Metering Code-2019
for
Intra-state Transmission System
Maharashtra.

(MERC Approved)

CE (STU)- 1705
Date: 06/12/19

महाराष्ट्र विद्युत नियामक आयोग
Maharashtra Electricity Regulatory Commission

MERC/ DSM /STU/2019-20/ 1141 **Date: 5 December 2019**

Chief Engineer,
State Transmission Utility,
Maharashtra State Electricity Transmission Company Ltd.,
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Bandra, Mumbai 400 051

Subject: Approval of Metering Code for Intra-State Transmission System in the State of Maharashtra

Ref: -MSETCL/CO/STU/ABT 065987 dated 3 September 2019

Sir,

This has reference to the Metering Code for Intra-State Transmission System in the State of Maharashtra submitted by STU vide letter dated 3 September 2019 for approval of the Commission.

I am directed to inform you that the Commission has approved the said Metering code and the same is enclosed herewith. Further, it is also informed that the said Metering Code need to be uploaded on your website at the earliest.

Yours sincerely,

(Prafulla Varhade)
Director (EE), MERC

Encl.: - Approved Metring Code

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MAHATRANSCO
Maharashtra State Electricity Transmission Co. Ltd.

METERING CODE FOR INTRA-STATE TRANSMISSION SYSTEM OF MAHARASHTRA

(Pursuant to Section 34 of State Grid Code)

Prepared by

State Transmission Utility

Approved by

Maharashtra Electricity Regulatory Commission

(Vide Letter dated 5 December 2019)

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METERING CODE FOR INTRA-STATE TRANSMISSION SYSTEM OF MAHARASHTRA

1. Introduction

1.1. These regulations may be called **Metering Code for Intra-State Transmission System (InSTS) of Maharashtra** and shall come into force immediately on approval of the Commission.

1.2. Metering code prescribes a uniform policy in respect of electricity metering in the InSTS and provide the minimum requirements and standards for installation and operation of meters for commercial and operational purposes for the State Transmission Utility, Transmission Licensees, and Users connected to InSTS.

1.3. This Metering Code has been prepared by the State Transmission Utility (STU) in pursuance of Regulation 34 of the State Grid Code Regulations and forms the integral part of the State Grid Code. This Metering Code shall repeal the existing Metering Code, 2006 formulated under State Grid Code Regulations.

2. Objective

2.1. The objective of the code is to define minimum acceptable metering standards for the purpose of accounting, commercial billing, and settlement of electrical energy in InSTS and also to provide system information for operation of State power system in economical and efficient manner by MSLDC.

2.2. The Metering Code provides for type, standards, ownership, location, accuracy class, installation, operation, testing and maintenance, access, sealing, safety, meter reading and recording, meter failure or discrepancies, anti-tampering features, quality assurance, error compensation, and periodical testing of meters, additional meters, and adoption of new technologies in respect of following meters for correct accounting and billing of electricity:

(i) Interface meters for InSTS,

(ii) Meters for Consumer directly connected to InSTS,

(iii) Meters for Generators directly connected to InSTS.

(iv) Meters for energy accounting in InSTS.

3. Scope and Applicability

3.1. This Metering Code for InSTS shall apply to following in the State of Maharashtra:

1. Transmission Licensees,

2. Generating Stations including Renewable Energy Generators connected to InSTS,
3. Distribution Licensees connected with InSTS including Deemed Distribution Licensees connected to the network,
4. EHV Consumers of Distribution Licensee directly connected to InSTS,
5. Transmission System Users connected to InSTS,
6. Open Access Consumers connected to InSTS,
7. Captive Generators connected to InSTS,

4. Reference Standards

4.1. All interface meters, consumer meters and energy accounting meters shall comply with the relevant standards of Bureau of Indian Standards (BIS). If BIS Standards are not available for a particular equipment or material, International Electro-technical Commission (IEC) Standards, CBIP Technical Report or any other equivalent Standard shall be followed.

4.2. Whenever an international Standard or IEC Standard is followed, necessary corrections or modifications shall be made for nominal system frequency, nominal system voltage, ambient temperature, humidity and other conditions prevailing in India before actual Adoption of the said Standard.

4.3. The following Indian Standards (amended up to date) shall be applicable as relevant to meters and associated equipment:

Sr. No.	Standard Number	Standard Title
i.	IS -14697:1999	Specifications for AC Static Transformer operated Watt Hour & VAR-Hour meters, class of 0.2S and 0.5S.
ii.	IS 2705	Indian Standard for Current Transformers
iii	IS 3156	Indian Standard for Voltage Transformers
iv.	IS 9348	Indian Standard for Coupling Capacitors and Capacitor Divider
v.	IS 5547	Indian Standard for Capacitor Voltage Transformer
vi.	CBIP -304	Standardization of AC static Electrical Energy Meters.
vii.	CBIP Technical Report – 111	Specification for Common Meter Reading Instrument
viii.	IS 9000	Basic Environmental Testing Procedures for Electronic & Electrical Items
ix.	IS 12063	Indian Standard for classification of degrees of protection. (IP)

x.	IS-15959:2011	Data Exchange for Electricity Meter Reading Tariff & Load Control- Companion Specification.
xi.	IEEE 830-1998	IEEE Recommended Practice for Software Requirements Specifications

