विद्युत् नियमन आयोग

(विद्युत् नियमन आयोग ऐन, २०७४ बमोजिम स्थापित स्वायत नियमनकारी निकाय)

विद्युत नियमन आयोग
सानोगौचरण, काठमाडौं

राय, सल्लाह, सुझाव तथा प्रतिक्रिया उपलब्ध गराईदिने सम्बन्धी सूचना

मितिः २०८३।०५।२६ गते

यस आयोगद्वारा तयार गरिएको **DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) Directives, 2083** र **ELECTRICITY REGULATORY COMMISSION (INSTALLATION AND OPERATION OF MATTERS) DIRECTIVES, 2083** को मस्यौदा आयोगको वेबसाइटमा प्रकाशित गरिएको छ।साथै, उक्त मस्यौदाहरु उपर ३० दिन भित्र राय, सल्लाह, सुझाव तथा प्रतिक्रिया उपलब्ध गराइदिनुहुन समेत सम्पूर्ण सरोकारवालाहरुमा अनुरोध छ।

विद्युत नियमन आयोग
सानोगौचरण, काठमाडौं

सम्पर्क नं: +977-1-4522442/4539004/4543390

इमेल: info@erc.gov.np

वेबसाइटः *https//:www.erc.gov.np*

DRAFT

ELECTRICITY REGULATORY COMMISSION

(INSTALLATION AND OPERATION OF METERS) DIRECTIVES, 2083

Electricity Regulatory Commission

Sano Gaucharan, Kathmandu, Nepal

Bhadra, 2083 (September 2026)

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Electricity Regulatory Commission

INSTALLATION AND OPERATION OF METERS DIRECTIVES, 2083

PREAMBLE

Preamble: With the objective of establishing establish technical standards for the installation, operation, testing, maintenance, data management, and compliance of metering systems applicable to generation, transmission, distribution, and open access transaction;

Now, therefore, the Commission, in exercise of the powers conferred on it by section 43 of the Electricity Regulatory Commission Act, 2074 (2017 AD) and as mandated by Section 12(a) thereof hereby makes the following Directives; -

CHAPTER 1

PRELIMINARY

1. **Short Title and Commencement:** (1) These Directives may be cited as "the Electricity Regulatory Commission (Installation and Operation of Meters) Directives, 2083 (2026 AD)".

(2) These Directives shall come into force from the date of their notification by the Commission.

2. **2. Definitions:** 1) In these directives, unless the context otherwise requires; -

(a) "Act" means the Electricity Regulatory Commission Act, 2074 (2017 AD);

(b) 'Accredited Test Laboratory' means a test laboratory accredited by the Nepal Bureau of Standards and Metrology;

(c) '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;

(d) '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;

~~(e)~~ 'System Operator (SO)' means as defined in Open Access Directives;

(f) 'Transmission Utility' means an entity responsible for the planning, development, operation, and maintenance of electricity transmission system, including high-voltage and extra high voltage transmission lines, substations, and associated infrastructure, for the purpose of transmitting electricity from generating stations to distribution systems or large consumers;

(g) 'Availability Based Tariff (ABT)' means a tariff structure based on availability of generating units and having components, of Capacity Charges (CC), Energy Charges (EC) or Variable Charges (VC) and charges for Deviations;

(h) 'Buyer' means any generating company or licensee or consumer whose system receives electricity from the system of generating company or licensee;

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

(j) 'Consumer Meter' means a meter used for accounting and billing of electricity supplied to the consumer but excluding those consumers covered under Interface Meters;

(k) 'Energy Accounting and Audit Meter' means meters used for accounting of the electricity across 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;

(l) 'Instrument Transformer' means the 'Current Transformer' (CT), 'Voltage Transformer' (VT) and 'Capacitor Voltage Transformer' (CVT) or Capacitor Potential Transformer (CPT);

(m) '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 Transmission System or Distribution who have to be covered under ABT and have been permitted open access;

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

(o) 'Meter' means a device suitable for measuring, indicating and recording consumption of electricity or any other quantity related with electrical system and shall include, wherever applicable, other equipment such as Current Transformer (CT), Voltage Transformer (VT) or Capacitor Voltage

Transformer (CVT)/ Capacitor Potential Transformer (CPT) necessary for such purpose;

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

(q) '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;

(r) '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 complexor and current complexor, measured in 'Volt – ampere reactive' (VAr) and in standard multiples thereof;

(s) 'Standards' means 'Standards on Installation and Operation of Meters' given in the Schedule unless otherwise any other standard specifically referred;

(t) 'Standby Meter' means a meter connected to CT and VT, 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;

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

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

(2) The words and expressions used and not defined in these Regulations but defined in the Act shall have the meaning assigned to them in the Act.

