j. Training of personnel (Substation, SLDC, CTU, RLDC and RPC)

2.2 Exclusions from Bidder's Scope of Work

Followings are not included in the scope of the bidder and shall be provided by local station without any extra cost to bidder:-

a. Space for installation of IEMs, Optical Switches, DCU, CDCS at respective locations

b. Auxiliary Power Supply for IEMs, Optical Switches, DCU at each location and server system at CDCS.

c. Provision of static IP (to be provided by POSOCO) and internet connection at IEMDCs/RLDC

d. Building, air conditioning systems and other infrastructures.

e. PC required for data downloading at each location.

f. Facility shall be provided for the RLDCs/NLDC to be able to receive raw data from the IEMDC using Secure File Transfer Protocol (SFTP-SSH protocol) also

g. Integration of CDCS data into Existing Energy Audit software by POSOCO

Any other work which is not identified in 2.1 & 2.2 or in the specification but is required for completion of the project within the intent of this specification shall also be in the scope of the Bidder without any extra cost.

4. General Requirements

3.1 CDCS

- System shall support entry / addition of data manually by an authenticated RLDC user.
- Uploading meter data files manually to the AMR system by an authenticated user shall also be supported.
- Data collection system shall use multi-tier, Purdue Enterprise Reference Architecture having separate tier for DMZ,database, application server and client.
- The Application shall be secured with password-protected access. It shall support multiuser access with role-based security. Access control and account management system shall be deployed to look after account and access control in systems, application and services deployed in AMR-CDCS-MDP systems. Centralized user authentication (e.g. LDAP) and authorization server shall be deployed. All users shall use a unique ID to access AMR systems and applications. Passwords shall be set in accordance with the Password Policy. System and application sessions must automatically lock after 15 minutes of inactivity.

Minimum configuration of servers may be :-

Server : (Minimum Requirement)

- 2 X Intel Xeon E5-2667 v4 3.2 GHz,25M Cache,9.6GT/s QPI,8C/16T (135W) Max Mem 2400MHz Cache 8MB.
- 128GB RDIMM,2400MT/s
- 1TB hot pluggable, RAID 5 for Server Internal HDD
- Remote Management- Shall be able to manage through dedicated 1G remote management port with Remote Access Controller with KVM redirection. Any licenses required for KVM redirection should be included with support for 5 years.
- DVD+/-RW SATA Internal
- Power Supply and Fans-Dual, Hot-plug, Redundant Power Supply(1+1). Redundant hot swap fans.
- USB 3.0 ports-4 nos.(minimum)
- Supported OS as per the requirements and latest technology
- Form Factor -1U Rack with rack mounting kit
- Management Software - Server management software with power management features and 5 years support should be included
- NIC Port - 4 X 1Gbps NIC card
- Office 2019 Business (64 bit) or latest.
- Operation System: latest
- 23" Wide TFT Monitor
- Makes: HP/DELL/Lenovo /equivalent
- CPU should be latest model fully compatible with the application.

Client PC Specification:(Minimum Requirement)

- Processor – 1 x Intel i5 -7300U (3M cache, 2 Cores, 4 Threads 2.60 GHz) CPU
- Memory- 1 x 16GB Dual Rank x8 DDR4-2666 SODIMM (expandable up to 32 GB)
- Hard Drive - Configured with 1 x 1TB SATA 6G Read Intensive M.2 Drive
- Graphics: Intel Integrated Graphics or Higher
- Ports- One SD Card slot,1 GbE management Port, 2 1GbE port,2 USB 2.0 port, 2 USB 3.0 and 1 HDMI Port
- Integrated sound controller; Gigabit Ethernet controller; DVD writer dual layer ; 104 Keys OEM Keyboard and OEM Optical Mouse; all necessary Plug-ins/utilities and driver software, bundled in CD/DVD Media
- 4 USB Port
- 23 " TFT Monitor
- Windows 10 Professional or latest, MS office 2019 or latest

External & Internal Firewall :(Minimum Requirement)

All firewalls shall be hardware box firewall and shall be complied with the operational requirements of the project. The firewalls shall meet the following requirements:

- The Firewall proposed family should attain Common Criteria EAL4+

- Firewall shall belong to product family which minimally attains Internet Computer Security Association (ICSA) firewall Product Criteria 4.1 Certification
- The proposed system shall comply/support industry standards, supports without additional external solution, hardware or modules: IPSEC VPN, PPTP VPN, L2TP VPN, and SSL VPN
- Firewall should support profile base login account administration, offering gradual access control such as only to Policy Configuration & Log Data Access
- The system shall be able to provide outbound Wan link load-balancing capabilities
- Shall support assigning of zones to virtual and physical interfaces and assigning of firewall policies between zones, physical interfaces and virtual interfaces
- Port Forwarding
- IEC 61850-3 compliance or better
- NERC-CIP Compliance
- IP20 rating

1. Routing requirements in FW:

- Sufficient number (considering future requirements as envisaged in the project) of Ethernet interfaces 100Mbps/1Gbps routable ports.
- Hot standby operation with a similar router and fail-over to backup router on wan link failure, Pre-empt mode.
- IEEE 802.3u: Auto-negotiation
- IEEE 802.3x, 802.1p: flow control and prioritization,
- IEEE 802.1Q: VLANs tagging, maximum 255 VLANs,
- IEEE 8021.1d, 802.1w: Spanning Tree
- IEEE 802.3ad-Link Aggregation
- Firewall should have integrated quality of service (802.1p) and Traffic Shaping functionality including these features:
- capable of enable and disable traffic shaping per firewall policy
- capable of setting guarantee bandwidth per firewall policy
- capable of setting maximum bandwidth allocated per firewall policy
- capable of setting minimally 3 levels of prioritization
- ability to pass Differentiated Service tagging
- Shall support simultaneous operation with both IPv4 and IPv6 traffic
- Dynamic IP Routing - OSPF, OSPF with authentication (MD5), RIP v2, & BGP
- Shall support unicast as well as multicast IP Routing (IGMP)
- OSPF Route filtering
- The system shall be able to operate as a Protocol Independent Multicast (PIM) version 2 routers.
- Shall support NAT (Network Address Translation) including dynamic and static NAT translations.

2. Management & monitoring Features

- Firewall appliance should be 1U/2U size and rack mountable and have redundant power supply arrangements
- LEDs for indication of Port activity as well as presentation of major alarms
- Shall have System Management interface using Web UI (https) and Command Line Interface (console/telnet/SSH).
- SNMPv3 for monitoring from Network Management system, The device shall log events send SNMP traps, send alert email when fail-over occurs
- Diagnostics with logging and alarms
- SNTP/NTP based clock synchronization
- Different privileges for different users. Administrator authentication to be facilitated by local database, PKI & remote services such as Radius, LDAP and TACACS+ with option of 2 factor authentication
- Memory for Storage of logs for at least 1 week
- Shall support events logging/monitoring features using syslog, email, and VPN Tunnel Monitor.
- Shall have definition updates for virus/signatures/engine upgrade/software patches for the complete AMC period.
- Shall operate in Active/Passive with State Synch and Active-Active complete UTM features with High Availability features like Load balancing, failover for Firewall and IPsec VPN. Any other operations mode, which does not result in loss of session (including IPsec VPN sessions), is also acceptable.
- Firewall should have integrated SSL VPN gateway functionality and should support 10000 concurrent SSL users
- Firewall should support 200000 New sessions per second
- Firewall should support 500000 Million concurrent sessions

3. Security Features in Firewall:

- Shall have provision to configure multiple IP Sec VPNs, at least 500 (?) nos., (one-to-many or many-to-one). Shall support redundant operation with a similar router after creation of all the IP Sec VPN.
- IPSec VPN (Virtual Private Networking) support ESP protocol with encryption 3DES (168 bits), AES 128-, 192-, 256- bit and hashing algorithm like MD5 , SHA-1, IKE, PKI (X.509) and IKEv2 with EAP.
- Firewall should have at least 1 (?) Gbps of IPSEC VPN throughput and 500 (?) Mbps of SSL VPN throughput.
- Stateful packet inspection with NAT and filter Protocols such as FTP, SMTP, HTTP, HTTPS, SNMP, UDP, ICMP, RPC, DNS, DHCP, ARP, TCP, POP3, XML, and content filter for JAVA & ActiveX blocking.
- IP firewall features – address filtering, port inspection & filtering. Shall filter packets (both incoming and outgoing) based on Source address, Destination address, Protocol type, User, Port number, URL, applications, etc.
- Shall have to provision to define application control list based on selectable application group and/or list and its corresponding actions

- The solution should be able to enable or disable Web Filtering per firewall policy or based on firewall authenticated user groups for both HTTP and HTTPS traffic
- Shall have Denial of service (DoS) & Distributed Denial of Service (DDoS) prevention. DOS and DDOS protection should be applied and attacks stopped before firewall policy look-ups, AV scan.
- Shall have network IPS as an integral part or have tight integration with the Network Intrusion Prevention System (NIPS)
- IPS solution should have capability to protect against Denial of Service (DOS) and DDOS attacks.
- Enable/disable ports, MAC based port security. VLAN (802.1Q) to segregate and secure network traffic, VLAN - port based support.
- Firewall rules should be applicable to normal traffic and IPsec VPN traffic.
- IPS and application control–support for industrial provision and offline signature/patch update. Firewall IPS throughput of at least 1(?) Gbps
- Shall support IPv6 features like DoS attack detection, SIP, RTSP, RPC, RIPng, BGP4, DHCPv6 Relay, IPv4 to IPv6 translations & encapsulations, etc.
- SNMPv3 encrypted authentication and access security
- Shall have protection against Antivirus, anti-worm, anti-spam and anti-spyware as applicable.
- The system should be able to block, allow or monitor only using AV signatures and file blocking based on per firewall policy based or based on firewall authenticated user groups with configurable selection.
- Firewall antivirus throughput of at least 1 Gbps (Flow Based)
- Shall have provision for Zone based IP Spoofing
- Shall have protection against malformed packet
- Shall have DNS attack prevention features
- Shall have Brute force attack mitigation
- Shall support DLP capability. It shall be configured by creating individual rules for the following protocol & activities such as AIM, ICQ, MSN, Yahoo!, HTTP/HTTPS POST, HTTP/HTTPS GET FTP PUT, GET, SMTP, IMAP, POP3, SMTPS, IMAPS, POP3S, and NNTP.
- Shall have deep packet inspection capability and it shall have the ability to intercept and inspect content of SSL encrypted traffic

LAN Switch :(Minimum Requirement)

- ISO8802 or IEEE 802 Series Standards
- LAN switch shall be a rack-mountable with 1U form factor.
- The switch should have hot-swappable and field-replaceable internal redundant power supply and fan from day one.
- Layer-3 switching & VLAN
- Minimum 8- 1 Gbps Ethernet ports (However, the no. of ports in a LAN switch shall be as per the network architecture. Vendor has to provide required no. of switch as per

the requirement of technical specification)

- The switch should have 1x USB Console Port, 1x OOB management port, and 1x serial console port.
- Flash Memory- 128 MB or more and DRAM 512MB or more.
- Cat 6 or higher bandwidth cable
- The switch should support hardware-based ACL with support for VLAN, Port, MAC, and IP based ACLs.
- The switch should support SNMPv1, SNMPv2c, and SNMPv3.
- The Switch should be manageable through SSHv2, SSL, and/or SNMPv3 etc.
- All Functionalities of Switch shall be IPv6 compliant and it should work on IPv6 Platform without any additional hardware/software.

GPS based time facility :(Minimum Requirement)

- Minimum 2ppm time stability of internal time base
- Feature of Propagation delay compensation .
- Feature includes an offset to permit correction to local time
- Feature of reverting to internal time base upon loss of signal from UTC source
- Resynchronization delay should not be more than 5 minutes
- Accuracy of synchronization must be less than 1.5 micro Sec
- Minimum port details: 2 no Ethernet ports, 2 IGIG-B port

SAN Storage :(Minimum Requirement)

- Minimum 10 TB capacity. Min 50% expandable including slots with storage enclosure.
- 1 number spare HDD
- RAID level-5
- 16 Gbps FC interface port
- Snapshot features with license
- Hard Drives speed-10000

The above-mentioned hardware specification is minimum requirement, if the vendor ABT application requires higher configuration than vendor has to quote for the same. After supply of material during commissioning or during observation period if any server hardware/software up gradation required than it shall be in vendor scope. The contractor shall ensure that at the time of final approval all the hardware must be as per latest technology and industry standard.

5. Functional Requirements

4.1 Central Data Collection System (CDCS)

A central data collection system (CDCS) shall be provided at IEMDCs for collection and processing of data from DCUs installed at remote locations. The software provided at IEMDCs will manage all functionalities of collection of data through DCUs, validate the data, store the data in a database, and manage the complete system. Software will also have a scheduler for scheduling the task of collection of data periodically. The periodicity of data collection shall be user defined.

CDCS shall perform following functions:-

- Communication with DCUs.
- Collection of energy data from DCUs.
- Collection of status/alarm data form DCUs
- Remote Configuration of DCUs
- Time synchronization of DCUs/IEMs
- Processing of meter data.
- Storing of data.
- Providing data to energy accounting software.
- Reporting functions.
- Monitoring and Alarm generation.
- Audit trail and logging.
- Meter management.
- Shall have user Interface for
- CDCS shall include a web based application for utilities/stations to manually upload the data in case of AMR communication system failure due to any reasons. The following shall be taken care of in this regard:

  - The web application link shall be made accessible to all stations through RLDC website.
  - The downloaded data shall be in encrypted format.
  - Each utility shall be given User name and Password for login the web application.

  - Browser shall have the list of all Utilities and its station names.
  - Each station shall upload the encrypted data by selecting their Utility name and Station name.
  - Web Application shall generate the confirmation message to the station on successful uploading of data.
  - Web application shall generate the popup message at CDCS with Utility name and Station name on receipt of data.
  - All the encrypted data received at CDCS via web application shall be stored in predefined path.
  - CDCS shall have the provision to decrypt the data and store in the database for the further processing.

4.1.1 Processing of energy data

Collected energy meter data shall be provided to the data processing module. The time block period of the raw output from CDCS shall be used defined (5-min/15-min). This module shall check the data for completeness, error etc. and if any error is found, the same shall be displayed as an alarm.

4.1.2 Storing of data

If collected data is error free, it shall be provided to a data storage module. Data storage module shall load the collected energy data in to the database as per its structure. Archival of data shall be through Standard RDBMS such as SQL/ORACLE data base.

4.1.3 Providing data to energy accounting software

CDCS should have software module for providing energy meter data from the database to the energy accounting software. The data output shall be in the form of text file (as per RLDC standard text file format) or as query based output.

4.1.4 Reporting

CDCS shall have data reporting capability implemented through a separate dedicated module. Reporting module should be able to give report output on screen, in pdf or in XLS/csv form.

4.1.5 Monitoring and Alarm

CDCS shall generate an alarm whenever "data not received" occurs for one or more times for one or more DCU/IEM data. The alarm shall indicate which DCU/IEM has the problem.

All Alarms (such as loss of supply to IEM, DCU failure, Communication failure, AMR failure etc.) to be generated in CDCS within 5 min. of the event.

4.1.6 Performance levels for AMR and CDCS

Data from all the installed IEMs shall be received at CDCS within 8 hours after the scheduled hour. Report for missing data if any shall be generated instantly on demand.

Issues observed in data collection, processing, report generation etc. shall be flagged by RLDC to the vendor for redressal in line with the Emergency Support Response/Resolution time as per table XI-4.

4.1.7 Audit trail and logging

CDCS should have audit and logging function for each and every activities either completed successfully or failed.

The system shall provide audit trail of user and system activities that enables data changes to be tracked and reported, including changes made by the system administrator.

For editing of energy meter data, the system shall record the following information in a log and store it for a minimum of 12 months:

- User ID
- Date and Time of Change

User shall be prompted to input a reason for editing using either a standard reason code or a freeform text field. In addition to data stored in the edit log, each interval containing edited data shall be marked with a status to indicate that the data has been edited. The pre-edited value shall be stored in the database as a previous version, which can be retrieved using "as- off" date functionality.

Changes to configuration data by users shall be logged by date, time, and user ID and such logs shall be stored for a minimum of 12 months.

Critical changes relating to measuring parameters (pulse multipliers, transformer ratios, etc.) and formulae change shall be stored indefinitely as a previous version. The database for these is to be maintained in CDCS.

For regular system tasks, such as meter communication, task processing, validation, etc. the information will be kept for minimum one month.

It should have provision of full data and system audit ability such as version controls and data retrieval according to the date and time. Additionally, all versions of meter data shall be stored such that they may be retrieved by "as-off" date for user to inspect.

6. System Sizing and Performance Requirements

AMR System shall meet the following system sizing and performance requirements. The system sizing and performance requirements are specified for main subsystem. Back-up/Standby subsystem shall have the same sizing and performance requirements. The Acceptance of the product shall be based on the Employer/RLDC approved test protocols/ schedules to be submitted in advance by the successful Bidder ahead of factory/site inspection.

5.1 System Sizing

The system sizing for CDCS System is only specified for initial sizing. The delivered system shall be expandable as the input and output requirements grow. Vendor is required to demonstrate their system's expandability in FAT(Factory Acceptance Test).

5.1.1 CDCS

CDCS shall meet following sizing requirements:

5.1.1.1 Population of Energy Meters

CDCS shall be capable to receive data from a minimum 500 DCUs, which is collecting up to 35 energy meters connected per DCU, at the minimum data collection interval. However, CDCS shall have provision to collect and handle data from up to 1000 DCUs and up to 5000 energy meters without any significant degradation of performance. The Server size shall be enough to accommodate additional meters in future .