4.4. The following International Standards (amended up to date) shall be applicable as relevant to meters and associated equipment not complying to Indian Standards or not manufactured in India:

Sr. No.	Standard Number	Standard Title
i.	IEC 62053-22	Electricity metering equipment (AC) – Particular requirements- Part 22: Static meters for active energy (classes 0.2 S and 0.5 S)
ii.	IEC 62053-23	Electricity metering equipment (AC) – Particular requirements- Part 23: Static meters for reactive energy (classes 2 and 3)
iii.	IEC 62052-11	Electricity metering equipment (AC) – General requirements, tests and test conditions- Part 11: Metering equipment
iv.	IEC 62053-21	Electricity metering equipment (AC) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)
v.	IEC 62056	Standards for Electricity metering data exchange

4.5. Standards for installation and operation of meters

The meters and metering equipment shall conform to the requirements of the CEA (Installation & Operations of Meters) Regulations,2006 dated 17March 2007, as amended from time to time, and standards prescribed thereunder.

5. Definitions

5.1. In the Metering Code for InSTS of Maharashtra, the following words and expressions shall, unless the subject matter or context otherwise requires or is inconsistent therewith, bear the meaning given hereunder:

1) **'Act'** means the Electricity Act, 2003;

2) **'Accredited Test Laboratory'** means a test laboratory accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL);

3) **'Active Energy'** means the electricity supplied or consumed during a time interval, being the integral of Active Power with respect to time, measured in the units of 'Watt – hours' or standard multiples thereof. One 'kilowatt – hour' (kWh) is one unit;

4) **'Active Power'** means the electrical power, being the product of root mean square (rms) voltage, root mean square (rms) current and cosine of the phase angle between

the voltage and current vectors and measured in units of 'Watt' (W) or in standard multiples thereof;

5) **'Appropriate Load Dispatch Centre'** means 'National Load Dispatch Centre'(NLDC) or 'Regional Load Dispatch Centre' (RLDC) or the 'State Load Dispatch Centre' (SLDC) which includes any 'Area Load Dispatch Centre' (ALDC) attached to SLDC as the case may be;

6) **'Appropriate Transmission Utility'** means the 'Central Transmission Utility' (CTU) or the 'State Transmission Utility' (STU), as the case may be;

7) **'Buyer'** means a person, including distribution licensee, deemed distribution licensees or open access consumer, purchasing electricity through a transaction scheduled in accordance with the regulations applicable for short-term open access, medium-term open access and long-term access;

8) **'Check Meter'** means a meter, which shall be connected to the same core of the Current Transformer (CT) and Voltage Transformer (VT) to which main meter is connected and shall be used for accounting and billing of electricity in case of failure of main meter;

9) **'Correct Meter'** means a meter, which shall at least have, features, Accuracy Class and specifications as per the clause 12 and 15 of these Regulations;

10) **'Energy Accounting Meters'** means meters used for accounting of the electricity to various segments of electrical system so as to carry out further analysis to determine the consumption and loss of energy therein over a specified time period;

11) **'Instrument Transformer'** means the 'Current Transformer'(CT), 'Voltage Transformer' (VT) and 'Capacitor Voltage Transformer' (CVT);

12) **'Interface Meter'** means a meter used for accounting and billing of electricity, connected at the point of interconnection between electrical systems of generating company, licensee and consumers directly connected to the Inter-State Transmission System or InSTS, and have been permitted open access by the Appropriate Commission;

13) **'Main Meter'** means a meter, which would primarily be used for accounting and billing of electricity;

14) **'Meter'** means a device suitable for measuring, indicating and recording consumption of electricity or any other quantity related with electrical system.

15) **'Metering System'** means a system for measuring, indicating and recording consumption of electricity or any other quantity related with electrical system and shall include meter, Current Transformer, Voltage Transformer, Capacitor Voltage Transformer, Lead cables etc. whichever applicable for such purpose.

16) **'Power Factor'** means the cosine of the electrical angle between the voltage and current vectors in an AC electrical circuit;

17) **'Reactive Energy'** means, the integral of Reactive Power with respect to time and measured in the units of 'Volt-Ampere hours reactive (VARh) or in standard multiples thereof;

18) **'Reactive Power'** means the product of root mean square (rms) voltage, root mean square (rms) current and the sine of the electrical phase angle between the voltage complex or and current complex or, measured in 'Volt – ampere reactive' (VAr) and in standard multiples thereof;

19) **'Seller'** means a person, including a generating station or unit of generating station, supplying electricity through a transaction scheduled in accordance with the regulations applicable for short term open access, medium-term open access and long-term open access;

20) **'Special Energy Meters'** means such meters, of not less than 0.2S class accuracy, as are capable of:

   i. Recording time-differentiated measurements of active energy and voltage differentiated measurement of reactive energy, at intervals of fifteen (15) minutes, and five (5) minutes;

   ii. Onsite configuration for 15 min. or 5 min. interval whichever is applicable. Meter configuration/programming shall be carried out by authorized representative of STU only.

   iii. storing such measurements for not less than fifteen (15) days for 5 min. interval and forty five (45) days for 15 min. interval;

   iv. communication of such measurements at such intervals as maybe required by the State Load Dispatch Centre for balancing and settlement of energy transactions;

   v. Shall be DLMS protocol compliant, Communicable and have the intelligence to synchronize the time with GPS (Local GPS/CDCS GPS) signal.