CHAPTER 2

TYPE, OWNERSHIP AND LOCATION OF METERS

3. **Type of Meters:** (1) All Interface Meters, Consumer Meters and Energy Accounting and Audit Meters shall be of static type.

(2) Meters that do not comply with the prescribed technical standards shall be replaced by the licensee either on its own initiative or upon the request of the consumers.

(3) The meters may also be replaced as per the directives or directions of the Commission.

4. **Standards:** (1) All Interface Meters, Consumer Meters and Energy Accounting and Audit Meters shall –

(a) Comply with the International Electro-technical Commission (IEC) Standards, or any other equivalent Standard shall be followed:

Provided that 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 Nepal before actual adoption of the said Standard;

(b) All consumers in areas with communication network, shall be supplied electricity with Smart Meters conforming to relevant standards, within the timelines as provided by either the Govt. of Nepal or by the Electricity Regulatory Commission;

Provided that all consumer connections having current carrying capacity beyond that specified in relevant standards, shall be provided with meters having automatic remote meter reading facility or Smart Meters as per relevant Standards;

Provided further that in areas which are not covered with communication network, installation of prepayment meters, conforming to relevant standards, shall be allowed by the Electricity Regulatory Commission;

Provided also that all the Advanced Metering Infrastructure shall include the prepayment functionality and shall be interoperable in accordance with the guidelines issued by the Authority;

Provided also that the Smart Meter conforming to relevant Standards with accuracy class of 1.0/ 0.5S shall act as an Interface meter for the consumer permitted open access at voltage level not exceeding 650 V.

5. **Ownership of Meters: -** (1) the ownership of Interface Meters shall be as follows:

(a) All interface meters installed at the points of interconnection with Transmission System of Transmission Licensee for the purpose of electricity accounting and billing shall be owned by the Transmission Utility Nodal Agency(Grid Owner);

(b) All Interface Meters installed at the points of inter connection between the two licensees excluding those covered under Clause (a) above for the purpose of electricity accounting and billing shall be owned by respective licensee of each end;

(c) All Interface Meters installed at the points of inter connection for the purpose of electricity accounting and billing not covered under Clauses (a) and (b) above shall be owned by supplier of electricity.

(2) The ownership of the Consumer Meters shall be all follows:

(a) The Consumer Meters shall generally be owned by the licensee;

(b) If any consumer elects to purchase a Meter, the same may be purchased by him;

(c) The Meter purchased by the consumer shall be tested, installed and sealed by the licensee;

(d) The consumer shall claim the Meter purchased by him as his asset only after it is permanently removed from the system of the licensee;

(e) All Consumer Meters shall bear NS mark or equivalent, meet the requirements of these directives and have additional features as approved by the Commission,

(f) For the purposes of this Sub-section, the licensee shall provide a list of makes and models of the Meters.

(3) Energy Accounting and Audit Meters shall be owned by the generating company or licensee, as the case may be.

(4) All the "Advanced Metering Infrastructure (AMI)" systems shall be consistent with the 'Guidelines for Standardization and Interoperability in Advanced Metering Infrastructure systems for End-to-End communication between Smart Meter, Head End System and Meter Data Management' as annexed herewith as Annexure-I

6. **Locations of Meters:** (1) the location of Interface Meters, Consumer Meters and Energy Accounting and Audit Meters shall be as per the Table given below.

Provided that the generating companies or Licensees may install interface meters at additional locations in their systems depending upon the requirement.

Table

Sr. No.	Stages	Main Meter	Check Meter	Standby Meter
A	Generating Station	On all outgoing feeders.	On all outgoing feeders.	(i) High Voltage (HV) side of Generator Transformers (ii) High Voltage (HV) side of all Station Auxiliary Transformers
Explanation: The location of Main, Check and Standby Meters installed at the existing generating stations shall not be changed unless permitted by the Transmission Utility.				
B	Transmission and Distribution System	At one end of the line between the substations of the same licensee, and at both ends of the line between sub-stations of two different licensees. Meters at both ends shall be considered as main meters for respective Licensees	-	There shall be no separate Standby Meter. A Meter installed at other end of the line in case of two different licensees shall work as Standby Meter.
C	Inter-Connecting Transformer (ICT)	High Voltage (HV) side of ICT.	-	Low Voltage (LV) side of ICT
D	Consumer directly connected to the Transmission System who	As per the specification and standard set by the Nodal Agency, Subject to approval by the commission.		

Sr. No.	Stages	Main Meter	Check Meter	Standby Meter
	have to be covered under ABT and have been permitted open access at voltage level exceeding 650 V by the Commission or Any other system not covered above			

(2) The location of Interface Meters shall be as follows:

(a) Consumers who have interconnection with the Transmission System and have been permitted open access shall be provided with the Interface Meters;

(b) For consumers connected to distribution system and permitted open access, provision of the Interface Meters may be made as per the directives or directions of the Commission;

(c) The scheme for location of the Interface Meters shall be submitted to the licensee by owner of the meter in advance, before the installation of the scheme.