5.1.1.2 Data Storage-

After processing and validation, the meter data is archived every week in respective IEMDC/RLDC .For metering entity, the four weeks data should be available in respective RLDC/ SLDC website. The archived data is maintained at IEMDC/RLDC for last five years in their historical database, beyond the above mentioned time frame automatically last data shall be removed from database in FIFO mode. For instantaneous MW data, the 4 weeks data should be available to view by respective SLDCs.

5.1.1.3 Clients

CDCS shall be capable of supporting minimum 100 clients for providing collected data. Each client output shall be individually configurable by users.

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5.1.2 DCU

The number of meters at site may vary. Bidder shall decide the DCU requirement accordingly with sufficient future expansion capability. The detailed list of meters installed at substations as on date ……. is attached in Annex-1.

5.2 Data Handling Performance Requirements

CDCS shall meet the following performance requirements for data collection and data processing.

5.2.1 Performance requirements for CDCS

CDCS shall receive process and archive the complete data from all DCUs within specified time as guaranteed by the vendor excluding the waiting time for data arrival. This performance requirement shall be met under the maximum number of input DCUs and maximum number of SEMs with the maximum number of data points as specified for the delivered as-build or expanded system.

5.3 System Availability Requirements

After commissioning of the project, service level agreement shall come into effect. Bidder shall quote the monthly charges for 5 years which shall be based on the availability calculations in line with the scope defined in the Technical Specification.

AMR system and its subsystems and system components shall meet the following availability requirements.

The CDCS shall have a measured availability of 99.9% or better during the availability test. The CDCS software shall be considered available when all of the functions described in this

specification are operating as specified at their scheduled periodicity and within the execution time parameters and at the same time all hardware is available as specified.

The CDCS shall continue to operate without interruption under any single point of failure condition. That is, there shall be no hardware or software element whose failure renders the CDCS unavailable. This requirement shall specifically include all hardware, the interconnections among hardware, power supplies, and enclosures of the OP or PT subsystems.

II. METER DATA PROCESSING AND REPORTING

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This section describes the envisaged system architecture of Meter Data Processing (MDP) and Reporting in Host Region.

Intent of MDP and Reporting

The intent is to provide the requirement details of Standard RDBMS such as SQL/ORACLE Database oriented Meter Data Processing Software having compatibility to exchange and share data / information with similar Database systems that may be used by other RLDC / NLDC with a view to meet requirements of Data Warehousing and Business Intelligence systems etc. The Client Interface shall be Browser/console based and report formats shall be in user defined multiple formats like PDF, Standard Spreadsheet, CSV, Text file etc. The software is intended to meet the regional energy accounting requirements for the commercial mechanism adopted in respect of bulk power supplies and inter-State exchanges within and across a Region. The software shall also have a module for importing the interchange schedule of regional entities from an external system and computing the deviation by any regional entity from its interchange schedule. Further the software shall have a module to compute the deviation charges as per the prevailing DSM mechanism approved by CERC. This document describes the details of various functions like meter data - collection, formatting /conversion and facilities of existing software (which is to be replaced with the new proposed Standard RDBMS such as SQL/ORACLE database oriented software) and proposed solution for meter data processing.

1. General Requirements:

- The end-to-end metering system shall be supplied by the successful bidder and all meters' data shall be available at CDCS through AMR system. Database creation in MDP software shall be done by designing a suitable interface between MDP and CDCS at IEMDC.

- RLDC after receiving the meter data from different locations in encrypted form convert the same into readable format through suitable software.

IEMs Details (Master file) in MDP:

- MDP shall keep database (Meter No., Location ID, Utility Name, Station Name, Description, Meter Type, HV Voltage, LV Voltage, HV Current, LV Current etc.) of all IEMs used in accounting.
- One of the inputs required for computation of energy from raw data is a Master file containing details (CT/PT ratio, location, etc.) of all the available IEM's in the region.
- There shall be provision for updation of existing IEMs database and to add new IEMs to MDP database
- Whenever master file shall be modified, the old version of the master file shall be stored in database with date stamping. When computation of raw data for old dates is required, the S/W shall fetch the meter details (Meter ID, HV Voltage, LV

Voltage, HV Current, LV Current etc.), for the mentioned period, from the required version of the Master file.

- Meter associated with a particular location ID during particular period may need to have be associated with another location ID. MDP shall be able to handle this relocation.

- The MDP Master File format shall be as mentioned below.

Utility Name	Station Name	Location	Description	Element Type	Meter No	Local Meter	HV Voltage	LV Voltage	HV current	LV current
						ID	(kV)	(V)	(A)	(A)

Table V-1 - Master file format

- Activities to be carried out by the software can be broadly classified as follows:
  a. Uploading Meter Data in database
  b. Validation of Meter Data
  c. Computation of net injection, drawal and transmission loss
  d. Accounting
  e. Reporting

  After receipt of energy meter data from all metering locations, RLDCs are responsible for meter data processing, validation and computation.

a. Uploading Meter data in Database:

The process shall be through 'Database Interface Menu driven'. The Menu shall enable creation, uploading, validation, processing, modification, computation and retrieval of Meter data from Database.

File Upload Menu: The user shall be asked to enter / select from a calendar the "Start Date" and the "End Date" for the period for which the Meter data file shall be uploaded to the system. On entry the user shall be able to upload the file by browsing the computer or directly from database.

On successful upload, same shall be mentioned on the screen along with "Error Description" if any.

Data Availability Menu The availability of all data (i.e. data received /not received/partially received) w.r.t. individual meters can be checked through this menu. The user is required to select the dates (start date / end date) pertaining to the period concerned and select the location code against which the availability of data is required to be checked. The Menu shall also display a description of the location in brief.

On selection of the appropriate location(s), the status of availability shall be mentioned and in case of availability, the date-wise availability of data w.r.t. the concerned meter(s), for the subject location(s), shall be displayed under each location through an expandable drop down menu. The time-block-wise details regarding Frequency, WH data, Raw Data, Date of Receipt etc. shall also be displayed as shown below:

	Location	**Location Description.**	**Date**	**Availability**		
⊞	AB-01	ABC END OF XYZ-1 FDR	DD/MM/YYYY	YES / NO		
	In case of YES:					
	Time	**Meter**	**Frequency**	**WH Data**	**Raw Data****	**Received On**
	00:00	NP-0001-A	50.01	14.66	50.01 + 14.66	DD/MM/YYYY
	00:05	NP-0001-A	49.99	13.92	49.99 + 13.92	DD/MM/YYYY

	23:55	NP-0001-A	49	13.65	49 + 13.65	DD/MM/YYYY

** Raw Data is the combination of the frequency (Hz) and WH data.

Table V-2 - Data Availability Report

Further, the data regarding availability/ partial availability shall also be downloadable in consolidated format in a text file format (file extension as per IEEE standard/.txt) exportable to ISO/IEC 26300:2006/Amd 1:2012 or ISO/IEC-29500:2012 compatible Spreadsheet format. For partial availability of data for particular time blocks only, the same shall also be displayed/ reported.

All Checks Menu: Through the All Checks Menu the User shall be able to check the existence of any problems related to the various measurable parameters recorded by the meters viz. Voltage, Time Correction, Frequency, Watt Hr, any Algebraic sum problems etc. The user shall be able to select the start date and the end date, station type (Generator/ Inter Regional/ State/ Transmission Utility) and Location(s) for which the information is required. The same shall also be downloadable as "Details File" & "Summary File". The various checks to be performed along with sample format of reports are defined as follows:

1. **Voltage Check**: If during any time block, voltage in any of the phases fall below 80% of rated voltage, this would be flagged and reported.

Location	Date	Time	Meter	Problem	WH Data	Raw Data
NG-13	03/03/2018	00:30	NP-6889-A	Voltage Supply Failure	-4.54	50 * -04.54
NG-13	03/03/2018	02:30	NP-6889-A	Voltage Supply Failure	-3.37	48 * -03.37
NG-13	03/03/2018	05:15	NP-6889-A	Voltage Supply Failure	-3.15	49 * -03.15
NG-13	03/03/2018	07:15	NP-6889-A	Voltage Supply Failure	-11.71	50 * -11.71

Table V-3 – Voltage Check Report

(ii) **Time Correction Check**: In case of time drift in the meter, time correction command can be provided through DCU; which would be logged and stamped in meter data file. This check would list out such time correction commands.

Location	Date	Time	Meter	Problem	WH Data	Raw Data
AG-01	01/03/2018	13:45	NP-9081-A	Time Correction Retard	6.16	49 rr+06.16
AG-01	01/03/2018	14:00	NP-9081-A	Time Correction Retard	6.32	46 rr+06.32
AG-01	01/03/2018	14:15	NP-9081-A	Time Correction Retard	6.26	40 rr+06.26
AG-01	01/03/2018	14:30	NP-9081-A	Time Correction Retard	6.19	45 rr+06.19

Table V-4 – Time Correction Check Report

(iii) **Frequency Check**: A meter is defined in Meter database as Master frequency meter and frequency as recorded by Master frequency meter is used for all computations. This check lists all meters with frequency difference of more than a set tolerance value with reference to Master Frequency Meter. User shall be allowed to select the Master Frequency Meter from a list of defined Master Frequency Meters.

Location	Date	Time	Meter	Frequency	Master Frequency	Variance
ZZ-07	01/01/2018	00:00	NP-5285-A	51	48	3
ZZ-07	01/01/2018	00:15	NP-5285-A	47	50	3
ZZ-07	01/01/2018	00:45	NP-5285-A	51	47	4
ZZ-07	01/01/2018	01:00	NP-5285-A	48	50	2
ZZ-07	01/01/2018	01:45	NP-5285-A	51	55	4

Table V-5 – Frequency Check Report

(iv) **Watt Hr. Check**: This check is used to lists out any 'zero value' Wh reading (i.e. if the flow is '0') or any Wh reading which is greater than 2 digit (99.99) value i.e. beyond permitted range in any time block; and it is reported as 'no flow' and 'invalid reading' respectively. If there is a no flow condition, it is to be checked for non-availability or open/ floating condition of line/ ICT/ Generator or any other reason.

Location	Date	Time	Meter	Problem	WH Data	Raw Data
AG-01	05/02/2018	00:00	NP-9081-A	No Flow	0	00 * +00.00
AG-01	05/02/2018	00:15	NP-9081-A	No Flow	0	00 * +00.00
AG-01	05/02/2018	00:30	NP-9081-A	No Flow	0	00 * +00.00
AG-01	05/02/2018	00:45	NP-9081-A	No Flow	0	00 * +00.00
AG-01	05/02/2018	01:00	NP-9081-A	No Flow	0	00 * +00.00

Table V-6 – Frequency Check Report

(v) **Algebraic Problem:** In a meter, sum of Wh readings of all time blocks in a day should be equal to the Wh reading of whole day (difference between cumulative reading of 0000 Hrs and 2345 Hrs). This check flags if there is any discrepancy in this algebraic sum during the period.

ocation	Date	Problem	Cumulative Diff.	Algebraic Sum	Error
AX-02	01/01/2018	Algebraic sum	1,196.050000	1,196.100000	-0.050000
AX-03	01/01/2018	Algebraic sum	979.600000	979.560000	0.040000
AX-04	01/01/2018	Algebraic sum	1,346.900000	1,346.890000	0.010000
AX-05	01/01/2018	Algebraic sum	1,331.600000	1,331.580000	0.020000

Table V-7 – Algebraic Problem Report

View Menu: The View Menu shall enable the users to view and download all data pertaining to the following:

i. (M)WH Data

ii. (M)WH Daily Data

i. **(M)WH Data**: The following details shall be displayed on selection of start date, end date and location(s) / utility / station etc., for the selected locations for all available time blocks:

Time	Meter	CTR	PTR	WH Data	MWH Data*	Received On
00:00	NP-0001-A	800	1200	6.77	6.4992	DD/MM/YYYY
00:05	NP-0001-A	800	1200	7.08	6.7968	DD/MM/YYYY

23:55	NP-0001-A	800	1200	7.04	6.7584	DD/MM/YYYY

**MWH = WH x CTR X PTR*

Table V-8 – Algebraic Problem Report

The detailed files shall also be downloadable in pre-approved formats as shown in **Annexure-B**.

ii. **(M)WH Daily Data**: This option shall enable the user to view & download the details regarding daily total energy flow for all the selected locations for the selected period, for all the dates. The following shall be displayed and shall be downloadable in pre-approved format as shown in **Annexure-C.**

Location	Location Desc	Date	Total Energy
XY-01	ABC END OF XYZ-1 FDR	DD/MM/YYYY	532.7904
XY-02	ABC END OF XYZ-2 FDR	DD/MM/YYYY	399.4368
XY-03	ABC END OF XYZ-3 FDR	DD/MM/YYYY	399.4368

Table V-9 – (M)WH Daily Data

- The Computation (Multiplication of raw data with CT/PT Ratios to arrive at actual values) of meter data in MDP shall be done automatically after activating the import option for data fetching from CDCS.

b. Validation of Meter Data:

Real and Virtual/Fictitous Meters can be classified into three types viz., Main Meters, Check Meters and Standby Meters. For accuracy of Energy Accounting it is essential to carry out validation of meter data. Validation of Main Meters (both real and virtual meters) is done by pair checking of Main Meter readings with that of Check and Standby Meters (real and virtual/fictitous meters) data for every block. The pairs shall be configurable as per change of network configuration under Configuration Menu as mentioned in subsequent paragraphs.

Provision of "High Correlation Comparison" facility shall also be made available.

Validation Menu: The validation menu shall have two options:

A.Pair Check: The mismatch (difference) between the readings of the real or virtual meters of identified pairs is checked and listed as shown below:
The pair check menu shall display a list showing the following:
(i) meter pairs: Meter IDs for End-1 and End-2,
(ii) Station Names for End-1 & End-2,
(iii) pair relation (M – C, M – S, C – S),
(iv) the mismatch tolerance limit in MWH (the limit is set as
0.5/1/1.5 MWH for 132/220/400kV voltage level respectively),
(v) Name of Feeder/ Element Details
(vi) And there shall also be an option to "include Meter Replace Value Tolerance %"; which can be entered by the user; and which shall overrule the set tolerance limits and display the readings against those meters only and for those time blocks for which the value is beyond this user-specified limit.
(vii) Option to select the time period (i.e. Start & End dates)
The following list shall be displayed and upon selection of the required pair(s), the time block wise details and total mismatch for each day for the selected period will be displayed and can be downloaded.

End-1 Station Name	End-2 Station Name	MAIN Meter No./ ID	CHECK/ ST.BY Meter No./ ID	Pair Relation	MWH limit X	MWH limit Y	Element Name
ABC	XYZ	AG-01	TR-01	M - S	0.5	0.5	400KV ABC - XYZ-1
ABC	XYZ	AG-02	TR-02	M - S	0.5	0.5	400KV ABC - XYZ-2
ABC	PQR	AM-01	AM-02	M - S	1.5	1.5	400KV ABC - PQR-1
ABC	PQR	AM-03	ME-14	M - S	1.5	1.5	400KV ABC - PQR-2

Table V-10 – Validation (Pair-check) Report-1

detailed meter reading mismatch values shall be displayed for the whole day and for those blocks for which the value exceeds the tolerance limits:

Date	End-1	End-2	End-1 MWH	End-2 MWH	Diff MWH	% Diff.
05/03/2018	AM-19	AS-45	3371.7090	-3437.5272	-65.8181	1.95
		Time	**End-1 MWH**	**End-2 MWH**	**Difference**	**% Diff.**
		00:00	31.2727	-38.3272	-7.0545	22.56
		00:05	30.2545	-33.9636	-3.7090	12.26
06/03/2018	AM-19	AS-45	2822.6909	-2846.0727	-23.3818	0.83
		Time	**End-1 MWH**	**End-2 MWH**	**Difference**	**% Diff.**
		01:30	25.7454	-22.4727	3.2727	12.71
		01:45	30.4727	-23.6727	6.8000	22.32
		17:00	38.1090	-29.7090	8.4000	22.04

Table V-11 – Validation (Pair-check) Report-2

The results of the above pair checking shall be downloadable in .xlsx file formats; samples of which are given under **Annexures-D (I) & D (II).**

For calculation of MWH & percentage differences, the following shall be the consideration:
1.The polarity of Main & Check shall be same and that of Main & Standby meters shall be opposite.
2.For working out the percentage differences, the reference energy value shall be the Main Meter energy data.
Further, there shall be a provision for Graphical representation of Pair Checks in Excel as per samples shown below:

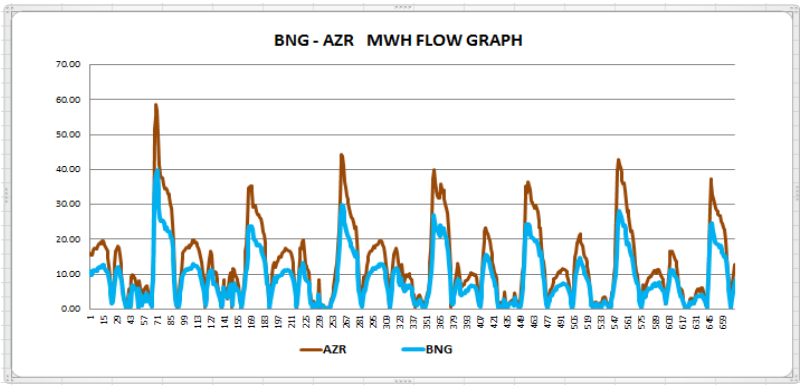


Fig:1 BNG-AZR MWH graph

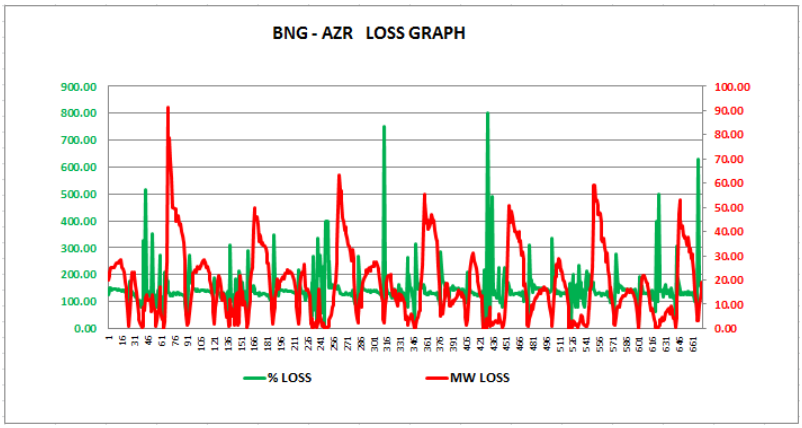


Fig:2 BNG-AZR loss graph

Further, the software shall provide other facilities like loss analysis trends and measurements of other statistical parameters like standard deviations etc. wherever possible.