21) **'Standards'** means Standards on Installation and Operation of meters given in these Regulations unless otherwise any other standard specifically referred;

22) **'Standby Meter'** means a meter connected to CT and VT or CVT, other than those used for main meter and check meter and shall be used for accounting and billing of Electricity in case of failure of both main meter and check meter;

23) **'Supplier'** means any generating company or licensee from whose system electricity flows into the system of another generating company or licensee or consumer;

24) **'Time of the Day (TOD) Meter'** means a meter suitable for recording and indicating consumption of electricity during specified time periods of the day.

25) **'DLMS- Device Language Message Specification'**- with the objective to provide an interoperable environment for structured modeling and meter data exchange. Applications like remote meter reading, remote control and value added services for metering any kind of energy like electricity are supported.

26) **'AMR- Automated Meter Reading System'**-The scheme to automate the task of data collection from each meter/location to MDAS at the central location.

27) **'MDP- Meter Data Processing'**-Data Validation, processing and generation of customized reports of received data from AMR at SLDC.

5.2. All other words and expressions used and not defined herein have the meanings respectively assigned to them in the Act or CEA Regulation or other relevant Regulations of the Commission, the State Grid Code or Indian Electricity Grid Code (IEGC).

6. Ownership

6.1. Interface meters

6.1.1. All interface meters installed at the points of interconnection with InSTS excluding meters installed at the points of interconnection with Inter-State Transmission System (ISTS) for the purpose of electricity accounting and billing shall be owned by STU.

6.1.2. Interface Meters installed at the points of interconnection with ISTS for the purpose of electricity accounting and billing shall be owned by CTU.

6.1.3. All interface meters installed at the points of inter connection between the two licensees excluding those covered under sub-clauses (6.1.1) and (6.1.2) above for the purpose of electricity accounting and billing shall be owned by respective licensee of each end.

6.2. Meters of EHV Consumer directly connected to InSTS shall be owned by STU and maintained by the licensee.

7. Access to meter

7.1. The owner of the premises where, the meter is installed shall provide access to the authorized representative(s) of the other entities for installation, testing, commissioning, reading, and recording and maintenance of meters.

8. Safety of meters

8.1. The supplier or buyer in whose premises the interface meters are installed shall be responsible for their safety.

9. Location of Interface Meters

9.1. The location of interface meters, meters for energy accounting and meters of EHV Consumer directly connected to InSTS shall be as given in Table-1.

Interface Point	Main Meter	Check Meter	Standby Meter
Generation-Transmission (G-T)	**Generating Stations- Conventional Power Plant (IPP)- Directly connected to InSTS bus**		
	i) EHV Side of each Generator Transformer (GT) ii) EHV/HV Sides of each Station Auxiliary transformer (SAT)	In series with the Main Meter.	All outgoing feeders of InSTS bus of generating station.
	Generating Stations- Conventional Power Plant (CPP) - connected to InSTS on dedicated transmission line.		
	1. InSTS end of transmission line. 2. i) EHV Side of each Generator Transformer (GT) ii) EHV/HV Sides of each station Auxiliary transformer (SAT)	In series with the Main Meter.	Other (InSTS) end of transmission line
	Generating Stations- Renewable Power (Co-Gen, Small Hydro, Solar, Wind etc.)		
	1. Radial Connection- a) At the generator end of the line in case the line is part of InSTS. b) At InSTS end of line in case line is not part of InSTS 2. LILO Connection- a) Common Point of LILO & common injection point in case of Generator bus. b) If common injection point is not available i.e. no generator bus, EHV Side of Generator Transformer (GT).	In series with the Main Meter.	1. Radial Connection- Other end of transmission line. 2. LILO Connection- Generator end of lines.
	Generators connected on 11/22/33kVBus of InSTS Substation		

Interface Point	Main Meter	Check Meter	Standby Meter
	HV Side of Generator Transformer (GT)	In series with the main Meter	InSTS end of feeders.
Transmission – Distribution (T-D)	1. If O/G feeders belongs to same Licensee- On each Transformer L.V. side. 2. If O/G feeders belongs to different distribution Licensee- On each O/G feeder of Distribution Licensee	In series with Main Meter	1. If O/G feeders belongs to same Licensee- On each Transformer H.V. side. 2.If O/G feeder belongs to different distribution Licensee- On L.V. side of each transformer
Between two Transmission Licensees (T – T)	On each O/G feeders at S/s. end, to whom belongs the ownership of Transmission Line. **Only CTU-STU interface points to be taken.**	In series with Main Meter	The meter at the other end of line
EHV Consumers directly connected to InSTS (T-D interface at EHV level)	At the consumer premises at the connection point.	In series with Main Meter	a) The meters at the LILO Point at Consumer End b) In case of redial, other end of redial line.
Open Access Customers directly connected to InSTS	Open Access Customers	In series with Main Meter	InSTS end of feeders
Additional Meters	Apart from above locations CE (STU)/ CE (SLDC) shall decide the location of IEM as per prevailing condition.		

10. Installation of meters

10.1. State Transmission Utility (STU), shall examine, test, and regulate all meters before installation **for above interface locations** and only correct meters shall be installed by STU.