(3) The Consumer Meters shall be installed by the licensee either at consumer premises or outside the consumer premises:

Provided that:

(a) Where the licensee installs the meter outside the premises of the consumer, then the licensee shall provide real time display unit at the consumer premises for his information to indicate the electricity consumed by the consumer;

(b) For the billing purpose, reading of consumer meter and not the display unit shall be taken into account.

(4) In the event that the supply of electricity is directly made from a generating company to consumer on a dedicated transmission system, the location of the meter will be as per their mutual agreement.

(5) Energy Accounting and Audit Meters shall be installed at such locations so as to facilitate to account for the energy generated, transmitted, distributed and consumed in the various segments of the power system and the energy loss. The location of these meters shall be as under:

(a) Generating Stations;

(i) At the stator terminal of the generator;

(ii) On HV and LV sides of the stations and the unit auxiliary transformers;

(iii) On feeders to various auxiliaries.

(6) Transmission System - All incoming and outgoing feeders (If the interface meters do not exist).

(7) Meters at the Distribution System shall be as follows:

(a) All incoming feeders (11 kV and above);

(b) All outgoing feeders (11 kV and above);

(8) Sub-Station Transformer including Distribution Transformer - Licensee may provide the Meter on primary or secondary side or both sides depending upon the requirement for energy accounting and audit.

7. **Accuracy Class of Meters:** Every Meter shall meet the requirement of accuracy class as specified in the standards given in the Schedule.

CHAPTER 3

INSTALLATION, OPERATION AND TESTING OF METERS

8. **Installation of Meters:** (1) Generating company or licensee, as the case may be, shall examine, test and regulate all meters before installation and only correct meters shall be installed.

(2) The meter shall be installed at locations, which are easily accessible for installation, testing, commissioning, reading, recording and maintenance.

(3) The place of installation of meter shall be such that minimum inconvenience and disruptions are caused to the site owners and the concerned organizations.

(4) In case of single-phase meters, the consumer shall ensure that there is no common neutral or phase or looping of neutral or phase of two or more consumers on consumers' side wiring.

(5) If such common neutral or phase or looping of neutral or phase comes to the notice of the licensee, it shall suitably inform the consumer through installation report or regular electricity bills or meter test report as applicable.

(6) Consumer shall install the Earth Leakage Protective Device (ELPD) in accordance with the provisions of the rules or directives in this regard.

(7) If the earth leakage indication is displayed in the meter, the licensees shall suitably inform the consumer through installation report or regular electricity bills or meter test report as applicable.

(8) In case CTs and VTs form part of the meters, the meter shall be installed as near to the instrument transformers as possible to reduce the potential drop in the secondary leads.

9. **Operation, Testing and Maintenance of Meters:** The operation, testing and maintenance of all types of meters shall be carried out by the generating company or the licensee, as the case may be.

10. **Access to Meters:** The owner of the premises where, the meter is installed shall provide access to the authorized representative(s) of the licensee for installation, testing, commissioning, reading, recording and maintenance of meters.

11. **Sealing of Meters:** (1) 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 sealing points as per the standards given in the Schedule:

(a) Sealing of Interface Meters, shall also be done by both the supplier and the buyer;

(d) Sealing of Consumer Meters shall be done by the licensee;

(c) Sealing of Energy Accounting and Audit Meters shall be done by the licensee or generating company as the case may be.

(2) 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.

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

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

(5) Polycarbonate or acrylic seals or plastic seals or holographic seals or any other superior seal shall be used.

(6) Lead seals shall not be used in the new meters. 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.

12. **Removal of Seals from Meters:** (1) 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.

(2) The breaking and re-sealing of the Meters shall be recorded by the party, 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.

(3) Seal of the Consumer Meters shall be removed only by the licensee. No consumer shall tamper with, break or remove the seal under any circumstances. Any tampering, breaking or removing the seal from the meter shall be dealt with as per relevant provisions of the Electricity Theft Control Act 2058.

(4) Seal of the Energy Accounting and Audit Meters shall be removed only by the generating company or the licensee who owns the meters.

13. **Safety of Meters:** (1) the supplier or buyer in whose premises the Interface Meters are installed shall be responsible for their safety.

(2) The consumer shall, as far as circumstances permit, take precautions for the safety of the consumer meter installed in his premises belonging to the licensee.

(3) Licensee shall be responsible for the safety of the Consumer Meter located outside the premises of the consumer and the consumer shall be responsible for the safety of the real time display unit installed by the licensee in consumer premises.

(4) The generating company or the licensee who owns the Energy Accounting and Audit Meters shall be responsible for its safety.