B.Net Bus Check: In any bus bar of substation or generating station, total energy incoming in any time block should be equal to total outgoing energy. This is checked in all identified buses and the result is listed. Mismatch beyond tolerance is flagged.

The net bus check menu shall display a list of "Net Bus Virtual Meters" and there shall also be an option for applying a Tolerance % limit. On selection of the desired meters and the range of dates for which the net bus checking is required to be carried out, the MDP software shall generate a list of the values for every time block for all the selected dates and the same shall be displayed as shown below. On entering the tolerance limit, only those time blocks for which the values of the net bus % mismatch is exceeding the set limit shall be displayed.

For example:

The Net Bus Virtual/Fictitious Meter for a generating station is the difference between the combinations of all the outgoing Main Meters at the outgoing feeders and the sum of the Standby Meters at HT of the Generator and the station transformer.

For calculating the % Mismatch, the difference is divided by that virtual meter value which is calculated out of the main meter readings.

NetBus tolerance value:				
Location	**Location Desc.**	**Station Name**	**NetBus***	**Date**
AG-91	NET BUS AT AGTPP	RC NAGAR (RCN)	-834.372600	01/12/2017
Time	**Formula**	**Expression**	**NetBus**	**% Mismatch**
00:00	+(AG-81) -(AG-71)	' +(9.0522) -(17.964)'	-8.911800	49.61%
00:05	+(AG-81) -(AG-71)	' +(8.5272) -(17.3664)'	-8.839200	50.90%
00:10	+(AG-81) -(AG-71)	' +(8.4768) -(17.064)'	-8.587200	50.32%

23:50	+(AG-81) -(AG-71)	' +(8.4168) -(16.9416)'	-8.524800	50.32%
23:55	+(AG-81) -(AG-71)	' +(8.3706) -(16.9272)'	-8.556600	50.55%

Table V-12 – Validation (Net Bus) Report

c. Computation of Injection/Drawal Of Utilities:

- The user shall have the option to convert any 15 min meter reading data into 5 min data and vice versa. For conversion of 15 min block length data into 5 min blocks, the MWH readings of each 15 min blocks shall be equally divided against three 5 min blocks, the total remaining same; and the frequency for each 5 min block being same as that of the 15 min block. Similarly, for conversion of 5 min reading to 15 min, the MWH value shall be the algebraic sum of three consecutive 5 min block readings and frequency shall be the average of the three 5 min readings.
- Energy data of IEMs shall be used for Computation of Injection/Drawal of utilities, which shall include application of algebraic functions on a set of predefined IEMs. Such injection/drawal of utilities may itself be treated as a fictitious meter data, which can be calculated through application of algebraic functions on real meter data.
- Addition and deletion of new utility shall be user defined. There shall also be provision to update the file with date stamp.
- There shall be two types of database for Fictitious IEMs. One for Fictitious ID details with description and other is for formulae set. All the data formats shall be user configurable.
- The format of Fictitious IEMs shall be as below:

FICTITIOUS ID	FICTITIOUS ID TYPE	DESCRIPTION
KO-901	Main	Korba Stage-1 Injection
KO-902	Check	Korba Stage-1 Injection
KO-902	Standby	Korba Stage-1 Injection
LK-901	Main	Lanco Stage-1 Injection
LK-902	Check	Lanco Stage-1 Injection
LK-902	Standby	Lanco Stage-1 Injection

Table V-13 Fictitious meter Description file format

FICTITIOUS ID	FICTITIOUS ID TYPE	FORMULA
KO-901	Main	(KO-01)+(KO-02)-(KO-03)*98/100
KO-902	Check	(KO-04)+(KO-05)-(KO-06)*98/100
KO-902	Standby	(KO-05)+(KO-06)+(KO-07)
LK-901	Main	(LK-01)+(LK-02)-(LK-03)
LK-902	Check	(LK-04)+(LK-05)-(LK-06)
LK-902	Standby	(LK-05)+(LK-06)+(LK-07)
IN-901	Main	(KO-901)+(LK-901)

Table V-14 Fictitious meter Formulae File Format

- Computation formula of a fictitious meter may involve other fictitious meters in its formula. Therefore, the software shall have the capability to compute the same. The fictitious meters used in the formula have to be computed first before they are used in other formulae.
- S/W shall have the capability to replace any meter used in fictitious formulae with its Check/Standby meter with application of transmission loss in case of non-

availability/discrepancy of main meter data. The replacement can be for a block/day/week. The percentage of loss to be applied shall be defined by user in configuration file base on the type and voltage rating. The configuration file format shall be as below.

Type of Element	Voltage Level KV	% of Loss to be applied
Line	765	1.5
Line	765	2
Line	220 and Below	4
ICT	-	0

Table V-15 – Loss configuration file

- All changes in fictitious meter in block wise shall be stored in database for future requirements.
- MDP shall be able to store the formula of Fictious meters with time stamp. During the computation of Fictious meter data, MDP shall fetch the formula as per the time stamp and compute the result.
- MDP shall be capable of fetching computed IEM data and fictitious meter data of required date and time block through query.
- MDP shall also store name associated with Location IDs with time stamp, to handle change in names after LILO of lines.
- If, while computing fictitious formula, any meter data is found missing/invalid, the same shall be shown in an error dialogue box with an option to bypass the same or not.
- MDP shall compute Injection/Drawal of Utilities while incorporating all the changes made in fictitious meter configuration files viz. replacement of main meters with Check/Standby meters due to non-availability/ discrepancy of main meter data.
- Report of all replacements and adjustments done shall be provided/available and downloadable.
- Meter associated with a particular location ID during particular period may need to have be associated with another location ID. MDP shall be able to handle this relocation.
- After uploading meter data into the database and validating the data, the user shall be able to carry out computation of the various parameters such as net injection, drawal and transmission loss etc.

  On clicking the "Compute" option, computation shall be carried out by the software and the following data shall be generated and stored in the database

  a)Virtual/Fictitious Meter Data
  b)Out MWH Data
  c)Out MVAR Data
  d)Loss Computation
  e)Pair check results.

After executing the above computations, the following information shall be viewable under the 'View Menu':

(i) Virtual/Fictitious Meter Data
(ii) Virtual/Fictitious Meter Daily Data
(iii) Reverse Flow Virtua/Fictitious Meter Data
(iv) Reverse Flow Virtual/fictitious Meter Data Summary

(i) **Virtual/Fictitious Meter MWH Data**: The user shall be required to select the date range and the Virtual meter(s) against which the MWH details are to be viewed. On selection, the following details shall be displayed showing the date-wise total MWH against each Virtual meter, expandable on the same screen to display the time-block-wise details (for the entire 96 or 288 blocks, as applicable), as shown below:

	Virtual Meter No.	Description	Station / State Name	MWH	Date	
⊟	AB-71	INJECTION BY ABC GEN. STN. (LINES)	ABC	---- (upto 2 decimal places)	01/01/2018	
Date	**Time**	**Formula$**	**Expression$**	**MWH**	**MW**	**Error$$**
01/01/2018	00:00	+(AB-01) +(AB-02) +(AB-03)	+(0) +(11.28) +(8.2224)	19.5024	78.0096	
	00:05	+(AB-01) +(AB-02) +(AB-03)	+(0) +(11.0304) +(8.2872)	19.3176	77.2704	
	--- *upto*					
	23:55	+(AB-01) +(AB-02) +(AB-03)	+(0) +(13.5648) +(6.7968)	20.3616	81.4464	

Table V-16– Virtual/Fictitious Meter MWH Data

$ *Formula refers to the various meters combining to form the Virtual* /Fictitious- *meter and Expression refers to the MWH flow for each meter.*

$$ *Error – an error message shall be displayed in case of non-availability of data of any of the meters, from the combination of meters, as per the formula; or any other problem with meter data.*

The above details shall be downloadable in .xlsx file format as shown in the sample placed at **Annexure-F (I).**

(ii) **Virtual/Fictitious Meter MWH Daily Data:** This menu shall enable the user to view and download (in .xlsx format) the overall total daily MWH energy flow for every Virtual meter for each day for the range to dates selected by the user and for the selected Virtual meter(s) as shown below:

Virtual/Fictitious Meter No.	Description	Station / State Name	Total MWH	Date
AG-71	INJECTION BY RC NAGAR (LINES)	RC NAGAR (RCN)	1526.9808	05/03/2018
AG-71	INJECTION BY RC NAGAR (LINES)	RC NAGAR (RCN)	1229.7696	06/03/2018
AG-91	NET BUS AT AGTPP	RC NAGAR (RCN)	-511.8900	05/03/2018
AG-91	NET BUS AT AGTPP	RC NAGAR (RCN)	-415.6944	06/03/2018
AS-51	TOTAL DRAWAL OF ASEB	ASSAM	18783.4893	05/03/2018
AS-51	TOTAL DRAWAL OF ASEB	ASSAM	17049.7198	06/03/2018

Table V-17 --Virtual Meter MWH Daily Data

The sample downloadable format is also attached in **Annexure–F (II)**.

(iii) **Reverse Flow Virtual/Fictitious Meter Daily Data**: The user shall be able to download and view the details regarding reverse flow (drawal by a generator and injection by a drawing entity is treated as reverse flow) of energy for the selected Virtual/Fictitious meter(s) for the selected days for all the time blocks for which reverse energy flow has occurred.

For the selected virtual/fictitious meter(s), the "formula" of meter combination and the "expression" showing the individual meter readings shall also be displayed. The following details shall be displayed and downloadable in .xlsx files for each selected meter as shown below (format placed at **Annexure-G (I)):**

Date	Time	Location	Station Name	Formula	Expression	MWH
DD/MM/YYYY	00:00	XY-71	XXYYZZ (XYZ)	+(XY-01) +(XY-02) -(XY-03) +(XY-04)	'+(0.6444) +(0.6444) -(-1.0584) +(-2.4156)'	-0.068400
01/01/2018	00:05	DY-71	DOYANG (DOY)	+(DY-01) +(DY-02) –(DY-03) +(DY-04)	'+(0.63) +(0.6408) -(-1.0332) +(-2.3616)'	-0.057600
01/01/2018	00:15	DY-71	DOYANG (DOY)	+(DY-01) +(DY-02) –(DY-03) +(DY-04)	'+(0.6624) +(0.6624) -(-1.0044) +(-2.394)'	-0.064800
01/01/2018	02:00	DY-71	DOYANG (DOY)	+(DY-01) +(DY-02) –(DY-03) +(DY-04)	'+(0.6948) +(0.702) -(-0.9792) +(-2.412)'	-0.036000

Table V-18 --Reverse Flow Virtual/Fictitious Meter MWH Data

(iv) **Reverse Flow Virtual/Fictitious Meter Data Summary**: The summary of the details regarding reverse flow of energy w.r.t. the selected meters for the selected days i.e. the total number of time blocks for which reverse flow has occurred and the total reverse flow MWh for the selected dates shall be viewable and downloadable as shown below (format at **Annexure-G(II)):**

Virtual/Fictitious Meter No.	Station Name	Date	Total Blocks	Energy MWh
XY-71	XXYYZZ (XYZ)	DD/MM/YYYY	73	-6.894000
DY-71	DOYANG (DOY)	01/01/2018	70	-5.130000
DY-71	DOYANG (DOY)	02/01/2018	68	-5.691600
DY-71	DOYANG (DOY)	03/01/2018	72	-6.048000
DY-71	DOYANG (DOY)	04/01/2018	73	-6.451200

Table V-19 Reverse Flow Virtual/Fictitious Meter MWH Data Summary

d. Accounting:

Account/accounting Menu: After computation. The account Menu enables a user to retrieve the energy accounting records of the IEM (both in 5 minutes and 15 minutes) pertaining to the following:

(i) MWH output
(ii) MVAR output
(iii) Load Curve
(iv) Lord Duration Curve
(v) Loss Computation

(i) MWH output: Through this option the user can compute the drawal / export by every entity, injection by the generators, MWH loss in the lines and Net Bus Check for Bus at the Substation End.

Time	Freq.	Line-1	Line-2	---Line-N	Total (MWH)
00:00	45	+0.401000	-0.471600	---	+154.436853
00:05	46	+0.390000	-0.612000	---	+151.328018

23:55	44	+0.382200	-0.748800		+139.487827
TOTAL		+38.732400	-34.53000		+16957.979817

The above details shall be downloadable in .xlsx / .txt file formats as shown in the examples below:

Examples:

(1) MWH Drawal Accounting for the State of A:

TIME	FREQ	PLP-JMB	SALK-BTPS-1	AZAR-SIL	AZAR-BONG	UMR-HAF	TOTAL
00:00	46	+0.009600	+16.560000	+29.600000	+6.545455	-1.262400	+149.682458
00:15	45	+0.004800	+16.080000	+30.181818	+5.527273	-0.912000	+147.842449
00:30	42	+0.004800	+15.936000	+29.963636	+5.163636	-0.864000	+145.915986
00:45	44	+0.009600	+15.712000	+30.545455	+4.654545	-0.835200	+145.025969
01:00	44	+0.004800	+16.192000	+31.927273	+7.200000	-0.763200	+150.995061
01:15	38	+0.004800	+16.016000	+32.436364	+6.618182	-0.648000	+151.223852
01:30	34	+0.009600	+15.856000	+33.090909	+6.254545	-0.604800	+150.108879
01:45	41	+0.004800	+15.776000	+33.090909	+5.818182	-0.528000	+149.109535
02:00	41	+0.004800	+14.896000	+34.472727	+2.400000	-0.556800	+145.824008
02:15	39	+0.004800	+14.928000	+34.690909	+2.400000	-0.662400	+147.439690
02:30	42	+0.004800	+14.768000	+34.763636	+1.890909	-0.710400	+146.381126
02:45	47	+0.000000	+14.528000	+34.981818	+1.454545	-0.696000	+144.886325
03:00	48	+0.004800	+14.448000	+34.909091	+1.672727	-0.672000	+144.281536
03:15	46	+0.000000	+14.224000	+35.418182	+1.309091	-0.643200	+143.612691
03:30	47	+0.000000	+14.144000	+35.272727	+1.309091	-0.628800	+143.322499
03:45	46	+0.000000	+14.176000	+35.418182	+1.600000	-0.619200	+144.351751
04:00	49	+0.000000	+14.224000	+35.490909	+1.672727	-0.648000	+144.721613
04:15	49	+0.000000	+14.464000	+35.054545	+2.254545	-0.633600	+145.459718
04:30	47	+0.000000	+14.800000	+34.763636	+2.909091	-0.681600	+147.319507
04:45	46	+0.000000	+15.248000	+34.836364	+3.709091	-0.628800	+149.426664
05:00	41	+0.000000	+15.584000	+34.254545	+4.800000	-0.571200	+154.337198
05:15	39	+0.000000	+16.352000	+33.454545	+6.909091	-0.696000	+158.811180
05:30	43	+0.000000	+17.040000	+32.145455	+9.527273	-0.811200	+163.910137
05:45	44	+0.000000	+18.688000	+29.236364	+14.545455	-0.955200	+172.501497
06:00	47	+0.000000	+20.576000	+26.545455	+19.272727	-1.224000	+183.756274
06:15	44	+0.000000	+21.952000	+26.400000	+22.327273	-1.488000	+195.608129

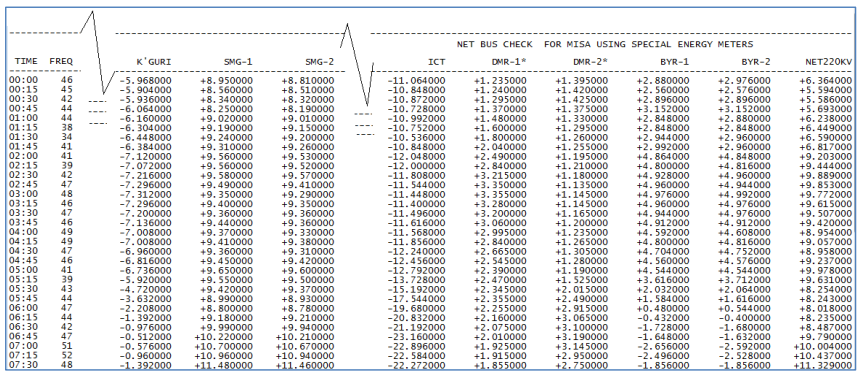
Table V-20: MWH drawal Accounting

(2) Net Bus Check for 'M' S/S (at 220kV bus):