10.2. The meter shall be installed at locations, which are easily accessible for installation, testing, commissioning, reading, recording, and maintenance. The place of installation of meter shall be such that minimum inconvenience and disruptions are caused to the site owners and the concerned organizations.

10.3. In case CTs and VTs form part of the metering system, the meter shall be installed as near the instrument transformers as possible to reduce the potential drop in the secondary leads.

11. Type of meters

11.1. All the **IEM** meters at interface point, meters for energy accounting and consumer's meters shall be of static type and DLMS compliant.

11.2. The meters not complying with these requirements shall be replaced by STU from the date of commencement of this Code.

11.3. The Static meters, related hardware, the communication system and the related software shall be such that progressive up-gradation to the newer technologies for improved facilities of data transfer, data security, user friendliness etc. shall be possible without undergoing major replacements.

12. Specification and Accuracy limits

12.1. Technical Specifications of 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, at different locations in the State of Maharashtra. Projection/flush mounted type, Static composite 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 15 min time block or 5 min time block as the case may be. All meters shall be compliant to IS 15959 and its latest amendments.

b. The meter shall be DLMS (Device Language Message Specification) compliant. 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. The Meter serial number within the meter shall be of DLMS standards and defined by the Object Identification System (OBIS) e.g.

S. No	Information	OBIS CODES					
		A	B	C	D	E	F
1	Manufacturer name	0	0	96	1	0	255
2	Meter Serial Number	0	0	96	1	1	255

c. The meters shall be suitable for communication with external device like modem, DCU, etc. which shall be able to communicate with Configurable Data Curation System (CDCS) for local/remote data transfer. The meter shall compulsorily have at least 1 optical port for taking reading through Hand Held Unit (HHU).

d. Auxiliary Supply to IEM- The meters shall normally operate with the power drawn from DC auxiliary power supply (Range 110V to 220V DC) to reduce the VT burden. In addition, there shall be provision to operate the meter from the VT secondary circuit having a rated secondary line-to line voltage of 110V, and CTs having a rated secondary current of 1 A or 5A. Any further transformers/ transactions/ transducers required for their functioning shall be in-built in the meters. Necessary isolation and/or suppression shall also be built-in, for protecting the meters from surges and voltage spikes that occur in the VT and CT circuits of extra high voltage switchyards. The reference frequency shall be 50Hz. Also, the meter shall have suitable of ±15% tolerance for DC supply.

e. 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 mal operation 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 frequency shall be done only for the period during which the VT supply was available in the 5-minute block. Any time block contraction or elongation for clock correction shall also be duly accounted for.

g. The total burden imposed by a meter for measurement and operation shall be defined as per IS 14697. 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. The battery mounting shall be designed to facilitate easy battery replacement without affecting PCB of the meter.

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

i. Each meter shall have a test output device (visual), as per clause 6.11 of IS 14697.1999, 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. However, purchaser/manufacturer may decide on their own. It shall be possible to couple this device to suitable testing equipment also.

j. Exception Management- The three line-to-neutral voltage shall be continuously monitored and in case any of these falls below defined threshold (70% 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 5% to 70% of Vref and if Voltage is less than 5% of Vref, meter should record Zero voltage symbol "Z". There shall also be a provision to generate an alarm/SMS (to predefined mobile numbers) in the software at CDCS in case of VT supply failure or to generate error log.

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 with GPS (Local GPS/CDCS GPS) signal and from PC using software. Limited time synchronization through meter communication port shall be possible at site. When an advance or retard command is given, twelve subsequent time blocks shall be contracted or elongated by five seconds each. Time advance and retard command should be limited to one command/week. All clock corrections shall be registered in the meter's memory and suitably shown on print out of collected data.

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. Preferably the display shall switch off automatically about one minute after the last operation of touch key/push button. When the display is switched on, the parameter last displayed shall be displayed again, duly updated.

m. The data of meter shall be available in text file format (file extension as per IEEE standard/.txt) exportable to Excel. Indication of time retard or advance to be provided without disturbing the proposed format. Each 5-min block data consists of Frequency (in HZ), Active energy (in Wh), Reactive energy (in VARh) and Voltage (in V). All 5 minute Wh and VARh figures in *.npc/output report shall be rounded off upto third decimal. Active and Reactive energy for High and Low voltage conditions to be in the order of 7+1 digits.

n. The Portable Hand held Unit (HHU)/ Common meter reading instrument (CMRI)/ Data Collecting Device(DCD) shall be having IS-15959:2011 compatibility for standardized parameters. The optical coupler for tapping data stored in the SEMs memory shall be compatible universally across different make of SEMs.

o. Constructional Features

i. The meters shall be supplied housed in compact and sturdy, metallic or molded 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. All terminals for CT and VT connections shall be arranged in a row along the meter's lower side. 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, except for transactions allowed in IS15959.

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. They shall have an IP54 category dust-tight construction, and shall be capable of satisfactory operation in an indoor, non-air conditioned installation & outdoor installation in a panel.

iv. Either the meters shall have built-in facility (e.g. test links in their terminals) for onsite testing, or a separate test block shall be provided for each meter.

v. The sealing arrangement should be suitable for application of polycarbonate seals.