CHAPTER 4

READING AND RECORDING OF METERS

14. **Reading and Recording of Meters:** (1) it shall be the responsibility of the Appropriate Transmission Utility or the 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 various agencies as per the procedure laid down by the Nodal agency and approved by the commission.

(2) It shall be the responsibility of the licensee to record the metered data, maintain database of all the information associated with the consumer meters and verify the correctness of metered data.

(3) The licensee shall maintain accounts for the electricity consumption and other electrical quantities of its consumers.

(4) Brief history, date of installation and details of testing, calibration and replacement of meters shall be maintained by the licensee.

(5) It shall be the responsibility of the generating company or licensee to record the metered data, maintain database of all the information associated with the energy accounting and audit meters and verify the correctness of metered data.

(6) Each generating company or licensee shall prepare quarterly, half-yearly and yearly energy account for its system for taking appropriate action for efficient operation and system development.

15. **Meter Failure or Discrepancies:** (1) whenever difference between the readings of the Main meter and the Check meter for any month is more than 0.5%, the following steps shall be taken:

(a) Checking of CT and VT connections;

(b) Testing of accuracy of Interface Meter at site with reference standard meter of accuracy class higher than the meter under test;

(c) If the difference exists even after such checking or testing, then the defective meter shall be replaced with a correct meter.

(2) 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.

(3) In case where both the Main meter and Check meter fail, at least one of the meters shall be immediately replaced by a correct meter.

16. **Billing for the Failure Period:** (1) the billing for the failure period of the meter shall be done as per the procedure laid down by the Nodal Agency and approved by the commission.

(2) Readings recorded by Main, Check and Standby meters for every time slot shall be analysed, crosschecked and validated by the System Operator.

(3) Any discrepancy noticed in meter readings shall be reported by the System Operator to the Energy Accounting Agency for proper accounting of energy.

(4) The System Operator shall also intimate such discrepancy to the Appropriate Transmission Utility or the concerned licensee, which shall take necessary action for testing, calibration, or replacement of the faulty meter in accordance with the applicable provisions.

(5) The defective meter shall be immediately tested and calibrated.

(6) In case the consumer reports to the licensee about consumer meter readings not commensurate with his consumption of electricity, stoppage of meter, damage to the seal, burning or damage of the meter etc., the licensee shall take necessary steps as per the procedures given in the Electricity Distribution Code of the Commission.

(7) Energy accounting and audit meters shall be rectified or replaced by the generating company or licensee immediately after notice of any of the following abnormalities:

(a) The errors in the meter readings are outside the limits prescribed for the specified Accuracy Class;

(b) Meter readings are not in accordance with the normal pattern of the load demand;

(c) Meter tampering, or erratic display or damage.

CHAPTER 5

QUALITY ASSURANCE AND CALIBRATION OF METERS

17. **Quality Assurance of Meters:** (1) the distribution licensee shall put in place a system for quality assurance and testing of meters with the approval of Commission.

(2) The licensee shall set up appropriate number of accredited testing laboratories or utilize the services of other accredited testing laboratories, or internationally recognized testing laboratories. The licensee shall take immediate action to get the accreditations of their existing meter testing laboratories from **Nepal Bureau of Standards and Metrology**, if not already done.

(3) The generating company or licensee shall ensure that all type, routine and acceptance tests are carried out by the manufacturer complying with the requirement of the IEC standards.

18. **Calibration and Periodical Testing of Meters:** (1) at the time of commissioning, each interface meter shall be tested by the owner at site for accuracy using standard reference meter of better accuracy class than the meter under test.

(2) All interface meters shall be tested at least once in five years. These meters shall also be tested whenever the energy and other quantities recorded by the meter are abnormal or inconsistent with electrically adjacent meters.

(3) Whenever there is unreasonable difference between the quantity recorded by interface meter and the corresponding value monitored at the billing centre via

communication network, the communication system and terminal equipment shall be tested and rectified.

(4) The meters may be tested using Nepal Bureau of Standards and Metrology accredited laboratory or at any accredited laboratory and recalibrated if required at manufacturer's works.

(5) Testing and calibration of Interface Meters may be carried out in the presence of the representatives of the supplier and buyer. The owner of the meter shall send advance notice to the other party regarding the date of testing.

(6) The testing of consumer meters shall be done at site at least once in five years. The licensee may instead of testing the meter at site can remove the meter and replace the same by a tested meter duly tested in an accredited test laboratory.

(7) The meters installed in the circuit shall be tested if study of consumption pattern changes drastically from the similar months or season of the previous years or if there is consumer's complaint pertaining to a meter.

(8) The standard reference meter of better accuracy class than the meter under test shall be used for site testing of Consumer Meters up to 650 volts.

(9) The testing for the Consumers Meters above 650 volts shall cover the entire metering system including CTs, VTs.