		NET BUS CHECK FOR MISA USING SPECIAL ENERGY METERS								
TIME	FREQ	K'GURI	SMG-1	SMG-2	ICT	DMR-1*	DMR-2*	BYR-1	BYR-2	NET220KV
00:00	46	-5.968000	+8.950000	+8.810000	-11.064000	+1.235000	+1.395000	+2.880000	+2.976000	+6.364000
00:15	45	-5.904000	+8.560000	+8.510000	-10.848000	+1.240000	+1.420000	+2.560000	+2.576000	+5.594000
00:30	42	-5.936000	+8.340000	+8.320000	-10.872000	+1.295000	+1.425000	+2.896000	+2.896000	+5.586000
00:45	44	-6.064000	+8.250000	+8.190000	-10.728000	+1.370000	+1.375000	+3.152000	+3.152000	+5.693000
01:00	44	-6.160000	+9.020000	+9.010000	-10.992000	+1.480000	+1.330000	+2.848000	+2.880000	+6.238000
01:15	38	-6.304000	+9.190000	+9.150000	-10.752000	+1.600000	+1.295000	+2.848000	+2.848000	+6.449000
01:30	34	-6.448000	+9.240000	+9.200000	-10.536000	+1.800000	+1.260000	+2.944000	+2.960000	+6.590000
01:45	41	-6.384000	+9.310000	+9.260000	-10.848000	+2.040000	+1.255000	+2.992000	+2.960000	+6.817000
02:00	41	-7.120000	+9.560000	+9.530000	-12.048000	+2.490000	+1.195000	+4.864000	+4.848000	+9.203000
02:15	39	-7.072000	+9.560000	+9.520000	-12.000000	+2.840000	+1.210000	+4.800000	+4.816000	+9.444000
02:30	42	-7.216000	+9.580000	+9.570000	-11.808000	+3.215000	+1.180000	+4.928000	+4.960000	+9.889000
02:45	47	-7.296000	+9.490000	+9.410000	-11.544000	+3.350000	+1.135000	+4.960000	+4.944000	+9.853000
03:00	48	-7.312000	+9.350000	+9.290000	-11.448000	+3.355000	+1.145000	+4.976000	+4.992000	+9.772000
03:15	46	-7.296000	+9.400000	+9.350000	-11.400000	+3.280000	+1.145000	+4.960000	+4.976000	+9.615000
03:30	47	-7.200000	+9.360000	+9.360000	-11.496000	+3.200000	+1.165000	+4.944000	+4.976000	+9.507000
03:45	46	-7.136000	+9.440000	+9.360000	-11.616000	+3.060000	+1.200000	+4.912000	+4.912000	+9.420000
04:00	49	-7.008000	+9.370000	+9.330000	-11.568000	+2.995000	+1.235000	+4.592000	+4.608000	+8.954000
04:15	49	-7.008000	+9.410000	+9.380000	-11.856000	+2.840000	+1.265000	+4.800000	+4.816000	+9.057000
04:30	47	-6.960000	+9.360000	+9.310000	-12.240000	+2.665000	+1.305000	+4.704000	+4.752000	+8.958000
04:45	46	-6.816000	+9.450000	+9.420000	-12.456000	+2.545000	+1.280000	+4.560000	+4.576000	+9.237000
05:00	41	-6.736000	+9.650000	+9.600000	-12.792000	+2.390000	+1.190000	+4.544000	+4.544000	+9.978000
05:15	39	-5.920000	+9.550000	+9.500000	-13.728000	+2.470000	+1.525000	+3.616000	+3.712000	+9.631000
05:30	43	-4.720000	+9.420000	+9.370000	-15.192000	+2.345000	+2.015000	+2.032000	+2.064000	+8.254000
05:45	44	-3.632000	+8.990000	+8.930000	-17.544000	+2.355000	+2.490000	+1.584000	+1.616000	+8.243000
06:00	47	-2.208000	+8.800000	+8.780000	-19.680000	+2.255000	+2.915000	+0.480000	+0.544000	+8.018000
06:15	44	-1.392000	+9.180000	+9.210000	-20.832000	+2.160000	+3.065000	-0.432000	-0.400000	+8.235000
06:30	42	-0.976000	+9.990000	+9.940000	-21.192000	+2.075000	+3.100000	-1.728000	-1.680000	+8.487000
06:45	47	-0.512000	+10.220000	+10.210000	-23.160000	+2.010000	+3.190000	-1.648000	-1.632000	+9.790000
07:00	51	-0.576000	+10.700000	+10.670000	-22.896000	+1.925000	+3.145000	-2.656000	-2.592000	+10.004000
07:15	52	-0.960000	+10.960000	+10.940000	-22.584000	+1.915000	+2.950000	-2.496000	-2.528000	+10.437000
07:30	48	-1.392000	+11.480000	+11.460000	-22.272000	+1.855000	+2.750000	-1.856000	-1.856000	+11.329000

Table V-20: MWH drawal Accounting

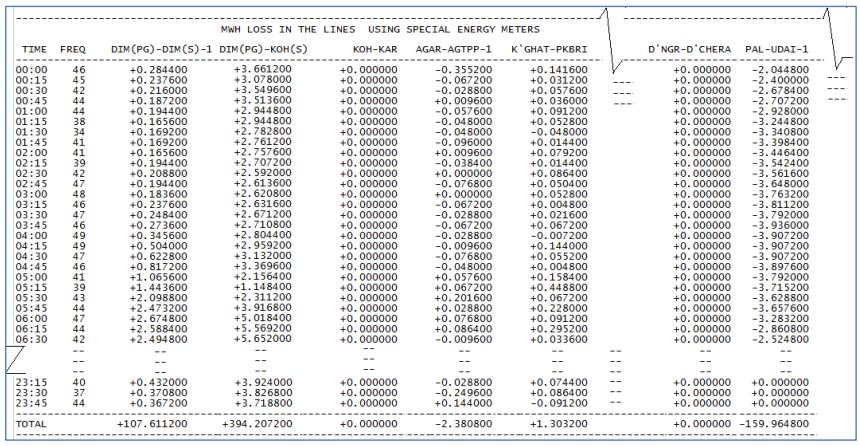
3: Net Bus Check for 'M' S/S (at 220kV bus):



NET BUS CHECK FOR MISA USING SPECIAL ENERGY METERS

TIME	FREQ		K'GURI	SMG-1	SMG-2		ICT	DMR-1*	DMR-2*	BYR-1	BYR-2	NET220KV
00:00	46		-5.968000	+8.950000	+8.810000		-11.064000	+1.235000	+1.395000	+2.880000	+2.976000	+6.364000
00:15	45		-5.904000	+8.560000	+8.510000		-10.848000	+1.240000	+1.420000	+2.560000	+2.576000	+5.594000
00:30	42	---	-5.936000	+8.340000	+8.320000		-10.872000	+1.295000	+1.425000	+2.896000	+2.896000	+5.586000
00:45	44	---	-6.064000	+8.250000	+8.190000	---	-10.728000	+1.370000	+1.375000	+3.152000	+3.152000	+5.693000
01:00	44	---	-6.160000	+9.020000	+9.010000	---	-10.992000	+1.480000	+1.330000	+2.848000	+2.880000	+6.238000
01:15	38		-6.304000	+9.190000	+9.150000	---	-10.752000	+1.600000	+1.295000	+2.848000	+2.848000	+6.449000
01:30	34		-6.448000	+9.240000	+9.200000	---	-10.536000	+1.800000	+1.260000	+2.944000	+2.960000	+6.590000
01:45	41		-6.384000	+9.310000	+9.260000		-10.848000	+2.040000	+1.255000	+2.992000	+2.960000	+6.817000
02:00	41		-7.120000	+9.560000	+9.530000		-12.048000	+2.490000	+1.195000	+4.864000	+4.848000	+9.203000
02:15	39		-7.072000	+9.560000	+9.520000		-12.000000	+2.840000	+1.210000	+4.800000	+4.816000	+9.444000
02:30	42		-7.216000	+9.580000	+9.570000		-11.808000	+3.215000	+1.180000	+4.928000	+4.960000	+9.889000
02:45	47		-7.296000	+9.490000	+9.410000		-11.544000	+3.350000	+1.135000	+4.960000	+4.944000	+9.853000
03:00	48		-7.312000	+9.350000	+9.290000		-11.448000	+3.355000	+1.145000	+4.976000	+4.992000	+9.772000
03:15	46		-7.296000	+9.400000	+9.350000		-11.400000	+3.280000	+1.145000	+4.960000	+4.976000	+9.615000
03:30	47		-7.200000	+9.360000	+9.360000		-11.496000	+3.200000	+1.165000	+4.944000	+4.976000	+9.507000
03:45	46		-7.136000	+9.440000	+9.360000		-11.616000	+3.060000	+1.200000	+4.912000	+4.912000	+9.420000
04:00	49		-7.008000	+9.370000	+9.330000		-11.568000	+2.995000	+1.235000	+4.592000	+4.608000	+8.954000
04:15	49		-7.008000	+9.410000	+9.380000		-11.856000	+2.840000	+1.265000	+4.800000	+4.816000	+9.057000
04:30	47		-6.960000	+9.360000	+9.310000		-12.240000	+2.665000	+1.305000	+4.704000	+4.752000	+8.958000
04:45	46		-6.816000	+9.450000	+9.420000		-12.456000	+2.545000	+1.280000	+4.560000	+4.576000	+9.237000
05:00	41		-6.736000	+9.650000	+9.600000		-12.792000	+2.390000	+1.190000	+4.544000	+4.544000	+9.978000
05:15	39		-5.920000	+9.550000	+9.500000		-13.728000	+2.470000	+1.525000	+3.616000	+3.712000	+9.631000
05:30	43		-4.720000	+9.420000	+9.370000		-15.192000	+2.345000	+2.015000	+2.032000	+2.064000	+8.254000
05:45	44		-3.632000	+8.990000	+8.930000		-17.544000	+2.355000	+2.490000	+1.584000	+1.616000	+8.243000
06:00	47		-2.208000	+8.800000	+8.780000		-19.680000	+2.255000	+2.915000	+0.480000	+0.544000	+8.018000
06:15	44		-1.392000	+9.180000	+9.210000		-20.832000	+2.160000	+3.065000	-0.432000	-0.400000	+8.235000
06:30	42		-0.976000	+9.990000	+9.940000		-21.192000	+2.075000	+3.100000	-1.728000	-1.680000	+8.487000
06:45	47		-0.512000	+10.220000	+10.210000		-23.160000	+2.010000	+3.190000	-1.648000	-1.632000	+9.790000
07:00	51		-0.576000	+10.700000	+10.670000		-22.896000	+1.925000	+3.145000	-2.656000	-2.592000	+10.004000
07:15	52		-0.960000	+10.960000	+10.940000		-22.584000	+1.915000	+2.950000	-2.496000	-2.528000	+10.437000
07:30	48		-1.392000	+11.480000	+11.460000		-22.272000	+1.855000	+2.750000	-1.856000	-1.856000	+11.329000

4: MWH Loss in the Lines:



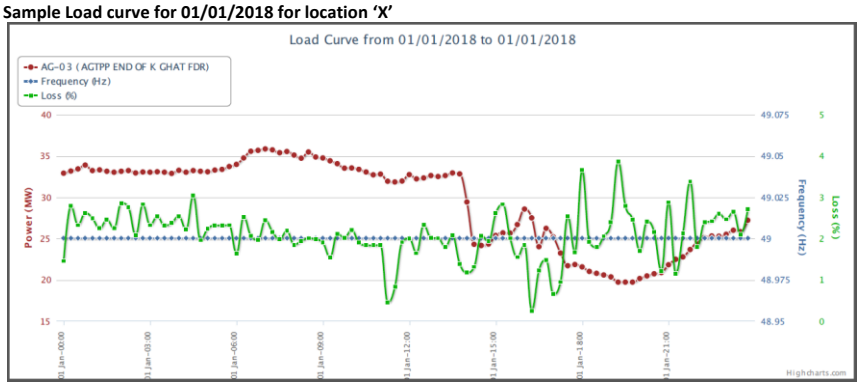
MWH LOSS IN THE LINES USING SPECIAL ENERGY METERS

TIME	FREQ		DIM(PG)-DIM(S)-1	DIM(PG)-KOH(S)	KOH-KAR	AGAR-AGTPP-1	K'GHAT-PKBRI		D'NGR-D'CHERA	PAL-UDAI-1	
00:00	46		+0.284400	+3.661200	+0.000000	-0.355200	+0.141600		+0.000000	-2.044800	
00:15	45		+0.237600	+3.078000	+0.000000	-0.067200	+0.031200	---	+0.000000	-2.400000	---
00:30	42		+0.216000	+3.549600	+0.000000	-0.028800	+0.057600	---	+0.000000	-2.678400	---
00:45	44		+0.187200	+3.513600	+0.000000	+0.009600	+0.036000	---	+0.000000	-2.707200	---
01:00	44		+0.194400	+2.944800	+0.000000	-0.057600	+0.091200		+0.000000	-2.928000	
01:15	38		+0.165600	+2.944800	+0.000000	-0.048000	+0.052800		+0.000000	-3.244800	
01:30	34		+0.169200	+2.782800	+0.000000	-0.048000	-0.048000		+0.000000	-3.340800	
01:45	41		+0.169200	+2.761200	+0.000000	-0.096000	+0.014400		+0.000000	-3.398400	
02:00	41		+0.165600	+2.757600	+0.000000	+0.009600	+0.079200		+0.000000	-3.446400	
02:15	39		+0.194400	+2.707200	+0.000000	-0.038400	+0.014400		+0.000000	-3.542400	
02:30	42		+0.208800	+2.592000	+0.000000	+0.000000	+0.086400		+0.000000	-3.561600	
02:45	47		+0.194400	+2.613600	+0.000000	-0.076800	+0.050400		+0.000000	-3.648000	
03:00	48		+0.183600	+2.620800	+0.000000	+0.000000	+0.052800		+0.000000	-3.763200	
03:15	46		+0.237600	+2.631600	+0.000000	-0.067200	+0.004800		+0.000000	-3.811200	
03:30	47		+0.248400	+2.671200	+0.000000	-0.028800	+0.021600		+0.000000	-3.792000	
03:45	46		+0.273600	+2.710800	+0.000000	-0.067200	+0.067200		+0.000000	-3.936000	
04:00	49		+0.345600	+2.804400	+0.000000	-0.028800	-0.007200		+0.000000	-3.907200	
04:15	49		+0.504000	+2.959200	+0.000000	-0.009600	+0.144000		+0.000000	-3.907200	
04:30	47		+0.622800	+3.132000	+0.000000	-0.076800	+0.055200		+0.000000	-3.907200	
04:45	46		+0.817200	+3.369600	+0.000000	-0.048000	+0.004800		+0.000000	-3.897600	
05:00	41		+1.065600	+2.156400	+0.000000	+0.057600	+0.158400		+0.000000	-3.792000	
05:15	39		+1.443600	+1.148400	+0.000000	-0.067200	+0.448800		+0.000000	-3.715200	
05:30	43		+2.098800	+2.311200	+0.000000	+0.201600	+0.067200		+0.000000	-3.628800	
05:45	44		+2.473200	+3.916800	+0.000000	+0.028800	+0.228000		+0.000000	-3.657600	
06:00	47		+2.674800	+5.018400	+0.000000	+0.076800	+0.091200		+0.000000	-3.283200	
06:15	44		+2.588400	+5.569200	+0.000000	+0.086400	+0.295200		+0.000000	-2.860800	
06:30	42		+2.494800	+5.652000	+0.000000	-0.009600	+0.033600		+0.000000	-2.524800	
	--		--	--	--	--	--	--	--	--	
	--		--	--	--	--	--	--	--	--	
	--		--	--	--	--	--	--	--	--	
23:15	40		+0.432000	+3.924000	+0.000000	-0.028800	+0.074400	--	+0.000000	+0.000000	
23:30	37		+0.370800	+3.826800	+0.000000	-0.249600	+0.086400	--	+0.000000	+0.000000	
23:45	44		+0.367200	+3.718800	+0.000000	+0.144000	-0.091200	--	+0.000000	+0.000000	
TOTAL			+107.611200	+394.207200	+0.000000	-2.380800	+1.303200		+0.000000	-159.964800	

(ii) **MVARH output:** This option enables a user to compute the reactive energy accounting of all States.

(iii) **Load Curve:** Through this option , the user can be obtain a graphical representation of the power flow, frequency and percentage loss pertaining to all the locations for the selected time periods .