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 net active energy (Wh) sent out from the substation bus bars during each successive 5 min /15 min block (whichever applicable), and store it in its memory up to fourth decimal with plus sign if there is net Wh export and with a minus sign if there is net import. Further Wh data in *.npc/output report shall be rounded upto third decimal.

c) The meter shall count the number of cycles in VT output during each successive 5min /15 min block (whichever applicable) block, and divide the same by 300 (60 sec/min x 5min) or 900 (60 sec/min x 15min) as the case may be to arrive at the average frequency. The least count of the frequency data shall be 0.01 Hz.

d) 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%, a better accuracy such as 0.2% in the 97-103% range being desirable. The voltage data shall be stored in the meter's memory in volts up to third decimal. Further Wh data in *.npc/output report shall be rounded upto second decimal.

e) 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. The meter shall compute the net Reactive energy (Net VARh=(VARh Export- VARh Import)) sent out from the substation bus bars during each successive 5 min block, and store it in its memory up to fourth decimal with plus sign if there is net VARh export and with a minus sign if there is net VARh import. It shall also display on demand the net VARh sent out during the previous 5 min block. Further Wh data in *.npc/output report shall be rounded up to third decimal.

f) 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), with a minus sign if negative, 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 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 and configure the meter accordingly to ensure correct recording of reactive energy. For Reactive High & Low recordings, PT secondary voltage shall be configured in the meter. Therefore, it is required that the same shall be confirmed from the site. Voltage high and Low parameters should also be available in load survey.

g) 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 busbars.

h) Errors for different power factors shall be as defined in IS14697.

i) 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 class 0.5S.

j) The harmonics shall be filtered out while measuring Wh, V and VARh, and only fundamental frequency quantities shall be measured/computed. Total harmonic distortion (THD) measurement for currents and voltages.

k) Data security shall be ensured as per IS 15959 (three layers of security). Four-quadrant import/export metering for active, reactive and apparent power

3. Memory/ Storage

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

i. Average frequency for each successive 5 min block, in Hertz up to third decimals.

ii. Net Wh transmittal during each successive 5 min block, up to fourth decimal, with plus sign if there is net Wh export and with a minus sign if there is net Wh import.

iii. Net VARh transmittal during each successive 5 min block, up to fourth decimal, with plus sign if there is net VARh export and with a minus sign if there is net MVARh import.

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

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

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

vii. Average RMS voltage for each successive 5min block

viii. 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 forty five (45) days for 15 min. interval and 15 days for 5 min. interval.

c. The software provided at CDCS, i.e. SLDC/ALDC, 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.

4. Display

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

i. Meter serial no. and model: IEM12345678 or IEM12345678

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

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

iv. Cumulative Wh reading: 1234567.8 C

v. Average frequency of the previous block: 49.89F

vi. Net Wh transmittal during the previous block: - 28.75E

vii. Net VARh transmittal during the previous block: - 18.75R

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 register reading: 1234567.4 L

xii. Instantaneous phase voltages

xiii. Instantaneous line currents

xiv. Instantaneous value of average power factor of three phases

xv. Low battery indication

xvi. The three line to neutral voltages shall be continuously monitored and in case any of these falls below 70 %, 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 70 %. The LED shall automatically resume flashing when all VT secondary voltages are healthy again.

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

Any other better or more informative mechanism to display the above shall be preferred. The above shall be mutually agreed between the meter buyer and vendor. Navigation keys to be provided at the meter front plate to navigate the display menu.

5. Communication

a) Each meter must have an optical port on its front for tapping all data stored in its memory through HHU. In addition to the above each meter shall also be provided with a RS-485, RS-232,Ethernet and USB port on one of its sides as per DLMS requirement, from where all the data stored in the meter's memory can also be transferred to CDCS (through DCU), local computer and external storage using DLMS. The overall intention is to tap the data stored in the meter's memories at a scheduled time from any of the above mentioned ports or any other means and transmit the same to a remote central computer using suitable means of communication. It shall be possible to securely download the IEM data through an USB port via external storage thereby removing the requirement of a MRI (Meter Reading Instrument). It shall be ensured that data transfer through USB shall be unidirectional only i.e. from

Meter to external storage device in an authentication process. Meter data shall be tamper-proof.

b) All meters shall be compatible with Optical port, RS-485 port, RS-232, Ethernet port and USB all together at a time and communicate using DLMS independently. It shall also be possible to obtain a print out (hard copy) of all data collected from the meters, using the local PC. Data collection from any local laptop/PC shall be possible by installing data collection software.

6. Testing

a) Meters before dispatch from manufacturer's works, shall be duly tested to verify that it is suitable for supply to the Owner. Routine and acceptance tests shall be carried out on the meters in line with IS 14697.

b) Any meter which fails to fully comply with the specification requirements shall be liable to be rejected by the Owner.

7. Communication ports-

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

i. Downloading Meter Data from the Meter(s) to PC via optical port.
ii. Downloading meter data through USB port.
iii. Downloading meter data to DCU/CDCS through Ethernet port.
iv. Compatibility with PC Software.
v. Functioning of Time synchronization, advance and retard time commands.
vi. Per meter downloading time verification.

8. Type Tests

Type test shall be carried out as per IS14697 and IS15959.