(10) Testing of the Meters specified in sub-section (9) may be carried out through Nepal Bureau of Standards and Metrology accredited laboratory using secondary injection kit, measuring unit and phantom loading or at any accredited test laboratory and recalibrated if required at manufacturer's works.

(11) Energy Accounting and Audit Meters shall be tested at site at least once in five years or whenever the accuracy is suspected or whenever the readings are inconsistent with the readings of other meters, e.g., check meters, standby meters. The testing must be carried out without removing the CTs and VTs connection.

(12) Testing of the Meters specified in sub-section (11) may be carried out through Nepal Bureau of Standards and Metrology accredited laboratory using secondary injection kit, measuring unit and phantom loading or at any accredited test laboratory and recalibrated if required at manufacturer's works.

19. **Additional Meters:** (1) In addition to any meter which may be placed for recording the electricity consumed by the consumer, the licensee may connect additional meters, maximum demand indicator or other apparatus as he may think fit for the purposes of ascertaining or

regulating either the quantity of electricity supplied to the consumer, or the number of hours during which the supply is given, or the rate per unit of time at which energy is supplied to the consumer, or any other quantity or time connected with the supply to consumer.

Provided that:

(a) The meter, indicator or apparatus shall not, in the absence of an agreement to the contrary, be placed otherwise than between the distributing mains of the licensee and any meter;

(b) Where the charges for the supply of energy depend wholly or partly upon the reading or indication of any such meter, indicator or apparatus as aforesaid, the licensee shall, in the absence of an agreement to the contrary, keep the meter, indicator or apparatus correct.

CHAPTER 6

MISCELLANEOUS

20. **Anti-tampering Features of Meters:** The meters shall be provided with such anti-tampering features as per the Standards on Installation and Operation of Meters given in the Schedule.

21. **Adoption of New Technologies:** The distribution licensee shall make out a plan for introduction and adoption of new technologies such as pre-paid meters, time of the day meters (TOD), automatic remote meter reading system through appropriate communication system with the approval of the Commission or as per the directives or directions of the Commission or pursuant to the reforms programme of the Government of Nepal.

22. **Grievance Redressal:** Any grievance arising in connection with the use of open access User(s) under these Directives shall be resolved in accordance with the provisions of the Electricity Regulatory Commission (Grievance Redressal Mechanism for Open Access Customers) Directives.

23. **Power to remove difficulties:** If any difficulty arises in giving effect to any of the provisions of these directives, the Commission may, either *suo motu* or on an application made to it, by general or special order, do or undertake or direct the licensee to do or undertake things,

which in the opinion of the Commission are necessary or expedient for the purpose of removing the difficulty.

24. **Power to amend Schedule:** The Commission, may, at any time, by an order, published in the Official website of the Commission followed by the publication of notice in the widely circulated Newspapers in Nepali and English languages add, vary, alter, modify or amend any of the provisions of the Schedule to these directives.

SCHEDULE

Standards on Installation and Operation of Meters

Part— I

Standards Common to All Type of Meters

1. **Specifications of Meters:** (1) the standards stated below shall provide for specification of Meters, immunity to external factors, sealing points and functional requirements that are required from regulatory perspective.

(2) The detailed technical specification shall be prepared by the purchaser of the meter.

(3) Specifications of Meters shall be as follows:

<table>
<tr><td>Standard Reference Voltage</td><td>As per IEC</td></tr>
<tr><td>Voltage Range</td><td>As per IEC</td></tr>
<tr><td>Standard Frequency</td><td>As per IEC</td></tr>
<tr><td>Standard Basic Current</td><td>As per IEC

(Current range of consumer meters shall be so chosen as to record the load current corresponding to the sanctioned load)</td></tr>
<tr><td>Accuracy Class</td><td>Meters shall meet the following requirements of Accuracy Class:
<table><tr><td>Interface Meters</td><td>0.2</td></tr><tr><td>Consumer Meters</td><td></td></tr><tr><td>Up to 650 Volts</td><td>1.0 or better</td></tr><tr><td>Above 650 Volts and up to 33 kV</td><td>0.5S or better</td></tr><tr><td>Above 33 kV</td><td>0.2S</td></tr></table></td></tr>
</table>

	Energy accounting and audit meters The accuracy class of meters in generation and transmission system shall not be inferior to that of 0.2S Accuracy Class. The accuracy class of meters in distribution system shall not be inferior to that of 0.5S Accuracy Class
Starting Current and Maximum Current	As per IEC
Power Factor Range	As per IEC
Power Frequency Withstand Voltage	As per IEC
Impulse Voltage Withstand Test for 1.2/50 micro sec	As per IEC
Power Consumption	As per IEC

(4) The Meters shall have downloading facilities of metered data through Meter Reading Instrument (MRI).

2. **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.