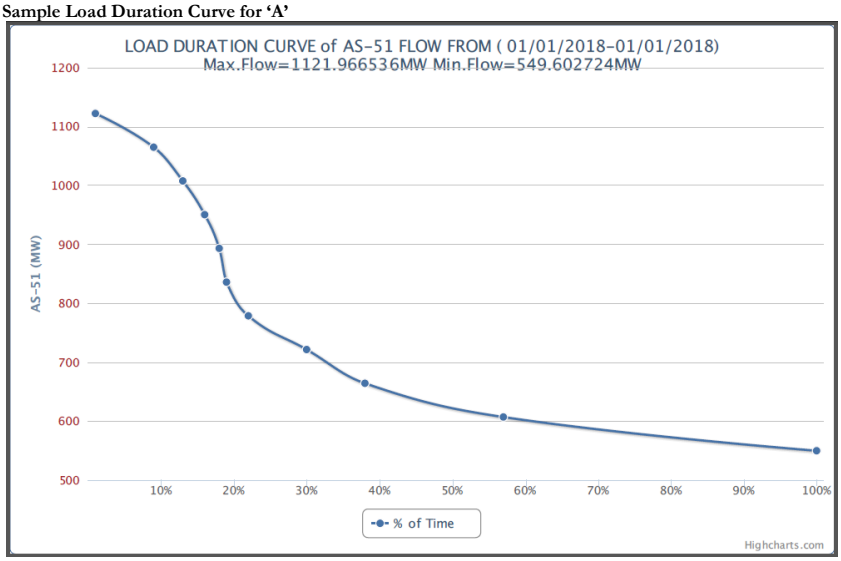
Sample Load curve for 01/01/2018 for location 'X'



The above graph shall be downloadable in .pdf file format.

(iv) **<u>Load Duration Curve:</u>** This option enables the user to view and download a graphical representation of the MW load flow vs time duration (in percentage) for which the load flow was below/above a particular maximum or minimum load.

Sample Load Duration Curve for 'A'



The above curve shall be downloadable in .pdf, .jpeg, .png & SVG Vector Image file format.

(v) Loss Computation: Regional pool loss for each time block for a selected time period can be computed and also represented and also represented graphically.

As per Procedure for Sharing of Inter-State Transmission System Losses, actual Regional transmission loss is computed as below:
Actual Transmission losses (in MWh) in Regional ISTS, L =
(ΣInjection of Regional Entities, G + ΣInterregional injection, I) - (ΣRegional Entity drawals + Σ Inter-regional drawals)

Actual Percentage Regional losses, LPA = L / (G+I) *100

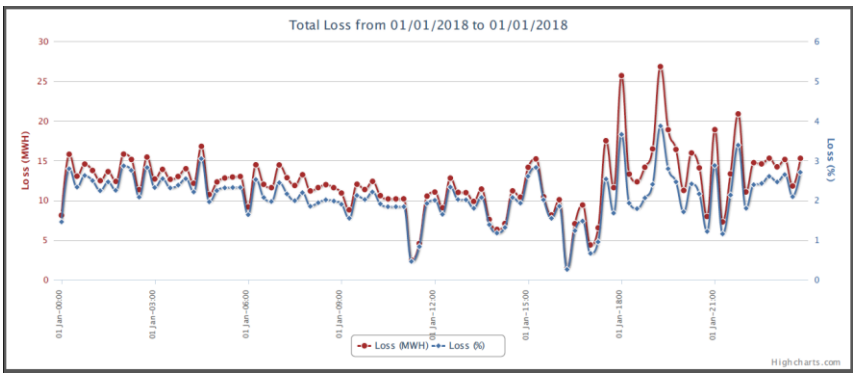
Total injection or drawal by any Regional entity in a time block is considered to arrive at Regional injection or drawal.

Entity wise Loss Computation of the Region

Date: 01/01/2018	Inj: 47,078.741303	Drawal: -45,924.740298	Loss: 1,154.001005	Loss %: 2.47	TOTAL 7,926.889393	0.000000	7,926.889393		2,594.108800	19,557.668917	-16,963.560117		13,744.432762	113.457600	13,630.975162	0.000000
Time	Inj	Drawal	Loss	Loss%	BTPS (BTP) [NT-71] (Inj)	BTPS (BTP) [NT-71] (Drawal)	BTPS (BTP) (Net)		ASSAM [AS-51] (Inj)	ASSAM [AS-51] (Drawal)	ASSAM (Net)		ER-NER [ER-51] (Inj)	ER-NER [ER-51] (Drawal)	ER-NER (Net)	NR-NER[NR-51](Inj)
00:00	456.123054	-448.044125	8.078929	1.77	76.925527	0.000000	76.925527		31.898311	186.414964	-154.516653		141.552836	0.000000	141.552836	0.000000
00:15	457.648493	-441.889091	15.759402	3.44	81.943110	0.000000	81.943110		32.501836	183.882054	-151.380218		140.498837	0.000000	140.498837	0.000000
00:30	449.297199	-436.291876	13.005323	2.89	81.652800	0.000000	81.652800		33.804488	180.655055	-146.850567		132.960145	0.000000	132.960145	0.000000
00:45	439.245629	-424.720072	14.525557	3.31	81.214937	0.000000	81.214937		34.843573	176.724118	-141.880545		122.786365	0.000000	122.786365	0.000000
01:00	435.232145	-421.506342	13.725803	3.15	81.215236	0.000000	81.215236		35.881313	179.350691	-143.469378		119.404509	0.000000	119.404509	0.000000
01:15	436.393192	-423.956810	12.436382	2.85	80.122828	0.000000	80.122828		35.705417	181.722263	-146.016846		121.483746	0.000000	121.483746	0.000000
01:30	431.765483	-418.189946	13.575537	3.14	81.577373	0.000000	81.577373		36.382720	180.305155	-143.922435		115.607128	0.000000	115.607128	0.000000
01:45	428.519590	-416.171929	12.347571	2.88	81.722227	0.000000	81.722227		36.666935	180.293809	-143.626874		113.533345	0.000000	113.533345	0.000000
02:00	430.926456	-415.148287	15.778169	3.66	81.794055	0.000000	81.794055		37.904386	178.598963	-140.694577		114.841273	0.000000	114.841273	0.000000
02:15	426.772617	-411.665053	15.107564	3.54	73.140109	0.000000	73.140109		38.158312	177.016328	-138.858016		118.553708	0.000000	118.553708	0.000000
--	--	--			--				--				--			
--	--	--			--				--				--			
--	--	--			--				--				--			
23:00	482.719428	-468.541994	14.177434	2.94	63.616736	0.000000	63.616736		32.713434	188.546937	-155.833503		161.810292	0.000000	161.810292	0.000000
23:15	473.749590	-458.643851	15.105739	3.19	64.414936	0.000000	64.414936		34.256523	183.188610	-148.932087		150.542181	0.000000	150.542181	0.000000
23:30	462.842255	-451.070989	11.771266	2.54	64.051600	0.000000	64.051600		35.108993	176.893636	-141.784643		142.510182	0.000000	142.510182	0.000000
23:45	458.434710	-443.189207	15.245503	3.33	63.904346	0.000000	63.904346		36.845500	176.383127	-139.537627		135.471709	0.000000	135.471709	0.000000

Total loss for 01/01/2018 to 01/01/2018	Inj:	Drawal:	Loss:	Average Loss %:
	47,078.741303	-45,924.740298	1,154.001005	2.47

Sample Total Loss Graph



The Loss Graph shall be downloadable in .pdf, .jpeg, .png & SVG Vector Image file format.

Format of loss output file shall be as below:

Name	Date	Time Blk	Injection(A)	Drawl(B)	Loss(A-B) (MWH)	Loss (MW)	Region Loss (%)
	27-03-2017	1	6084.85	5837.30	247.54	990.16	4.07
	27-03-2017	2	6071.78	5845.74	226.03	904.12	3.72
	27-03-2017	3	6075.19	5837.96	237.24	948.96	3.91
	-	-	-	-	-	-	-
	02-04-2017	96	5669.85	5449.95	219.90	879.6	3.88
	02-04-2017	97	5748.77	5520.88	227.90	911.6	3.96
	02-04-2017	96	5780.30	5560.22	220.08	880.32	3.81
			∑ (A)	∑ (B)	∑ (loss MWH)	∑ (loss MW)	

Table V-22 – Loss output file

S/W shall have the feature to generate loss output files for required period (From "Date and Time block" & To "Date and Time block") through user query.

- **Line Wise Transmission Loss Computation:** Configuration file for line wise transmission computation shall be as below:

Meter ID (A)	Meter ID (B)	Loss (MWH) (C)	Loss (%)
KO-001	KO-005	If A is +ve "A-B" or else "B-A"	If A if +ve "(C/A)*100)" or else "(C/B)*100)"
KO-007	KO-009	"	"
-	-	"	"
-	-	"	"
TR-001	TR-005	"	"
BL-007	BL-009	"	"

Table V-23 – Line wise Transmission loss configuration file

- Format of line wise transmission loss output file shall be as below:

Date	Time Blk	"KO-001"-"KO-005"		-	-	-	"LA-001"-"LA-005"	
		Loss (MWH)	Loss (%)	-	-	-	Loss(MWH)	Loss (%)
27-03-2017	1	-1.12	-3.18	-	-	-	-2.12	-3.18
27-03-2017	2	-0.27	-1.16	-	-	-	-3.27	-1.16
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
02-04-2017	95	-0.27	-1.00	-	-	-	-1.27	-3.00
02-04-2017	96	-0.40	-1.56	-	-	-	-3.40	-3.56

Table V-24- Line wise transmission loss output file

- S/W shall have the feature of browsing the line wise loss configuration files with respect to utility/Station/Voltage level etc. so that the required pair can be easily computed.
- Software shall also have the provision to compute loss for a user specified no. of time blocks for any entity.

- **ICT loss computation** configuration file and their output file formats shall be same as that of the line wise loss formats.

- **Bus loss Computation:** The bus loss configuration shall be user defined.

  Configuration file for bus loss computation shall be as below:

BUS ID	Bus Description	Bus Section Formulae (L)	Bus Section Loss (MWH)	Bus Section Loss (%)
KO-025	KSTPS-400KV	L=(KO-001)+(KO-002) -(KO-003)	L	{L/sum of injection into the bus (negative energy recordings)}
-	-	-	-	-

Table V-25- Bus loss configuration file format

Format of bus wise transmission loss output file shall be as below:

Bus ID	Bus Description	Bus Section Loss (MWH)	Bus Section Loss (%)
KO-025	KSTPS-400KV	10.2	1.2
-	-	-	-
-	-	-	-

Table V-26 – Bus loss output file format

e. Configuration Management: This menu enables the user to configure the following information in the System or database:

(i) Location/ Meter data: Through this option a user shall be able to create, enter, update, delete or modify details pertaining to Real Meters or Virtual/Fictitious Meters, into the system database, as per requirement from time to time.

Utility Name	Station Name	Location	Description	Meter No	Meter Type	Voltage Label	HV Current	LV Current	EHV Voltage	LV Voltage
		AB-01	AB END OF AB-CD-1 FDR	NP-9081-A	Main	132	600	1	132	110
		AB-04	ABC GT-1	NP-6857-A	Stand by	132	250	1	132	110
		XY-05	X END OF XY FDR	NP-6887-A	Line meter	132	400	1	132	110
		EF-24	EF END OF EFGH-1 FDR (CHECK METER)	NP-9458-A	Check	220	500	1	220	110

Table V-27 – Location Data

(ii) Find & Replace: This option enables a user to find real meters or Virtual/Fictitious meters and replace them with their compatible pairs or otherwise modify the formula as applicable.

This option can be used in case the data pertaining to a meter is missing due to any reason.

Once location id of the meter to be replaced is entered in "Find", software will suggest other end meter from "Pairs" or net-bus of other end as probable replacement. User can accept suggestion or use own meter location-id / formula and specify from - to date and time for replacement in all formulae (except validation checks).

Against every transmission line and the replaceable meter pairs, the software shall maintain records of previous 2 (two) months loss history in the form of "Export Loss" & "Import Loss". Thus, in case of replacement of any end meter with its pair, a multiplying factor shall be applied by the software in order to account for the line loss; for which the software shall check the direction of flow of energy and follow proper sign convention as defined in the preceding paragraphs under validation menu and apply the multiplying factor accordingly considering either import loss or export loss as applicable for that time block. The following shall be the consideration for applying the multiplying factor:

(1) In case of (+)ve reading in the available end meter, the applicable multiplying factor for replacing the missing meter reading shall be (1 - % previous 2 mths. Avg. Import Loss)
(2) In case of (-)ve reading in the available end meter, the applicable multiplying factor shall be 1/(1 - %previous 2 mths. Avg. Export Loss)

(a) OUT MWH Configuration: This function is used to configure the formulae for obtaining the desired active MWH power output of an entity. The MWH output is calculated based

on real meter MWH output and Virtual meter MWH output, which can be modified as required. The software should be able to handle computation of virtual meter within a Virtual meter.

(b) **OUT MVAR Configuration**: This function is used to configure the formulae for obtaining the desired reactive MVARH power output of the States. The reactive MVARH output is calculated based on real meter reactive MVARH power output and Virtual/Fictitious meter reactive MVARH power output. This is similar to OUT MWH.

(c) **Master Frequency:** Master frequency meter is a IEM whose recorded frequency code is considered as standard freq. code by all synchronously inter-connected electrical regions, viz., NR, ER, WR, SR and NER for any calculation such as DSM etc. within the above mentioned Region.

Through this option, Master frequency meters can be defined. There shall be option to define multiple Master Frequency Meters in order to enable validation check with reference to any frequency.

(d) **Pair Configuration:** Through this menu the user shall be able to define and edit the pairs of real meters and also enter new pairs or delete obsolete ones. The list of pairs and their details such as errors, feeder name etc. are displayed; and the pairs can be selected from a scrolling menu for changing them, if required; and each of the other details can also be modified once the option to 'edit' is clicked against a selected pair.

(e) **User Information:** It is list of authorized users who can access the Meter data processing software.

(f) **Location/ Meter Master Data:** Through this menu, a user shall be able to update the list of various Utilities – Generation/ Transmission Utilities, States, Regions, Regional Boundaries etc. involved in the Regional / State power flow.

f. Historical Record: The History of each connected real meter right from the beginning of operation of the meter, changes in CT or PT ratio, meter no., replacement of the meter etc. shall be maintained in the database for viewing or downloading as stated below:

(i) Location/ Real Meter Data History
(ii) Change in CTR, PTR, Meter No & Replacement

(i) **Location/ Real Meter Data History**: This option shall enable the user to view and download the details regarding history of the meter(s); which includes start date & time and end date & time of the meters, installation date, testing date, Make etc.. A sample downloadable file is placed at **Annexure-H(I)**.

(ii) **Change in CTR, PTR, Meter No. & Replacement during the period:** Through this menu, **the user can view and download the details regarding the changes in CT & PT Ratios of the** meters, change in meter number, as well as details regarding the history of the meter such as start date & time and end date & time and details regarding replacement of the meter by another meter, if any. The following details are mentioned

Utility Name	Station Name	Loc	Meter Name	Start Date	Start Time	End Date	End Time	HV Current	LV Current	EHV Voltage	LV Voltage	Nature of Change
ABC	XYZ	XY-01	NP-1001-A	05/06/2017	00:00	12/11/2017	23:45	400	1	132	110	
ABC	XYZ	XY-01	NP-1001-A	13/11/2017	00:00			300	1	132	110	CT ratio/ PT ratio

Table V-28 – Table of Historical Records (Change in CTR/PTR/Meter no.

Meter Replacements:

Further, the following record is downloadable regarding meter replacements history

Utility Name	Station Name	Location	Meter No	Start Date	Start Time	End Date	End Time	Meter Replaced With
ABC	XYZ	XY-01	XY-1001-A	01/01/2016	00:00	01/01/2018	23:55	-(XY-11)

Table V-29 – Table of Historical Records -Meter Replacement Menu

g. Reports:

S/W shall provide two options to generate reports in 5/15 min depending upon the user requirement.. The reports (5/15 min) shall be in pre-defined Text file, PDF, ISO/IEC 26300:2006/Amd 1:2012 or ISO/IEC-29500:2012 compatible Spreadsheet and CSV formats. The format of the 5-min processed data reports shall be exactly same as that of the existing

15-min processed data reports for compatibility with the existing system.
The report configuration files shall be user configurable. There shall be provision for addition of new columns in the report to incorporate new elements and there shall also be a provision to configure new report to incorporate new utility.