9. General

a. The meter shall be supplied with DLMS latest/compatible software (shall be compatible with old & new meters data download handling). Any new software as required to be installed within warranty period are to be done by party or through remote support to client.

b. The total arrangement shall be such that one (1) operation (click on "data download from meter" button on software) can carry out the whole operation in about five (5) minutes per meter or preferably faster.

c. The layout of software front end/user interface has to be approved by SLDC/ALDC during technical evaluation/demonstration.

d. The software shall be able to convert DLMS/COSEM compliant data to existing format as well as in tabular (.csv) format as applicable. Software for windows/office/antivirus to be supplied. Antivirus should not slow down processes and same will be demonstrated during technical demonstration.

e. Above specification is indicative only, any higher standard required for the purpose intended (meter data handling) would be assessed by STU in consultation with MSLDC and would be supplied accordingly. The detailed architecture shall be approved during drawing approval stage.

f. Meters shall be accommodated in existing C&R panel of standard size in kiosk or C&R panel with door closed. Separate panel may be provided if the space is not available in the C&R Panel.

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

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

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

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

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

10. Automated Meter Data Reading (AMR) System

This section describes the envisaged system architecture of AMR within the Region.

Intent of AMR

The intent of AMR scheme is to automate the task of data collection from each meter/location to the Central Data Collection System (CDCS) followed by validation, processing and generation of customized reports. The data shall be stored in Standard RDBMS database located at Host State Load Dispatch Centre.

AMR shall accept data from interface meters of any make complying prevalent open protocols like DLMS. AMR MDAS shall accept data either directly from the meter or from the DCU as the case may be. It shall have an intelligence to track receipt of data from each meter and also be capable of automatically polling any missed data during communication link failure.

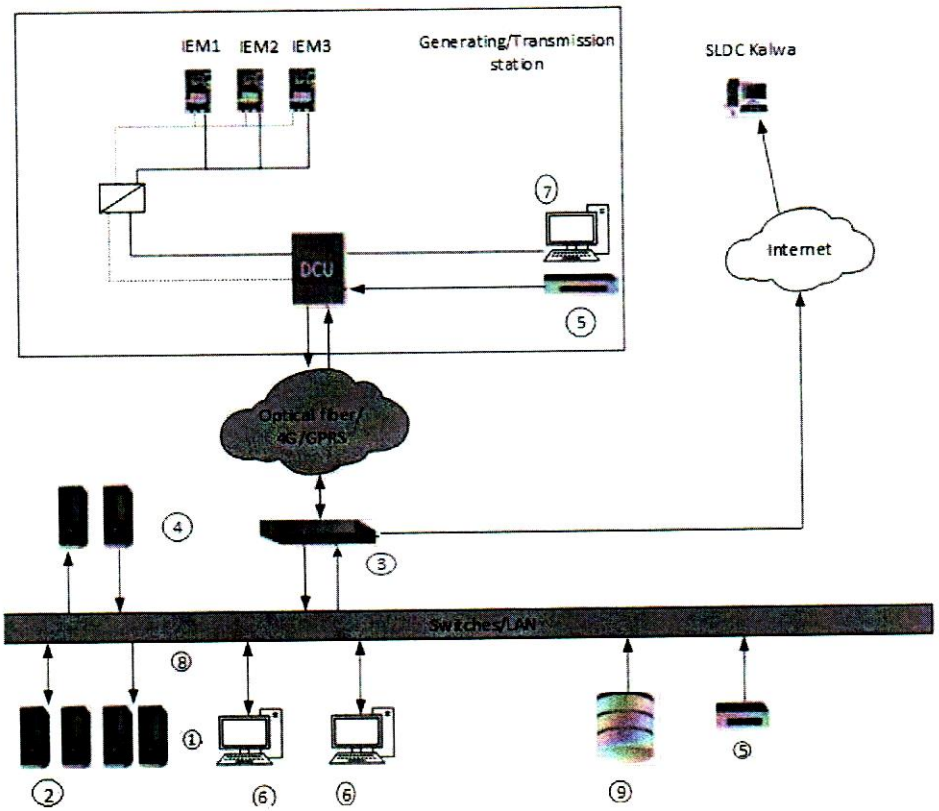

Figure 1: Concept diagram of the envisaged AMR system

Legends

Sr. No	Description
1	Application Server – Main & Standby
2	Database Server
3	Firewall
4	Web Servers
5	GPS clock
6	Client PCs
7	Local PC at site
8	Network Management System (NMS) (to be installed in
9	Storage

12.2. Accuracy Class:

The specification of the main meters and check meters for interface points, meters for energy accounting, and standby meters is given in Table-2

Table 2: Specification of Main and Check Meters for Interface Point meters

Sr.	Parameter	Standards
1	**Standard Reference Voltage**	As per IS
2	**Voltage Range**	The meter shall work satisfactorily on 110 Volts AC (Line-Line) with voltage variation range as per IS
3	**Standard Frequency**	The meter shall work satisfactorily on 50 Hz with variation range of -5% to +5%.
4	**Standard Basic Current**	As per IS (Current range of consumer meters shall be so chosen as to record the load current corresponding to the sanctioned load)
5	**Accuracy Class***	Meters shall meet the following requirements of Accuracy Class: Interface meters - 0.2S(active) - 0.5S (reactive)
6	**Starting Current and Maximum Current**	As per IS
7	**Power Factor Range**	The meter shall work satisfactorily over a power factor range of zero lag to unity to zero lead
8	**Power Frequency Withstand Voltage**	As per IS
9	**Impulse Voltage Withstand Test for1.2/50 micro sec**	As per IS
10	**Power Consumption**	As per IS

* All Interface meters should have accuracy class of 0.2S.