3. **Sealing Points:** Sealing shall be done at the following points (as applicable):

(a) Meter body or cover

(b) Meter terminal cover

(c) Meter test terminal block

(d) Meter cabinet

4. **The Accuracy of Current Transformers and Voltage Transformers:** (1) the accuracy class of Current transformers (CTs) and Voltage transformers (VTs) shall not be inferior to that of associated meters.

(2) The existing CTs and VTs not complying with these directives shall be replaced by new CTs and VTs, if found defective, non-functional or as per the directions of the Commission.

(4) In cases where 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.

(5) The Voltage Transformers shall be electromagnetic VT or Capacitive Voltage Transformer (CVT).

Part— II

Standards for Interface Meters

5. **Functional Requirements:** (1) Interface meters suitable for ABT shall be static, composite, self-contained meters capable of measuring active and reactive energy and such other parameters as specified herein:-

(a) The Meters shall be suitable for being connected directly to voltage transformers (VTs) having a rated secondary line-to-line voltage of 110 V, and to current transformers (CTs) having a rated secondary current of 1A (Model-A: 3 element 4 wire or Model C: 2 element, 3 wire) or 5A (Model-B: 3 element, 4 wire or Model D: 2 element 3 wire).

(b) The reference frequency shall be 50Hz.

(c) The meters shall have a non-volatile memory in which the following shall be automatically stored:

(i) Average frequency for each successive 15-minute block, as a two-digit code (00 to 99 for frequency from 47.5Hz to 52.50Hz);

(ii) Net Wh transmittal during each successive 15-minute block, up to second decimal, with plus/minus sign;

(iii) Cumulative Wh transmittal at each midnight, in eight digits including one decimal;

(iv) Cumulative VArh transmittal for voltage high condition, at each midnight, in eight digits including one decimal;

(v) Cumulative VArh transmittal for voltage low condition, at each midnight, in eight digits including one decimal;

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

(2) The Meters shall store all the above listed data in their memories for a period of at least 180 days.

(3) Each Meter shall have an optical port on its front for tapping all data stored in its memory using a handheld data collection device.

(4) The meter shall be suitable for transmitting the data to remote location using appropriate communication medium.

(5) The active energy (Wh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy as per class 0.2 S of IEC-687/IEC-62053-22. In model A and C, the energy shall be computed directly in CT and VT secondary quantities and indicated in watt-hours.

(5) In Model-B and Model D, the energy display and recording shall be one fifth of the Wh computed in CT and VT secondary quantities.

(6) The Var and reactive energy measurement shall also be on 3-phase, 4-wire principle, with an accuracy as per class 2 of IEC-62053-23 or better. In model-A or Model C, the Var and VArh computation shall be directly in CT and VT secondary quantities.

(7) In Model-B or Model D, the above quantities shall be displayed and recorded as one-fifth of those computed in CT and VT secondary quantities.

(8) There shall be two reactive energy registers, one for the period when average RMS voltage is above 103% and the other for the period the voltage is below 97%.

(9) The 15-minute Wh shall have a +ve sign when there is a net Wh export from substation busbars, and a –ve sign when there is a net Wh import. The integrating (cumulative) registers (third register) for Wh and Varh shall move forward when there is Wh/Varh export from substation busbars, and backward when there is an import.

(10) The meters shall also display (on demand), by turn, the following parameters: -

(a) Unique identification number of the Meter;

(b) Date and Time;

(c) Cumulative Wh register readings;

(d) Average frequency of the previous 15-minute block;

(e) Net Wh transmittal in the previous 15-minute block, with +/-sign;

(f) Average percentage voltage;

(g) Reactive power with +/- sign;

(h) Voltage-high VArh register readings;

(i) Voltage-low VArh register reading.

(11) The three line-to-neutral voltages shall be continuously monitored and in case any of these falls below 70%, the condition shall be suitably indicated and recorded.

(12) The Meters shall operate with the power drawn from the VT secondary circuits, without the need for any auxiliary power supply. Each meter shall have a built-in calendar and clock, having an accuracy of Less than 0.5s per day or better.

(13) The Meters shall be totally sealed and tamper-proof, with no possibility of any adjustment at site, except for a restricted clock correction.

(14) The harmonics shall be filtered out while measuring Wh, Var and VArh, and only fundamental frequency quantities shall be measured/computed.

(15) The Main meter and the Check meter shall be connected to same core of CTs and VTs.

Part —III

Standards for Consumer Meters

6. **Measuring Parameters:** (1) the Consumer Meter shall be suitable for measurement of cumulative active energy utilized by the consumer.

(2) The Consumer Meter may have the facilities to measure, record and display one or more of the following parameters depending upon the tariff requirement for various categories of consumers.

(a) Cumulative reactive energy;

(b) Average power factor;

(c) Time of use of energy;

(d) Apparent power;

(e) Maximum demand;

(f) Phase voltage and line currents.