Different types of Reports to be prepared are as below.

a. Active Energy Reports

i. S/W shall have the capability to prepare the day wise active energy reports (in 5/15 min blocks data) of Utilities for submission to RPC.
ii. These reports shall be prepared for each utility. The formats shall be user configurable.
iii. The Active energy report shall consist of computed data of all elements which shall be used for computation of drawal/injection of utilities and total value.
iv. These configuration files shall be user configurable. There shall be suitable provisions for addition of new columns in the report to incorporate new element and there shall also be provision for configuration of new reports to incorporate new utility.
v. Typical Active energy output file format (5/15 min) shall be as below:

Active Energy(MWH) Accounting of "Utility Name" for 31-03-17								
Date	**Time**	**Time Blk**	**Meter ID-1**	**Meter ID-2**	**-**	**-**	**-**	**Total**
31/03/2017	00:00	1	33.163635	33.054546	-	-	-	100.036362
31/03/2017	00:15	2	32.072727	32.072727	-	-	-	100.690903
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
31/03/2017	23:30	95	36.545452	36.436363	-	-	-	100.254555
31/03/2017	23:45	96	36.327271	36.327271	-	-	-	100.254539

Table V-30- Active Energy Output file format

b. Reactive Energy Reports

i. Reactive Energy Settlement at ISTS level is being done day wise for Low Voltage (<97% of Rated Voltage) and High Voltage (>103% of Rated Voltage) conditions.
ii. S/W shall have the capability to prepare the weekly reactive energy reports of
iii. Utilities for submission to RPC.
iv. These reports shall be prepared for each utility. The Reactive energy report shall consist of Cumulative reactive data (LV & HV registers) of all elements which shall be used for computation of drawal/injection of utilities. However, there shall be an option to provide reactive energy reports similar to active energy report with block-wise details of reactive energy consumption/injection.
v. Typical block wise Reactive energy output file format shall be as below:

Reactive Energy (MVARh) Accounting of "Utility Name" for 31-03-17								
Date	**Time**	**Time Blk**	**Meter ID-1**	**Meter ID-2**	**-**	**-**	**-**	**Meter ID-n**
31/03/2017	00:00	1	11.163635	12.054546	-	-	-	100.036362
31/03/2017	00:15	2	12.072727	12.072727	-	-	-	100.690903
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
31/03/2017	23:30	95	16.545442	16.436347	-	-	-	100.254555
31/03/2017	23:45	96	16.327261	16.327252	-	-	-	100.254539

Table V-31– Reactive energy output file (block wise)

vi. Along with block wise reactive report for High voltage /Low voltage conditions, a report mentioning net VAR exchange in each TB may be added.

vii. Day wise Reactive energy output file format shall be as below:

Reactive Energy(MVArh) Accounting of "Utility Name" for 31-03-17									
Date	**Meter ID-1**		**Meter ID-2**		**-**	**-**	**-**	**Total Reactive Energy Drawl**	
	LV	**HV**	**LV**	**HV**	**-**	**-**	**-**	**LV**	**HV**
01/02/2016	2346.20	0.00	2324.70	0.00	-	-	-	6584.25	0.00
02/02/2016	2356.00	0.00	2334.50	0.00	-	-	-	7524.25	125.25
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
06/02/2016	1142.90	0.00	2195.60	0.00	-	-	-	7558.39	25.30
07/02/2016	1718.60	0.00	2339.30	0.00	-	-	-	6548.35	365.20

Table V-32 - Reactive energy output file (day wise)

c. Voltage Reports:

i. S/W shall have the option for preparation of Voltage reports (5/15 min block wise) for required meters. The configuration files shall be user configurable.

ii. The format of 5/15 min block wise Voltage reports are same as that of active energy reports.

iii. S/W shall have the option for preparation of Low Voltage Logging report (5/15 min block wise).

iv. The S/W shall fetch the details of meter IDs which have recorded the Low Voltage using low voltage logging symbols "*" and "Z".

v. The output format of Low Voltage reports shall be as below:

Meter ID	Low Voltage(*) Logging report for the period "31-03-17" to "02-04-17"											
	Total No. of Blocks (LV Logging)	31-03-2017			01-04-2017			-	02-04-2017			
		Blk-1	2	-	-	-	-	-	-	-	96	
KO-001	12 5	*	*	-	-	-	-	-	-	-	*	
LA-028	18		*	-	-	-	-	-	-	-		
KS-012	7	*		-	-	-	-	-	-	-	*	
-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	
MB-005	8	*	*	-	-	-	-	-	-	-	-	

Table V-33 – Low voltage Log file

Meter ID	Low Voltage(Z) Logging report for the period "31-03-17" to "02-04-17"											
	Total No. of Blocks(LV Logging)	31-03-2017			01-04-2017			-	02-04-2017			
		Blk-1	2	-	-	-	-	-	-	-	96	
KO-001	2	Z	Z	-	-	-	-	-	-	-	Z	
LA-028	5		Z	-	-	-	-	-	-	-		
KS-012	6	Z		-	-	-	-	-	-	-	Z	
-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	
MB-005	0			-	-	-	-	-	-	-		

Table V-34 – Zero voltage log file

d. Frequency Reports:

i. Frequency data of reference IEM (user defined) shall be used for DSM Accounting. If main reference meter data is not available, first standby meter (user defined) frequency data shall be used for accounting. If both main and first standby meter frequency data are not available for a particular period, second standby meter (user defined) frequency data shall be used for these periods.

ii. The S/W shall have a user frequency configuration file for selection of any of the reference IEMs.

iii. The output file format of reference IEM frequency data to submit to RPC for DSM accounting shall be as below:

Date	Time	Time Block	Frequency of Main IEM	Frequency of First Standby IEM	Frequency of Second Standby IEM
31-03-2017	00:00	1	49.97		
31-03-2017	00:15	2	49.88		
-	-	-	-		
-	-	-	-		
-	-	-	-		
-	-	-	-		
31-03-2017	23:30	95	50.03		
31-03-2017	23:45	96	50.01		

Table V-35 – Frequency report output file format

iv. S/W shall have the module to compare the frequency data recorded by all IEMs with reference IEM frequency data and to generate the report/trend for any required period (Date and Time) through query. The module shall also have the option to define frequency tolerance value. If difference in the frequency data is greater than the tolerance then report shall show the same. The output file format as below:

Frequency Comparison Report for the Period "30/03/17" to "31/03/17"							
Date	**Time**	**Blk No**	**Meter ID-1**	**Meter ID-2**	**-**	**-**	**Meter ID-n**
31-03-2017	00:00	1	0.02	0	-	-	0.02
31-03-2017	00:15	2	0.01	0.01	-	-	0.01
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
06-04-2017	23:30	95	0.06	0	-	-	0.02
06-04-2017	23:45	96	0.01	0	-	-	0.03

Table V-36 – Frequency Comparison Report

2. Other Requirements:

(i) The software should be expandable to include databases of up to 5000 Meters without compromising performance and speed. Load test shall be carried out to verify the performance of the software. For computations of any Fictitious meter or creation of any OUT.MWH files maximum time taken should be less than 5 min.

(ii) In case Regional pool loss in any time block during a day is outside the tolerance range as specified by the user, all such time blocks will be flagged. The software will provide suggested rectification for the flagged time blocks based on Validation checks.

(iii) The system should facilitate concurrent login of multiple users after proper authentication and verification.

(iv) The computed Virtual meter data and OUT MWH files shall be stored in the database.

(v) The software shall be able to provide diagrammatical representation (GUI based) in the form of circuit diagram, single line diagram etc. expandable (on clicking) to provide more detailed descriptions such as information regarding connected meters, power flow etc. of each of the grid connected elements viz. transmission lines, substations, generating stations etc. The diagrams shall be modified automatically in case of addition or deletion of any element or modification of data by the user so as to match with the existing updated system.

(vi) "High Co-relation comparison" features should be available to evaluate the main meter missing/wrong/zero measurement data.

(vii) Provision to modify in MDP menu/Report formats/ addition of reports must be possible.

3. Transition Requirements

Presently the time period for Scheduling and Settlement at ISTS level is 15-min. Special Energy Meters data is used for computation of injection/drawal of all entities, which are under the jurisdiction of RLDC. Injection/Drawal computed from SEMs data is used as input data for preparation of following regional accounts.

- Deviation Settlement (Weekly)
- Reactive Energy (Weekly)
- Congestion (Weekly)
- Ancillary Services (Weekly)
- Regional Energy Account (Monthly)
- Transmission Deviation Account (Monthly)

Bidders are encouraged to refer the appropriate regulation to understand the settlement system. They are also encouraged to check the following links on RLDC website to understand the format of existing output reports.

- Active Energy Reports- http://RLDC.org/dropdown_semdata.aspx
- Reactive Energy Reports- http://RLDC.org/semdata_reactive.aspx

Until the amendments for 5-min Settlement in the appropriate regulations come, the settlement at the interstate level shall continue to be done at 15-min interval. Hence, the data of 5-min interval received from the IEMs shall be converted to 15-min interval at CDCS, so that it is compatible with the existing software for energy accounting at RLDC and RPC. After the entire infrastructure envisaged under this project is in place, the output files generated for energy accounting shall be compatible with the existing software. In a nutshell, the execution of work shall be planned in such a manner that there is no interruption in the existing regional energy accounting system.

Shutdown Coordination for meter installation

The successful bidder shall prepare and submit a schedule for replacement/testing of meters to Employer and RLDC. If the meter installation requires shutdown of transmission elements, the indent for the same shall be forwarded to RPC through the respective utilities/Employer 45 days in advance for the approval of the regional Operation Coordination Committee. Employer shall coordinate for gate pass and other administrative approvals from the utility in whose premises the IEM/DCU have to be installed. RLDC shall coordinate the shutdown as per the OCC approved list subject to real time grid conditions. The bidder shall keep suitable margins for grid related uncertainties while formulating the meter installation plan.

For smooth handling of transition phase, following issues are to be well addressed in AMR and new MDP software.

Compatibility of raw data (text file) with existing software

AMR system shall have the options to generate raw text files of IEMs in 5/15min at CDCS. Format of the raw text file (*.npc) in 15-min shall be exactly same as that of the existing format (Existing format is given in example).

In existing 15-min raw text file, frequency is stored in terms of codes from 00 to 99. This can be addressed in new AMR system by converting frequency to codes at RLDC end (CDCS) for compatibility with existing MDP S/W (Detailed explanation is given in example-1.

Existing SEMs have 7 character unique serial number where as new IEMs shall have 12 character serial number. This can also be addressed by mapping old meter SEM IDs to IEM IDs in CDCS data base at RLDC so that new IEMs raw data could be extracted with old SEM IDs for compatibility with existing software.

Example

The format of the decoded file (text file) of our existing SEM meter is shown in Fig.3.

Where the first two digit (for e.g. "00","04", etc.) denotes the starting hour i.e. 00 hrs, 04:00 hrs, etc., the next two digits denotes the frequency code for the current block (Freq. = 49.5 + (freq. code)/100) and the next digits denote the active energy measurement (in MWH) of the current time block.

The decoded file of the IEM (with 5 min accounting) is shown in Fig. 4.

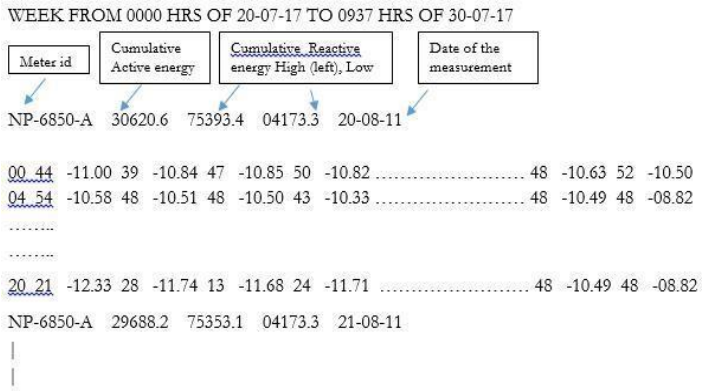


Figure 3 – Standard raw data format for SEM

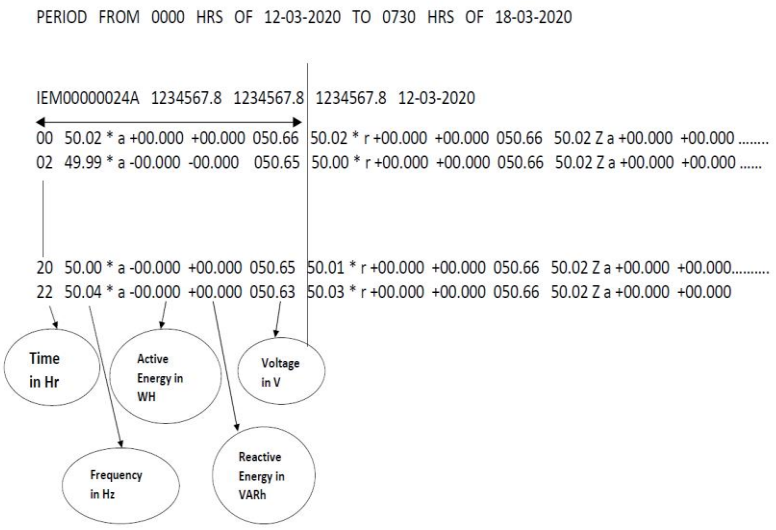


Figure 4 – Standard raw data format for IEM

In the transition phase, above 5 min data shall be converted into 15 min data in the existing format as defined in Fig. 3. For conversion of 5 min data into 15 min data, active energy and frequency data in three consecutive time blocks (5 min.) starting from 00 hrs shall be averaged to arrive at 15 min active energy and frequency data.

For e.g. in Figure-4, the active energy in the first three time blocks (5 min) are +14.72, -77.25 and -77.20. The frequency in the same consecutive time blocks are 49.99, 50.79 and 50.78.

When this file will be converted to the existing format (15 min), the 15 min active energy data (00 hrs) will be calculated as the average of the +14.72,-77.25 and -77.20, i.e. -46.58.

Similarly, the frequency code data will be calculated as = 100*[{Average of (49.99, 50.06, 50.07)}-49.5]

= 100*[50.04 – 49.5]

= 100*[0.54] = 54

'Average current value' and 'Process Status Word' to be included in the above mentioned format after Voltage value. As per the clause 'III.1.m'.

4. Deviation and Other Reports

This module shall compute deviation of regional entity by comparing the actual injection/drawal with its interchange schedule. It shall also compute the applicable deviation charges and generate the reports that include time block wise normal deviation charges, additional deviation charges, capped deviation charges, aggregate deviation charges.

The module shall be capable of importing the interchange schedules in .xls/.csv format from the external system. The user shall be able to define the applicable deviation rates (in paisa per unit) in line with the formula notified in the appropriate CERC regulations. There shall be adequate flexibility for the user to configure the methodology for computation of deviation/ deviation charges in line with the prevailing CERC regulations and/or as per the decisions of the regional power committees.

As on date of delivery, the supplied S/W shall comply with all statutory regulation as required under CERC/IEGC as applicable and the same should be declared by the vendor during delivery along with warranty certificate.

The module shall provide interface for generating user defined reports using arithmetic, logical and statistical functions.

5. Graphs/Trends

- S/W shall have the option to display the graphs/trends in user defined standard chart type such as line scatter plot, bar chart etc. of different electrical quantities (Energy,

Voltage, Frequency etc.) already stored in database for the required period (Date and Time) through query.

- There shall also be a provision to display the Actual vs Schedule graphs of utilities for user defined period. S/W shall have the provision to upload standard CSV 5/15 min schedule data.
- There shall be provision to download the Graphs/Trends in required formats (JPEG, PDF etc.)
- The X and Y axis parameters of the graphs are user definable.

III. GENERAL SOFTWARE REQUIREMENTS

AMR System and MDP software shall meet the following general software requirements.

1. Upgradability

All software kernel/OS and application programs supplied shall be fully upgradable through firmware upgrade and/or other software upgrade methods. The firmware/software upgrade may include

- General software upgrade such as kernel/OS upgrade
- Adding new features and functionalities, such as supporting new data format and communication protocols
- Fixing bugs and deficiencies

The Vendor shall keep RLDC and Employer informed of the latest software updates of revisions available after the system is shipped.

Users shall be able to perform the necessary software upgrade in the field.

2. Software Security Requirements at Delivery

The development of the software for AMR and MDP system shall be done in consultation with RLDC/Employer. Software at delivery shall meet following requirements in accordance with general software security assurance practices.

2.1 Security Tested and Configured

All software and associated application software modules shall be the most secure version of the software available at the time of start of the Factory Acceptance Test. The delivered software shall to be tested to ensure the followings:

- Free of computer viruses, worms, Trojan horses, and other software contaminants
- Unused services are disabled/removed, this includes device drivers for devices not included in the hardware.
- Unused networking protocols.

- Unused administrative utilities, diagnostics, network management, or system management functions.
- Administrative utilities, diagnostics, network management, or system management functions or workstations unused by administrators.
- Backups of files, databases, and programs, used during system installation/upgrade but not needed in the operational system
- Accounts that are not End-User Administrator shall be removed, this include any guest accounts (with and without passwords) or default administrator or maintenance accounts other than the initial system administrator account for Procurement Entity or any guest accounts or default administrator or maintenance accounts for any third party software.

2.2 Maximum Initial Security Settings

The software shall be shipped with all security settings at their maximum setting. All software shall be delivered with all the latest relevant patches installed.

All security-related parameters and options shall be placed at their most restrictive settings at the delivery, i.e. affording the access and execution privileges to the smallest class of users consistent with meeting the functional specifications, and restricting their rights to the narrowest range of privileges.

2.3 No Automatic Downloading and Execution of Executable Code

All active content activated through any link or script into the CDCS or DCU must be disabled in the browser using script blockers such as No Script add-on for Mozilla based Browsers implementing pre-blocking any ActiveX, JavaScript or its derivatives of any description, Java servlets, binary executables etc. preventing any cross-scripting or clickjacking incident.

2.4 File Access Control

The CDCS and DCU software shall support controlled access privileges for files, including at least access, read, write, execute and combinations of these. The access privileges for each user can only be assigned by system administrator of CDCS or DCU as the case may be, and shall be assigned on an individual user account basis.

The default access privileges for each new user account shall be no access to any file on the system at all.

No user, including system administrator, shall be given the privilege of modifying operating system files and other files that are never supposed to change while the system is running.

2.5 Free of "Electronic Self-Help" Enabled Software

It shall be strictly prohibited for delivered software to contain embedded faults or back-door mechanisms that allow the software manufacturer to remotely disable some or all of the functions of the software, or affect their performance, or in any way degrade its operation. The

software shall not contain any mechanism that automatically disables some of all of its functions or degrades their operation on a certain date or upon the occurrence of a specific event.

2.6. Requirement for Backup server, Software agent, Backup Hard disk Servers:

a. All data and software essential to continue the operation of AMR as well as all configuration files shall be backed up.

b. System shall be configured for primary and secondary back up.

c. All backup data preferably shall be stored in an encrypted manner.

d. Backup copies preferably shall be stored in an environmentally protected and access controlled secure offsite location.

e. Stored copies shall be made available upon authorized request.