* The accuracy class of Current Transformers (CTs) and Voltage Transformers (VTs) shall not be inferior to that of associated meters. The existing CTs and VTs not complying with these regulations shall be replaced with new CTs and VTs by STU, In case the CTs and VTs of the same Accuracy Class as that of meters cannot be accommodated in the metering cubicle or panel due to space constraints, the CTs and VTs of the next lower Accuracy Class can be installed till it is replaced with CTS and VTs of appropriate accuracy class by STU.

12.3. Data download capability of Meters

All Meters shall have downloading facilities of metered data through Common Meter Reading Instrument (CMRI). CMRI shall be capable of downloading data/information from various makes of AC static energy meters when loaded with the corresponding Meter specific downloading software(s) called Meter reading instrument programs. The CMRI shall be able to extract information about energy data, load survey data, billing parameters, meter status, meter anomaly and tamper data from the memory of the meter and store for retrieval at a later stage. The meter shall be able to store at least 100 tamper events on FIFO basis; which includes PT miss, CT reversal, Voltage unbalance, Current unbalance and power on/off.

12.4. Immunity to External Factors

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.

12.5. Accuracy class of CTs & VTs

The accuracy class of Current transformers (CTs) and Voltage transformers (VTs) shall preferably not be inferior to that of associated meters. The existing CTs and VTs not complying with these regulations shall be replaced by new CTs and VTs in a phased manner. The Voltage Transformers shall be electromagnetic VT or Capacitive Voltage Transformer (CVT).

12.6. Lead Cables

Lead Cables of CTs and PTs shall be of sufficient cross-section for reducing voltage drop to minimum between end connections (connection between cable lead end and CT/PT terminal as well as between cables lead and meter terminals). No joints shall be allowed in lead cables. The burden on metering cores of CTs and PTs including burden of lead cable and Meters connected there to shall not exceeds rated burden.

13. Meter Reading and Recording

13.1. Interface Meters

The meter reading shall be provided by STU to SLDC or data centers through online Automated Meter Reading facility and communicated with suitable medium as detailed out under Deviation Settlement Procedure approved by MERC.

In case of non-functioning of AMR system, it shall be the responsibility of the Transmission Licensee to take down the meter reading and record the metered data, maintain database of all the information associated with the interface meters and

verify the correctness of metered data and furnish the same to SLDC or other agencies as per Deviation Settlement Procedure approved by MERC.

14. Rights of access to metering data

14.1. Authorized representatives of the following entities shall be entitled to have access to the metering data from the metering installed:

a) STU is responsible for the metering installation;

b) The State Load Dispatch Centre;

c) The State Transmission Utility;

d) The consumer of electricity or the generator of electricity at the metering installation as the case may be;

e) Any other person who has an authorization from persons at S. No. a, b & c or from Commission; and

f) The Commission.

15. Sealing of meters

15.1. Sealing Arrangements

All meters shall be sealed by the manufacturer at its works. In addition to the seal provided by the manufacturer at its works, the sealing of all meters shall be done as follows at various meter sealing points.

Sealing of interface meters, shall also be done by both, the supplier and the buyer.

15.2. Sealing Points

Sealing shall be done at the following points (as applicable):

(i) Meter body or cover

(ii) Meter terminal cover

(iii) Meter test terminal block

(iv) Meter cabinet

(v) The CT & VT secondary terminals terminated in the panel links

(vi) Monitoring Seals & Sealing Records

a) A tracking and recording software for all new seals shall be provided by the manufacturer of the meter so as to track total movement of seals starting from manufacturing, procurement, storage, record keeping, installation, and series of inspections, removal and disposal.

b) Seal shall be unique for each utility and name or logo of the utility shall be clearly visible on the seals.

c) Only the patented seals (seal from the manufacturer who has official right to manufacture the seal) shall be used.

d) Polycarbonate or acrylic seals or plastic seals or holographic seals or any other superior seals shall be used.

e) Lead seals shall not be used in the new meters installed at consumer premises. Old lead seals shall be replaced by new seals in a phased manner and the time frame of the same shall be submitted by the licensee to the Commission for approval.

15.3. Removal of seals from meters

15.3.1. Interface meters

Whenever seals of the interface meters have to be removed for any reason, advance notice shall be given to other party for witnessing the removal of seals and resealing of the interface meter. The breaking and re-sealing of the meters shall be recorded by the STU , who carried out the work, in the meter register mentioning the date of removal and resealing, serial numbers of the broken and new seals and the reason for removal of seals.

16. Meter failure or discrepancies

16.1. Interface meters

a) Whenever difference between the readings of the Main Meter and the Check Meter for any month is notified more than 0.5% by MSLDC, the following steps shall be taken by STU in a time bound manner:

(i) Checking of CT and VT connections;

(ii) Testing of accuracy of interface meter at site with reference standard meter of accuracy class higher than the meter under test.