(3) All parameters excluding instantaneous electrical parameters shall also be stored in memory.

(4) All the three phase meters shall have data storage capacity for at least 180 days in a non-volatile memory.

7. **Anti-Tampering Features:** (1) the meter shall not get damaged or rendered non-functional even if any phase and neutral are interchanged.

(2) The meter shall register energy even when the return path of the load current is not terminated back at the meter and in such a case the circuit shall be completed through the earth. In case of metallic bodies, the earth terminal shall be brought out and provided on the outside of the case.

(3) The meter shall work correctly irrespective of the phase sequence of supply (only for poly phase).

(4) In the case of 3 phase, 3 wire meter even if reference Y phase is removed, the meter shall continue to work. In the case of 3 phase, 4 wire system, the Meter shall keep working even in the presence of any two wires i.e., even in the absence of neutral and any one phase or any two phases.

(5) In case of whole current meters and LV CT operated meters, the meter shall be capable of recording energy separately in a different register correctly even if input and output terminals are interchanged.

(6) The registration must occur whether input phase or neutral wires are connected properly or they are interchanged at the input terminals.

(7) The Meter shall be factory calibrated and shall be sealed suitably before dispatch.

(8) The Meter shall be capable of recording occurrences of a missing potential (only for VT operated meters) and its restoration with date and time of first such occurrence and last restoration along with total number and duration of such occurrences during the above period for all phases.

(9) Additional anti-tampering features including logging of tampers such as current circuit reversal, current circuit short or open and presence of abnormal magnetic field may be provided as per the regulations or directions of the Commission or pursuant to the reforms programme of the Government of Nepal.

Part IV

Standards for Energy Accounting and Audit Meters

8. **Standards for Energy Accounting and Audit Meters:** (1) the Energy Accounting and Audit Meters shall be suitable for measurement, recording and display of cumulative active energy with date and time.

(2) The Energy Accounting and Audit Meters may also have the facility to measure, record and display one or more of the following parameters depending upon the energy accounting and audit requirement: -

(a) Apparent power;

(b) Phase wise kilowatt at peak KVA;

(c) Phase wise KVA (reactive) at peak KVA;

(d) Phase wise voltage at peak KVA;

(e) Power down time;

(f) Average power factor;

(g) Line currents;

(h) Phase voltages;

(i) Date and time;

(j) Tamper events.

(3) All parameters excluding instantaneous electrical parameters shall also be stored in memory.

(4) The energy accounting and audit meter shall have data storage capacity for at least 180 days in a non-volatile memory.

(5) Energy Accounting and Audit Meters shall have facility to download the parameters through meter reading instruments as well as remote transmission of data over communication network.

Annexure-I

Guidelines for Standardization and Interoperability in AMI Systems for End to End Communication between Smart Meter, HES and MDM

1. **Requirement of Advanced Metering Infrastructure (AMI):** The following are the essential parts of Smart Metering/AMI -

- Smart Meters -Single Phase & Three Phase whole current smart meters shall comply with the Technical Specifications (As per IEC 62052-11, IEC 62053-21 and IEC 62056)
- Communication infrastructure – RF/PLC/Cellular or combination of these
- Head End System (HES)
- Meter Data Management System (MDMS)

Along with, the following are also essential for consumer empowerment and consumer participation in management of load-

- Web application with updated on-line data of consumers etc.
- Mobile App through which consumer shall be able to see information related to his energy consumption. App shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc.

The success of smart metering depends on strong and reliable communication technology. In communication technology, there are various medium available to choose from like PLC/RF/GPRS etc. These all have their own distinct advantages and disadvantages based on the area to be covered and the network back bone available in the area.

2. **Power-line communication** (**PLC**) is a communication technology that uses electrical wiring to simultaneously transmit both data and electric power without any interference

as both are at different frequency. The PLC system is very old and reliable communication medium as compared to all other mediums. In the PLC communication, the network should be roughed, confined and parameter like phasing etc. are taken care since beginning of network laid. Some of the limitation of this technology are:

- slower data transfer,
- interruption on operation of switches, disconnections in Electrical system
- Distortion of signals during passing through power transformers, inductors etc

Power-line carrier communication (PLCC) is currently being effectively used for telecommunication, tele-protection and tele-monitoring between electrical substations through EHV power lines and proved to be best low cost communication media but the use of PLC through LT distribution lines fromconsumer meter up to the DCU would depend upon the condition of the distribution lines.

However, depending upon the network strength and site feasibility, PLC may be used in the smart metering of apartments and colonies where the system is robust and data can be collected at a central server through PLC communication. Ipv6, G3-PLC and PRIME are widely used protocols to enable large scale PLC communication on the electrical grid.