2.7. Disaster Recovery Requirements:

AMR and MDP project should have disaster recovery plan (DRP) for handling the any disaster. A DRP should be in place as a complete set of procedures to reduce downtime by focusing on the most effective way to recover. Sufficient capacity will be maintained for AMR system, network and communications to recover from the loss/disaster within target timescales.

a. Individual recovery procedures will be developed and maintained to restore each service in line with its required reinstatement time line.

b. A detailed step by step overall DR plan will be maintained and (periodically) tested of how recovery will be enacted using the individual recovery procedures including:

i. Switching to dedicated fall back equipment/systems deployed in different site.

ii. The re-assignment and reconfiguration of development systems to support production systems for which resilient hardware does not exist .

iii. Procurement arrangements for equipment, software or contract services to recover less critical systems.

3. Application Software Modification

Modifications in application software to comply with the prevailing CERC regulations for energy accounting and/or to implement the decisions at the RPC level shall be in the scope of the vendor. These modifications shall be considered as a part of O&M/AMC expenses. The modification shall be done in consultation with RLDC.

4. Source Code

After completion of the project, the final implemented source code shall be handed over to Employer and RLDC.

OR

The source code shall be kept in the escrow account.

OR

All source code developed under the project shall be under an appropriate Open Source License, to allow dispute free access to Source Code. Linking of such source code to a proprietary binary product shall be permissible, provided that it be documented along with applicable license restrictions of the named binary product. Vendor, must periodically update the owner on any vulnerabilities of the named binary product and provide patches to the owner without any additional cost implication.

5. Cyber Security Compliance

i. The Project shall adhere to all provisions of IS:16335 for cybersecurity process. ~~3~~IS/IEC/ISO:27001 2016 shall be the management standard for implementing applicable risk controls. IEC/ISO27701:2019 shall be the governing standard to implement Privacy requirements for sensitive personal data.

ii. The MDP should not have any provision to correct the IEMs raw data in database or replacement of the old data.

iii. Cyber security requirements for End to End Data Exchange communication between IEM (client) ,CDCS server and MDP application at RLDCs must conform to IS: 15959 2011/ IEC 62056 in general. The internals of Encryption Key generation and key distribution implementation according to DLMS/COSEM, must be in accordance to DLMS User Association Green Book v9 or later. The details of digital certificates, Certifying Authority and the PKI deployed must be clearly documented. The root CA must be an Indian Entity, recognized by Controller of Certifying Authorities, India, complying to provisions and Rules framed under Information Technology Act, 2000.

iv. All IEMs are to be tempered proof or there shall be a provision in all IEMs to implement an Intrusion detector system with appropriate data logs to facilitate audits to identify and isolate any fraudulent activity.

v. Details of any Optical and Wi-Fi sensors used and any Microcontrollers employed in the solution shall be provided.

vi. Wherever applicable and possible devices featured remote firmware upgrade/update, should have the facility of firmware integrity verification and checking. Firmware upgrade/update of exceptional items shall be done on need basis in consultation with the acquirer.

vii. All software developed and databases employed must meet applicable Open Web Application Security Project (OWASP) Security Guidelines. All applications and infrastructure hosted on public IP shall be audited by CERT-in empaneled agency by conducting Vulnerability Assessment and Penetration Testing and certificate for satisfactory closure of all observations made by the agency must be obtained.. Every year re-certification is to be obtained during maintenance period. Vulnerability assessment of other software applications hosted on the protected internal network and systems, shall be in the scope of vendor and the owner must assess the status every quarter.

viii. Suitable technical/management measures to be taken by service provider to minimize the impact of any loss of privacy to any Data Principal as detailed in ISO/IEC 27701:2019.

ix. The following things must be ensured for GSM based data communications using

4G/3G/2G/SMS:

a. Identity authentication shall be configured in IEM and associated GPRS component.
b. Identity confidentiality must be implemented and maintained.

c. Data and signaling protection: GPRS encryption algorithm (GEA4) must be configured for data and signal for communications.
d. Integrity protection and non-repudiation mechanisms shall be ensured.
e. The communication between the IEM/GPRS core networks and the CDCS needs to be protected, either by using an IPSec VPN solution or by implementing additional security measures.

x. DAM (Database Activity Monitoring) system should have the minimum features as below:

a. DAM should independently monitor and audit all database activity, including administrator activity and query transactions. Tools should record all database transactions without performance degradation.
b. DAM should have the ability to monitor attacks and back-doors on real time.
c. There should be a feature to store audit logs securely in a central logs server (may be syslog server) outside the audited database. Central logs server shall keep the logs for at least for 1 year.
d. DAM should ensure that a service account only accesses a database from a defined source IP, and only runs a narrow group of authorized queries. This can alert in case of compromises of a service account either from the system that normally uses it, or if the account credentials show up in a connection from an unexpected system.
e. DAM should enforce separation of duties (implementation of role base access control), by monitoring and logging database administrator activities.
f. DAM should generate alerts for rule-based or heuristic-based policy violations. For example, an alert to be generated based on a created rule such that each time a privileged user performs a query that returns more than a defined threshold (may be 5) of the outcome
g. DAM should offer closed-loop integration with external change management tools (if using any one) to track approved database changes implemented in database. Other tools can then track administrator activity and provide change management reports for manual reconciliation.
h. Utility level data anonymization which, based on the relative and subjective concept of anonymity executes a process of data de-personalization before they leave the user-level.
i. Vendor shall offer any data traffic analysis tools to detect anomalous communication patterns compatible with the Cyber Kill Chain (CKC) attack (in Central Security Agent)
j. Smart meters with the (remote) load flow control functionality fall into the wider category of ICS. Tool may also detect false data injections.

xi. System Hardening guidelines:

a. All systems shall be hardened.
b. USB port of all systems and devices shall be disabled.
c. CD/DVD Rom access in all system shall be disabled.

d. All unused ports of all systems shall be disabled.
e. Unused ports of the firewall, router and switches should be disabled.
f. All Unnecessary services and protocols should be disabled.
g. Unused software, applications and services shall be disabled.
h. Software shall run with least necessary privileges, taking account of both security and functionality.
i. All unnecessary accounts and privilege accesses shall be eliminated.
j. All systems shall be hardened by doing the whitelisting of applications and services.

xii. Vendor shall notify the all the software/firmware vulnerabilities which come to its knowledge. Vendor has to approve and install all patches/ settings to resolve vulnerabilities as notified by respective OEMs on the fly (suddenly/informal way). In case any patch is not installed, technical reason has to be provided. A suitable time period as shall be agreed between solution provider and owner to permit solution provider to test stability of the notified patch and integration efforts, if any.

xiii. Intrusion Detection and Prevention System, Web Application Firewall, Network Firewalls, Central Syslog Server, Endpoint protection, Centralised Software patch and configuration solution etc to be considered as below:

a. Malicious code detection, antimalware and intrusion detection shall be installed in all possible systems.
b. Intrusion prevention system must be facilitated for signature-based, behavioural, and protocol anomaly detection in firewall.
c. Firewall should have integrated web application and content filtering features without external solution, devices or hardware modules.
d. Firewall should be able to support of user authentication and authorization (such as LDAP/local/AD).
e. Firewall should support industry standards IPSEC, and SSL VPN.
f. Firewall should have the ability to prevent data loss/leakage
g. Firewall should provide protection against viruses, worms or any other malicious content in traffic.
h. Firewall should have log storing facility on a local disk or on to a remote system. Logs stored on the local disk must be transferable over network (scheduled) to a remote system and must be in a generic format.
i. Centralized patch management system shall be deployed following network architecture design for efficient distribution of patches and software updates. Patches are to be managed/fixed in every three months (quarterly basis).
j. There shall be centralized logs server to collect and store logs from all the system of network. This server should have the capability to provide sufficient and necessary resources to study, analysis and correlate logs for deriving readable logs.
k. Centralized configuration management system may be considered proper system configuration and change management.

xiv. Vendor shall offer any data traffic analysis tools to detect anomalous communication patterns compatible with the Cyber Kill Chain (CKC) attack (in Central Security Agent) Smart meters with the (remote) load flow control functionality fall into the wider category of ICS. Tool may also detect false data injections.

VII. DOCUMENTATION REQUIREMENTS

Details of services to be provided by the solution provider during and up to the end of warranty period must be catalogued along with a committed response and resolution time, through an appropriate Service Level Agreement (SLA). Documentation of AMR system and MDP shall meet following requirements. All documents shall be supplied in hard copies as well as computer readable soft version:-

1. Design Documents

Before starting the manufacturing of the AMR system components, a design document shall be submitted. The design document must essentially (but not limited to) included:-

- System Overview
- Functional diagram
- Flow diagram
- Functions of each major component
- Physical details of each major component
- Overall networking scheme
- System configurations
- Cyber Security Provisions

Similarly the design document for MDP shall also include (not limited to) the above sections.

2. Software Requirement Specifications Document

After approval of Design document software requirements specifications (SRS) document for the application software for CDCS and DCU should be prepared and submitted for approval. This SRS should be prepared as per IEC/ISO/IEEE 29148: 2018. Software should be designed as per approved SRS.

3. User Manuals

Following user manuals shall be prepared and supplied for the system:-

3.1 User Manual for central site

User manual for central site i.e. location where CDCS shall be installed and where all data collection activities shall be taken up, should contains all user instructions, block diagrams, user screens etc. in order to make itself contain complete document required for operation of

complete AMR and MDP system including each and every component of the metering system.

3.2 User Manual for DCU site

Separate user manual shall be provided which shall be used by the users located at DCUs site. This user manual shall contain details of IEMs, external connections to DCU, communication system, block diagram of system at DCU site, instructions of using DCU system, trouble shooting of DCU system etc. This user manual should be self-contained and shall not require any external reference document in order to use and trouble shoot DCU system.

3.3 Training Documents

Training document to be used during training of site personals shall contain major functional details of the overall metering system, its features and major instructions for understanding the overall working of the system.

3.4 Testing Documents

Testing documents shall be prepared and submitted as per Testing Requirements clause of this specification.

3.5 Documents providing software details

Documentation of all software used in solution providing details of Name of Software Used, Version No (as on date of FAT/SAT), License Type (Third party Commercial/ Proprietary of Solution provider/ Open Source) with validity duration (Perpetual/ Term based) shall be prepared and submitted. All software requiring upgradation/ service support, based on any renewal subscription, should be separately listed.

VIII. TESTING REQUIREMENTS

All equipment, materials and software for AMR and MDP System shall be subject to both Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT). The purpose of Acceptance Testing is to determine compliance to this specification in every respect in regard to the delivered and installed system.

1. Acceptance Test Plans and Procedures

The Vendor shall develop and document proposed Test Procedures and Test Plans for Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT) of the delivered and commissioned system and its components. Vendor shall finalize the proposed FAT and SAT acceptance test plans and procedures. The final Test Procedures and Test Plans shall be subject to review and approval prior to testing.

The Acceptance Test Plans (ATP) shall enable Employer to verify the ability of the delivered and commissioned system and its components to individually and simultaneously fulfil all functional and performance requirements of the system set forth in the contract through a series

of mutually agreed to structured tests.

All system documentations shall be completed, reviewed and approved by Employer in consultation with RLDC before any testing.

The ATP shall include, but not be limited to, functional tests that demonstrate compliance of

the functional, performance, software, hardware, communication, interface, and operational aspects of the delivered and installed system.

2. Factory Acceptance Test (FAT)

The Vendor shall perform a preliminary FAT (Pre-FAT) prior to the FAT. The pre-FAT shall be a complete dry run of the FAT, following the test plans and procedures. The intent is for the Vendor to detect and correct most design, integration, and database, display, and performance problems prior to the FAT. The representatives of Employer shall have the right to witness all or parts of pre-FAT for which vendor shall intimate Employer in sufficient advance.

Test results (including documentations and certifications) for tests conducted by Vendor or third parties that are not included in the FAT test plan and procedures shall be furnished to Employer prior to FAT for review and evaluation. Vendor and/or third parties conducted tests deemed inadequate shall be repeated until accepted by Employer .

Vendor's project manager shall sign off each test of Pre-FAT. The completed test results shall be sent to Employer for review before their representative's travel to the Vendor facilities for the FAT. All tests shall be conducted using the contract-specified databases unless Employer authorizes the Vendor to use a test database.

The FAT shall be conducted according to the FAT Test Plan and Test Procedure documents approved by Employer in consultation with RLDC shall cover, as a minimum:

- Visual Inspection – To verify that the system to be delivered has all required components and is properly configured. Visual inspection shall verify acceptable workmanship and that all equipment, including cables and connectors, are appropriately labelled
- Hardware Diagnostic Test – Individual tests of all system hardware. These tests shall consist of running standard hardware diagnostic programs, plus all special diagnostic programs used by the Vendor.
- Communications and Interfacing Test – Verify that all interconnected system components, such as data acquisition, control, monitoring, and data management functions are operating properly when correctly connected.
- Software Development Tools – Verify that all required software development tools, utilities, software diagnostics, and debugging tools for the system, including the UI and database, are included in the system and are functioning correctly.
- Functionality verification – Verify that all system functions are working normally as set

forth in the contract.

- Performance Testing – Verify that the system throughput, timing and response time requirements are satisfied. Tests shall include verification of:

  - ❖ Data exchange times
  - ❖ Local and remote request response times
  - ❖ Communication latency
  - ❖ User Interface function response time

- Security Testing – Verify that the system meet the software at delivery security requirements and other aspects of secure operation and system access including:

  - ❖ Communication error detection capabilities
  - ❖ Correct operation of system configuration, control, maintenance, and management procedures
  - ❖ Safe system recovery with no erroneous data or control operation generation after system restarts
  - ❖ Protection against unauthorized access to the system and control functions

- Environmental Testing – Verify that

  - ❖ All system functions shall operate correctly over the specified temperature range
  - ❖ The accuracy of the inputs and outputs remain valid over the specified temperature range.

The test schedule shall allow sufficient time for verification and/or additional unstructured testing by the RLDC/Employer's representative, who shall be able to schedule unstructured testing at any time, including during structured tests.

3. Site Acceptance Test (SAT)

The SAT will be conducted by the OWNER with support as required from the vendor after the system has been installed and commissioned. The system will be subjected to a subset of the functional and performance tests. The SAT will also include any type of testing that could not be performed in the factory. Unstructured tests will be employed by the Employer/RLDC's representative, as necessary, to verify overall system operation under field conditions. Any defects or design errors discovered during the SAT shall be corrected by the Vendor. The SAT includes the commissioning test, the functional and performance test, and the cyber security audit after the installation of the delivered system.

3.1 Commissioning Test

The commissioning tests shall be conducted by the vendor and include:

- The same visual inspection and verification as in FAT

- Loading of the software and starting the system. At the option of the Employer, all software shall be recompiled from the source or distribution media.
- Interface of the AMR and MDP System to communications facilities for all data sources and other systems that interface with the AMR System.
- Initialization and preliminary tuning of application software as needed.

3.2 Site Functional and Performance Test

The site functional and performance test ("site test") shall be comprised of a subset of the functional and performance tests conducted in FAT. The tests to be performed shall be proposed by the Contractor and approved by Employer in consultation with RLDC. These tests shall be extended as necessary to test functions simulated during the FAT, such as communications with all field devices and all other systems that interface with the CDCS.

3.3 Site Cyber Security Audit

The site cyber security audit shall repeat the audit performed during factory testing in every year during Annual maintenance.

3.4 Test Approval

The Vendor shall maintain a complete computer record of all test results with variance reporting and processing procedures for approval by Employer and RLDC. In the event that the AMR/MDP system does not successfully pass any portion of the Acceptance Testing, the Vendor shall notify the Employer and RLDC of the specific deficiency. The Vendor shall promptly correct the specified deficiency, which will then be re-tested until successful.

IX. TRAINING REQUIREMENTS

Comprehensive training programs shall be provided to enable the efficient and effective use and operation of the deployed system by users of the system, and to develop a self-sufficient hardware and software support team within CTU, RLDC, SLDCs and the registered users of RLDC.

Training shall include, where appropriate, a combination of formal training classes, workshops, as well as continuous (informal) knowledge transfer from the Vendor's technical specialists to the personnel of RLDC and its constituents during the deployment process and after the commissioning of the AMR and MDP system. In-person training sessions could be offered at Vendor's location or at the CTU/RLDC/Employer own facilities or any other locations of choice by both parties.

1. Training for personnel at Generating/Transmission substation where IEM is installed

Hands on training program for personnel at Generating Stations/Transmission substation shall cover the following:

- Features of IEM, DCU, Communication Interface.
- IS/IEC protocols.
- Extension of Auxiliary Supply, CT/PT connection.
- Time synchronization through station GPS, Time correction through software.
- Data downloading from IEM.
- Data uploading through web interface.
- Installation of software in local PC/Laptop.
- System Diagnostics.

Minimum duration of training session shall be 3 hours.

Soft and hard copy of the training manual shall contain Step by Step procedure (on screen shot type and desktop video capture) for

- Installation/Re-installation of software in to Laptop / PC.
- Meter maintenance/site-testing procedure as per relevant IS/IEC standard.
- Procedure for data downloading from Meter by Laptop/Desktop PC.

2. Training programs for system users

Training program for system users shall include but not restricted to the following:

- System overview including system functionalities and features.
- System configuration and operations oriented training.
- System alarms handling.
- Local/Remote configuration procedures.
- Engineering oriented training for development/testing.
- Minimum classroom training for a group of system users shall be 18 hours (6 hours x 3 days). Minimum hands-on training for a team of system users shall be 48 hours (6 hours x 8 days). The group shall comprise of representatives from RLDCs, SLDCs, RPC, NLDC, CTU, Registered Users of RLDC etc.