If the difference exists even after such checking or testing, then the defective meter shall be replaced with a correct meter by STU in a time bound manner.

b) In case of conspicuous failures like burning of meter and erratic display of metered parameters and when the error found in testing of meter is beyond the permissible limit of error provided in the relevant standard, the meter shall be immediately replaced with a correct meter by STU.

c) In case where both the Main Meter and Check Meter fails, at least one of the meters shall be immediately replaced by a correct meter by STU. Also, in case

of addition of new feeder in existing installation or establishment of new substations, the interface meters shall be provided and commissioned by STU, with prior approval of MSLDC to the Single Line Diagram of Metering arrangement.

16.2. Billing for the failure period

a) The billing for the failure period of the Meter shall be done as per the procedure laid down in the respective agreement such as PPA, BPTA or as specified under DSM Procedure approved by the Commission.

b) Readings recorded by Main, Check and Standby Meters for every time slot shall be analyzed, cross checked and validated by SLDC. The discrepancies, if any, noticed in the readings shall be informed by the SLDC to the energy accounting agency for proper accounting of energy.

c) SLDC shall also intimate the discrepancies to the STU or the concerned licensee or generating company as the case may be who shall take further necessary action regarding testing, calibration or replacement of the faulty Meters in accordance with the provisions laid down.

d) The defective meter shall be immediately tested and calibrated in time bound manner by STU.

17. Calibration and periodical testing of meters

17.1. Interface meter

a) All interface Meters shall be tested at least once in Three years by the STU at site for accuracy using standard reference meter of better accuracy class than the meter under test. These Meters shall also be tested whenever the energy and other quantities recorded by the Meter are abnormal or inconsistent with electrically adjacent Meters.

b) Whenever there is unreasonable difference between the quantity recorded by interface meter and the corresponding value monitored at the billing center via communication network, the communication system and terminal equipment shall be tested and rectified by STU.

c) The defective Meters may be tested using NABL accredited mobile laboratory or at any accredited laboratory and recalibrated if required at manufacturer's works.

d) Testing and calibration of defective interface meters may be carried out in the presence of the representatives of the supplier and buyer. STU shall send advance notice to the other party regarding the date of testing.

18. Metering Code Committee

18.1. State Transmission Utility shall be responsible for managing and serving the Metering Code for InSTS of Maharashtra with each constituents/Users of InSTS discharging respective obligations under the Code.

18.2. A Metering Code Committee (MCC) shall be constituted by the Grid Coordination Committee (GCC) consisting of following members:

(a) A Chairman from STU, who shall be Director (Operation) MSETCL.

(b) A Member (Secretary) from STU, who shall be Chief Engineer from MSETCL.

(c) Chief Engineer State Load Dispatch Center.

(d) Five representative from of Generating Companies/IPPs in State having maximum generation capacity.

(e) One representative from each Transmission Licensee in the State.

(f) One representative from each Distribution Licensee in the State.

(g) Three representatives from Solar Power Producers having maximum power generation capacity.

(h) Three representatives from Wind Power Producers having maximum power generation capacity.

(i) Three representatives from Bagasse Co-gen Power Producers having maximum power generation capacity.

(j) Two representatives from Hydro Power Producers having maximum power generation capacity.

18.3. The rules to be followed by the committee in conducting their business shall be formulated by the committee itself and shall be approved by Grid Coordination Committee. The committee shall meet and conduct the following functions:

(a) To keep Metering Code for InSTS and it's working under scrutiny and review.

(b) To consider all requests for amendment to the Metering Code for InSTS which any user makes.

(c) To publish recommendations for changes to the Metering Code for InSTS together with the reason for the change and any objection if applicable.

(d) To issue guidance on the interpretation and implementation of the Metering Code.

Any amendments and changes recommended by the Metering Code committee and subsequently approved by the Grid-coordination committee shall be put up to the Commission for approval before they become effective.

19. Mechanism for Dispute Resolution

Any disputes relating to metering amongst STU, other transmission licensees, Transmission system user of InSTS, any Generating Company, Distribution licensees in Maharashtra, any traders registered in Maharashtra, any EHV consumer connected directly to the InSTS and any disputes relating to inter-utility metering between STU and any Generating Company/Distribution Licensees/Users shall be settled in accordance with procedures given in State Grid Code. The dispute relating to billing and settlement among the entities shall be resolved under relevant agreements like PPA, BPTA, and Connection Agreement etc.

20. Dynamic Code

The Metering Code requires review and updation from time to time in view of continuously and fast changing metering and communication technology and for new commercial agreements and tariff, industry structure. All changes and revision in the Metering Code shall be discussed in MCC and approved by the Commission.

STU and SLDC shall have the authority to define/decide location of Energy Accounting meters wherever necessary on case to case basis.

21. Quality Assurance of Meters

The Transmission Licensee, Generating Company, CPP/Co-generating plant, Distribution Licensee, and Consumers directly connected to the InSTS who are responsible for procurement and/or installation and commissioning of the meters covered under this Metering Code shall ensure that all type, routine and acceptance tests as per IS 14697:1999 & IS 15959:2011 are performed by the suppliers satisfactorily on these meters before they are commissioned. Subsequent to commissioning of the meters at site, the owners of the meters and the entities responsible for satisfactory functioning of the meters shall draw up a plan for routine maintenance / testing of the meters in line with Regulation 17 above and shall submit the same to the MCC for approval.