3. **Radio frequency (RF)** is the communication technology whose frequencies lies in the range extending from around 20 kHz to 300 GHz, typically these are used in radio communications. This is also called as wireless communication as compared to wired connection between point of communication in PLC or PLCC.

In RF, higher is the frequency lower is the band width available, reducing the range of communication. The distance over which radio communications is useful depends significantly on various factors like wavelength, transmitter power, receiver quality, type, size, and height of antenna, mode of transmission, noise, and interfering signals etc.

As the allocation of special spectrum for the Discoms for meter usages is a lengthy process and involve the recurring cost which may not be cost effective for project,

it would be advisable to consider the use of license free ISM band for use RF communication.

In Nepal, following are the free band as notified by department of the telecommunication.

a. Frequency Band: 865-868 MHz Expandable upto 872 MHz – Use: Low power RFID equipment or any other low power wireless devices or equipment

   Power: Maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power)

   Carrier Bandwidth: 200 KHz, (Multiple Channels with frequency hopping)

   Reference: GSR 564 (E) dated 30 July 2008

b. Frequency Band: 2.4-2.4835 GHz, Use : Low power equipment

   Power: Maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power)

   Carrier Bandwidth: spectrum spread of 10 MHz or higher,

   Reference: GSR 45E dated 28.1.2005

c. Frequency Band: 5.825 to 5.875 GHz, Use : Low power equipment

   Power: maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power)

   Carrier Bandwidth: spectrum spread of 10 MHz or higher
   Reference: GSR no 38E dated 19.1.2007

The best part of this technology is that the data transmission range can be increased by hopping of the signal over the modems/ frequencies to reach the target destination. For effective hopping of the signal, the overlapping of the range of each radio frequency is very important and can be taken care while designing a network RF canopy.

With the use of this technology, there is an advantage that there is no running cost for using this technology and hence it turns out to be economical for utilities in long

run. Only one time canopy installation cost is the main cost which may be recovered in few years of operation.

There is one challenge in RF due to reduction in range when line of sight of modem/radio is not clear as the signals do not penetrate through concrete structures. To mitigate this, the use of repeaters and high gains antennas need to be installed according to the network topology and geological positioning of modems. Additionally, there is also an interoperability issue as the smart meter would be designed based on the NIC card/ RF card of only one company which would provide the communication medium from smart meter to MDM. However, now a days, a plug and play type configuration of smart meters are available from where the NIC card of one company may be removed and another may be put up in case of change of communication provider.

This technology can be used in smart meters with proper management of the RF canopy communication back bone in any confined area like city or townships etc. The use of this technology ensures lower costing hence lower impact on tariff of consumers in long run.

4. Cellular network - 3G/4G technology: This is fast changing wireless mobile telecommunications technology as this has been evolved every around 5-10 year interval form 1G,2G with GPRS to 3G and latest 4G. From 2G GPRS to 3G& 4G, the mobile technology developed to handle voice and data on the same network with good speed.

As this wireless network has expanded upto many small towns/villages, this technology may be used widely in remote areas also. Many countries have used 3G technology in smart metering successfully transferring data to central servers of utility.

This is best suitable technology to use the widespread existing network of mobile operator for handling data. With use of this technology, the utilities are relieved from

the maintenance of communication network but they have to bear the monthly rentals/ data charges for using the network of Mobile service provider. This technology provides data at faster speed and found very beneficial in many cities where competition between service providers ensures cost competitions along with good network reach, however, there may be data delay/data loss in the remote areas/ villages where the network strength is poor.

This is having a disadvantage that there is running cost involved for each meter and in long run and for large area coverage, the cost turns out to be significant part of operating cost. Also, there may be many dark patches where we don't get good network coverage many times so collecting data from meters installed in those areas shall pose a challenge in remote villages.

This will have big challenge of obsolescence of the technology in long run (as from 3G to 4 G and from 4G to 5 G etc) hence the maintenance of communication modems and chips along with rental charges may increase the Opex budget of utilities.

5. Comparison of various Communication Technologies

In comparison of the PLC and RF, the initial investment cost for implementation of PLC at micro level is higher than laying the RF network as more number of collectors are required compared to RF. Also, the biggest advantage of RF over other media is self-healing nature of RF hence more reliable. Sometime PLC communication may be affected by interference/noise in some cases.

Once the RF canopy is developed then all the other smart equipment can also be communicated over the same canopy hence there shall be a leap in automation in micro level and better monitoring of the network and effective implementation of Smart Grid.

Depending on the utility road map of AMI and smart grids implementation the utilities need to choose these technologies keeping in view the long-term benefits of the AMI keeping the total cost minimal in long run perspectives and embracing to new technologies for becoming smart utilities. However, the ideal solution for successful smart metering may be mix of all the technologies based on the geographical and network conditions in particular area.