3. Training program for system hardware and software support team

Training program for hardware and software support team shall include but not restricted to the following:

- System overview including system design and detailed as-built system configuration information
- System software maintenance
- System hardware maintenance
- Engineering oriented training for development/testing
- System diagnostics and troubleshooting oriented training for engineers and technicians
- Minimum training for hardware and software support team shall be 18 hours (6 hours x 3 days). The software support team shall comprise of representatives from RLDC.

The bidder shall prepare and provide a description of the proposed training programs with course content, and technical level of the instruction for review and approval by the Employer and RLDC at the beginning of the deployment, and shall work with the RLDC to schedule, organize and execute the approved training programs.

Two hard copies and one soft copy of operating manual of the meter and DCU/AMR/MDP containing all details shall be made available to Employer and RLDC each.

X. SUPPORT AND MAINTENANCE REQUIREMENTS

Vendor shall provide onsite as well as remote support in order to keep system operational with system functionalities and performance in accordance with the specifications.

1. Scope of Warranty/O&M/AMC

During warranty/O&M/AMC period, vendor would be responsible for repair/ replacement/ modification/ rectification of software, hardware either manufactured or bought out, updation of software used in AMR and MDP scheme all times without any extra charges to Employer/RLDC.

2. On-Site Support and Maintenance

Vendor shall maintain a team of skilled personals having sufficient knowledge of the system in order to diagnose and set right any problem in AMR and MDP system in minimum time. Since, the locations of DCUs under this AMR system is geographically spread across entire Region, the vendor shall locate its supporting personals so as any problem may be attended within next

working day of reporting.

Vendor shall maintain an online web based help desk system on its own website for logging complaints and checking the resolution status round the clock on all days of the year. Web based help desk shall be accessible to the user through browser via Internet. Separate username and password shall be provided with separate privileges for users of central site as well as DCUs site.

Vendor shall post one Full Time Equivalent (FTE) resident engineer to central site (RLDC) throughout the warranty/O&M/ AMC period in order to diagnose and set right any problem in AMR/MDP/reporting system in minimum time. He/she shall coordinate with the substation personnel and the back end team of the vendor for complaint resolution. Resident engineer shall be provided with mobile phone for communication for escalation of complaint. Vendor shall maintain this mobile phone live and shall maintain same number throughout the contract period.

3. Remote Support and Maintenance

No remote login shall be permitted.

4. Upgradation and Patches

Vendor shall keep updated all supplied software kernel/OS and application software with all latest patch and upgrade. There shall be no separate liability for License renewable on the system user.

5. Maintenance and Support Of Brought Out Items

Vendor shall take back-to-back support from manufactures of bought out items like servers, printers and like items. However, vendor shall be responsible for all coordination work from OEM for all types of support and maintenance.

6. Maintenance and Support for Communication Channels

Vendor shall be responsible for all coordination with communication channel service provider like availability of channels, utilization, data volume certification etc. Bidder shall provide web based access to Network Management System and make it to RLDC and POWERGRID. Billing and payment of monthly and/or yearly bills will also be settled by the vendor to communication services provider. Channel utilization charges and rental charges of communication channels as billed by communication service provider shall be reimbursable to the vendor by POWERGRID against original documents. Bidder should estimate the optimum plan of service provider for each location & submit to POWERGRID before taking any connection.

7. Charges for support services

All recurring expenditure for support services shall be borne by the vendor.

8. Problem/Defect Escalation Order

The successful bidder shall submit their organization's escalation order for this project in the following format:

Vendor Executive Details	Description	Escalation Order
Name Designation Email ID Mobile number	Overall accountability	4th level
Name Designation Email ID Mobile number	RLDC Department head to interact if there is any change in business requirement or some change request need to be implemented within the existing contract or any other issue that need to have a mutual consent to move forward and if the problem/defect in the existing software is not resolved within the specified resolution time.	3rd level
Name Designation Email ID Mobile number	RLDC Team Lead to report if any concerns and some items within the scope need to be fixed in priority	2nd level
Name Designation Email ID Mobile number	Interaction with RLDC Team, to provide support, resolve the defects and work together for seamless operation.	1st level

Table XI-1- Escalation Matrix

9. System Availability and Recovery of Charges

The nature of maintenance support required for systems and components are described in the Table XI-2 below:

Sl. no.	System	Scope	System Availability
1	AMR system (Data collection and storage in database)	Hardware and software	99.9 %
2	Meter Data Processing, Energy Accounting and DSM accounting software	Hardware and software	99.9 %

Table XI-2- System availability requirement

Bidder shall be responsible for coordination with the OEM for all matter related to that equipment. The bidder shall also be responsible for meeting the overall response times and availability requirements as specified in the specification.

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

(a) Preventive Maintenance Activity (performance monitoring, system backup, patch management, updates, emergency response and troubleshooting)

(b) Maintaining a minimum no. of specified spares.

(c) Integration of new module etc.

9.1 Preventive Maintenance Activity

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

- Repair / replacement of defective equipment -The bidder shall be responsible for repair/replacement of all the hardware including consumables required for the various systems.
- Monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components.
- Providing all necessary assistance to Owner for addition and modification of database, Database sizing activities including Backup and restore of the system.
- Restoration of the systems upon its failure and to restore the functioning of the various systems.

9.2 Hours of Cover

The vendor shall provide engineers who have an experience and skill to maintain the AMR/MDP system to the desired level of availability. The vendor's on-site support for Control centre shall be standard hours of service i.e. Monday to Friday- 9:00 am to 5:30 pm local time (IST) throughout a year.

One expert Engineer on FTE basis having expertise in metering system shall be available during the standard hours of service at RLDC. The timings for Emergency Support shall be 24 hours a day, 7 days a week throughout the year.

Vendor and its personal have to follow all rules and regulations of owner's office premises in view of owner's certifications of ISO-9001, ISO-14001, OHSAS-18001 and ISO-27001 including any other future certification.

9.3 Problem/Defect Reporting

The bidder shall submit an appropriate problem/defect reporting procedure to meet the requirement of all severity level cases to get the approval of the same from Employer/RLDC

The problems will be categorized as follows:

Severity 4 – Emergency	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability. For e.g. system crash/both servers are not working.
Severity 3 – Serious	Degradation of services or critical functions such as to negatively impact system operation. Failure of any redundant system component such that the normal redundancy is lost. For e.g. meter data of a whole station is not available/both main & standby meter data not available/Main server not working, system shifted on standby server.
Severity 2 – Minor	Any other system defect, failure, or unexpected operation. For e.g. Main meter data is not available, however standby/check meter data is available.
Severity 1 – General	Request for information, technical configuration assistance, "how to" guidance, and enhancement requests.

Table XI-3- Severity Levels

9.4 Response and Resolution Time

This section describes the target times within which the bidder shall respond to support requests for each category of severity. The Initial Response Time is defined as the period from the initial receipt of the support request (email/telephone/fax or any other communication channels) and the acknowledgment of the vendor subject to the Maximum time defined in Table XI-4. The Action Resolution Time shall be computed after the expiry of the ideal initial response time subject to the Maximum time defined in Table XI-4.

This period includes investigation time and consideration of alternative courses of action to remedy the situation. The Action is defined as a direct solution or a workaround.

Except for Severity Level 4 all response and resolution times (hours and days) specified below are working hours only:

Severity	**Ideal Initial Response**	**Action Resolution Time(Max.) (to be commenced after**	**Action**

	Time	end of ideal initial response time)	
4	1 hour	6 hours	An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored – may be by workaround.
3	3 Hours	12 Hours	Attempt to find a solution acceptable to Owner (dependent on reproducibility) as quickly as practical.
2	8 hours	2 days	Evaluation and action plan. Resolution time is dependent on reproducibility, ability to gather data, and Owner's prioritization. Resolution may be by workaround.
1	1 day	4 days	Report on the problem/query is to be furnished.

Table XI-4 - Emergency Support Response/Resolution Time

The bidder shall submit the detailed format and procedure for all the activities such as Reporting time, Resolution time, Downtime etc. along with the bid proposal.

9.5 Availability and Payment charges Calculation

It is the endeavor of both the bidder and owner to maximize system availability to the extent possible. The bidder shall provide guaranteed availability for various types of Systems as specified in Table XI-2. The non-availability hours for availability calculation shall be counted from the end of the allowed Action Resolution time. The web based help desk software application shall have features for complaint reporting, severity level assignment, initial response time stamping, remarks of the resident engineer regarding actions taken, complaint resolution time stamp and statistics for computing duration of system outage under different severity level categories. There shall be separate login for RLDC/Employer for certification of the complaint resolution time. The complaint resolution time stamp shall be generated only after endorsement/acknowledgement by RLDC engineer in-charge.

Duration of outages over and above the Action Resolution time, as defined in Table XI-4 in each of the Severity levels shall be counted for the non- availability computation and shall be clearly brought out in the web based help desk. The resolution may be accomplished by a work around, and such solution shall mark the end of non-availability.

In the event of frequent failures at a site, due to a common cause, the first FPR (Field Problem

Report) logged shall be used for the purpose of availability calculation. However, simultaneous multiple outages due to unrelated cause would be counted separately.

9.6 Availability computation for AMR/MDP System

System availability is envisaged for overall data availability at RLDC whether by AMR or manually.99.9% data availability is to be ensured with the help of AMR and manual data.

Availability shall be computed on weekly basis. The formula to be used for availability computation would be as under:

$$\text{Availability per week} = \{THQ - (S4 + S3 + S2 + S1)\} \times 100\%$$

Where THQ is total hours in the week

S1 is the total non-available hours in Severity Level-1 in the week. S2 is the total non-available hours in Severity Level-2 in the week. S3 is the total non-available hours in Severity Level -3 in the week. S4 is the total non-available hours in Severity Level -4 in the week. The target availability would be 99.9 % or better.

9.7 Payment of maintenance charges (based on the total System availability)

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

Availability of the system per week	**Deduction in the AMC/O&M charges for the week**
More than or equal to 99.9%	NIL
Less than 99.9%	Deduction of 1% of the apportioned weekly AMC/O&M charges for every 0.1 % or part there of decrease in data availability from Target Availability subject to maximum deduction of 20%

Table XI-5- Deduction against less availability

The computation of Availability / Non-availability would be rounded up to 2 decimal places at Control Centre on weekly basis and any deduction in the maintenance charges thereof would be calculated as stated above on pro-rata basis.

9.8 Reliability Indices

The following reliability indices shall also be automatically generated on weekly basis from CDCS and archived for download on demand.

9.8.1 System Average Interruption Duration Index

The System Average Interruption Duration Index (SAIDI) shall measure the average duration for which the meter data was unavailable during a week. An Interruption shall be defined as the non-availability of meter data at RLDC end at the scheduled hour (for e.g. at 09:00 hrs everyday)

To calculate SAIDI, each interruption during a week shall be multiplied by the duration of the interruption to find the interruption time during which meter data was not available at RLDC. The time duration of all such interruptions would then be summed up to determine the total unavailability minutes. To find the SAIDI value, the total unavailability minutes would be divided by the total no. of meters. The formula is

SAIDI = Σ(ri * Ni) / NT

Where,

SAIDI = System Average Interruption Duration Index in minutes. Σ = Summation function.

ri = Restoration time in minutes.

Ni = Total number of meters interrupted.

NT = Total number of meters in the system.

For example the SAIDI for a sample week having three cases of interruptions is computed in the table below. It is assumed that the interruption and restoration in each case occurred simultaneously. It is further assumed that the system has a total of 1,500 meters.

Date of Interruption	No. of meters whose data was unavailable at RLDC	Interruption Duration (minutes)	Unavailability minutes
Date-1	50	120	6000
Date-2	25	240	6000
Date-3	100	30	3000
Total			**15000**

Table XI-6 – Calculation of unavailability minutes

The SAIDI for the above case would be

SAIDI = 15000/1500 = 10 minutes.

This implies that on an average, each meter was out for 10 minutes in the above week.

9.8.2 Average Service Availability Index (ASAI)

The Average Service Availability Index (ASAI) would be the ratio of the total number of minutes that meter data was available during a week to the total minutes in the week (7 x 24 x 60 = 10080). This is sometimes called the service reliability index. The ASAI shall be computed as

ASAI = [1 – (Σ (ri * Ni) / (NT * T))] * 100

Where,

ASAI = Average System Availability Index, percent. Σ = Summation function.

T = Time period under study in minutes.

ri = Restoration time in minutes.

Ni = Total number of meter data interrupted.

NT = Total number of meters installed in the system.

The ASAI value for the sample week based on the interruption data reported in Table XI-2 would be as under

The meter data unavailability minutes = 15000.

Study period = 7 x 24 x 60 = 10080

ASAI = [1 – (15000 / (1500 x 10080)] * 100

ASAI = 99.90%

XI. WARRANTY

Part-A (Meter)

a. The IEM shall be under warranty for 60 months from the date of installation. The bidder shall be responsible for meter testing as per CEA metering regulations. Support and maintenance during 5 years extended period after expiry of warranty period.

b. The warranty would include repair, replacement, part material replacement cost and both way transportation cost (including insurance of transit).

c. Meter software, if upgraded by OEM should be supplied free of cost with initiation taken from party. Remote service person name to be indicated during bidding.

d. Meters which are found defective/inoperative at the time of installation or become inoperative/defective within the warranty period, these defective/inoperative meters shall be replaced within one week of receipt of report for such defective/inoperative meters.

e. Copy of warranty certificate shall be submitted to owner.

Part-B (AMR +MDP System)

a. The AMR system and MDP software shall be under warranty for a period of 5 years from the date of successful commissioning.

b. The warranty shall include repair, replacement, part material replacement and both way transportation cost (including transit insurance) of the hardware items in the AMR system and MDP software.

c. The software developed shall be kept under warranty for a period of 5 years from completion of SAT (site acceptance test) and issuance of TOC. Necessary support towards un-interrupted operation of the software along with support for integration with third party software shall be ensured during warranty period. For the warranty period, bidder shall provide on-site, web and telephonic support for application support, as & when required, on all days of the week. In case site visit is necessary for the software system restoration/ upgradation, all such required visits shall be free and without any additional financial implication.

d. During the warranty period, the bidder shall implement the modifications in the software to implement amendment in CERC Regulations regarding metering and energy accounting.

XII. ANNUAL MAINTENANCE CONTRACT

After successful completion of warranty period Employer/RLDC, at their sole discretion, may decide to avail annual maintenance service from the successful bidder for providing technical/hardware support for the AMR system and the software system under the Annual Maintenance Contract (AMC). In such event, RLDC shall issue separate award of contract for the AMC.

XIII. SPARES/FUTURE REQUIREMENT

Bidder shall maintain sufficient number of IEMs as spares/future requirement at each substation/Generating station.

XIV. REFERENCES

a. CEA (Installation & Operation of Meters) Regulations 2006 available at http://www.cea.nic.in/meteringreg.html
b. Functional Requirement of AMI – CEA report available at http://www.cea.nic.in/reports/others/god/dpd/ami_func_req.pdf
c. CERC Regulations on IEGC, DSM, Congestion Alleviation, Ancillary Services, Sharing of Transmission Charges as available at http://www.cercind.gov.in/updated_consolidated_reg1.html
d. Report on Scheduling, Accounting, Metering and Settlement of Transactions in Electricity "SAMAST", http://www.forumofregulators.gov.in/Data/WhatsNew/SAMAST.pdf

Email **N. S. Mondal**

Draft Technical specifications (TS) of 5/15 minutes IEM with AMR, MDP system-reg

From : N. S. Mondal <mserpc-power@nic.in> Thu, Feb 04, 2021 06:37 PM

Subject : Draft Technical specifications (TS) of 5/15 minutes IEM with AMR, MDP system-reg 2 attachments

To : Gridco <sgm.pp@gridco.co.in>, SLDC Patna <sldc.bseb@gmail.com>, SLDC DVC <dvcsldc@gmail.com>, JSEB Ranchi SLDC <sldcranchi@gmail.com>, SLDC GRIDCO <sldcgridco@yahoo.com>, SIKKIM SLDC <sikkim.sldc@gmail.com>, chiefengineercr@gmail.com, secypower sikkim <secypower.sikkim@gmail.com>, acepowersikkim@gmail.com, srgmppgridco@yahoo.com, subrata ghosal <subrata_ghosal@dvcindia.org>, rekolbsphcl@gmail.com, cetransom bsptcl <cetransom.bsptcl@gmail.com>, ceptp wbsedcl <ceptp.wbsedcl@gmail.com>, SLDC WB <wbsldc.enac@gmail.com>, jseb commercial (coml.rev@rediffmail.com) <coml.rev@rediffmail.com>

Cc : nsmondalcea <nsmondalcea@yahoo.com>, SHYAM KEJRIWAL <shyam.ies11@gmail.com>, Shishir Pradhan <shishir.1505@gmail.com>

Sir,

As per NPC, CEA letter dated 02.12.2020, a Joint Committee comprising of members from RPCs, CEA, PGCIL/CTU & POSOCO has been constituted to finalize the Technical Specification (TS) of the 5/15 minute IEMs (Interface Energy Meters) with AMR, MDP system. Subsequently, NPC, vide email dated 28.01.2021, has circulated a **draft Technical specification (TS) in two parts**.

In this matter, the constituents of Eastern Region are requested to go through both the parts of draft Technical Specifications and furnish your views/comments to ERPC Secretariat (at mserpc-power@nic.in) and NPC Division, CEA (at cenpccea@gmail.com) within a week.

Regards,

Office of Member Secretary,
Eastern Regional Power Committee
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TS part 2.docx
926 KB

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184 KB