Metering Code for the Nigerian Electricity Supply Industry

MARCH 2026 (3RD EDITION)

INTRODUCTION

The current code – "Metering Code for the Nigerian Electricity Supply Industry March, 2026" – corresponds with the review of Version 2 by the Metering Code Review Panel ("MCRP"). The MCRP developed a draft of the Metering Code ("MC") taking into consideration comments received from stakeholders to the earlier version.

The "Metering Code for the Nigerian Electricity Supply Industry March, 2026" is presented in its amended, comprehensive form in the following sections.

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PART 1: GENERAL CONDITIONS

1. SECTION: BACKGROUND

1.1. TITLE

This Code shall be called the Metering Code for the Nigerian Electricity Supply Industry ("MC-NESI").

1.2. NEW ARRANGEMENTS FOR THE NIGERIAN ELECTRICITY SECTOR

1.2.1. The repealed Electric Power Sector Reform Act ("EPSRA") provided the legal framework for the unbundling of the power sector in Nigeria. EPSRA provided the platform for the functional unbundling of generation, transmission and distribution sectors.

1.2.2. To ensure financial viability of the electricity industry after the unbundling stated in 1.2.1, modern accurate metering systems with reliable communication facilities are being deployed across the industry for revenue assurance purposes.

1.2.3 The metering systems will cover all classes and types of meters, communication systems, and other components of an Advanced Metering Infrastructure ("AMI") deployment in order to measure electrical energy consumption, support billing (multi-tariff and multi-source), pre-paid and credit payment functionality, remote load control (connection/disconnection) and to report events/alarms to other control and monitoring systems e.g., Outage Management Systems ("OMS").

1.2.4 The metering systems will also provide information and data to support smart grid applications and have the capability of extending its functionality to load control, demand response and Demand Side Management ("DSM") services.

1.2.5 The EPSRA was repealed and the Electricity Act, 2023 (the "Act") was enacted to consolidate other laws relating to the Nigerian Electricity Supply Industry ("NESI") and reinforce the existing legal and institutional framework for the power sector in Nigeria in the areas of electricity generation, transmission, system operation, distribution, supply, trading, enforcement of consumer rights and obligations.

1.3. THE ELECTRICITY METERING CODE

1.3.1. This Nigerian Electricity Metering Code (MC-NESI) is divided into three different parts:

(a) The first part defines the General Conditions which applies to the whole Code.

(b) The second part, Grid Metering Code ("GMC"), sets out or refers to the requirements for the metering of the participant's connection points on transmission or distribution network; and provides for trading point metering systems. The Grid Metering Code is required to cover the interchange of Energy and Power:

(i) entering or exiting from the transmission network

(ii) entering or exiting from the distribution network, at any participant's connection point,

(c) The third part, the Distribution Metering Code ("DMC") specifies the technical and operational criteria, including the procedures to be complied with by distribution licensees, in carrying out their obligation to provide metering services, for the metering of end-use customers in the distribution system. The DMC is required to cover the interchange of energy and power entering or exiting the distribution network at any customer's connection point, provided that such customer is not a participant.

1.3.2. The MC-NESI is to be read in conjunction with the Market Rules, Grid Code, Distribution Code and the Metering Market Procedures.

2. SECTION: INTERPRETATION

2.1. INTERPRETATION

2.1.1. In this MC-NESI unless the context otherwise specifies or requires:

(a) references to the "Metering Code" are a reference to the entire MC-NESI, including any Schedules or other attached documents;
(b) the Schedules shall be deemed to be part of the Metering Code;
(c) capitalised words used shall have the meanings assigned to them in the definition section;
(d) words corresponding to persons or parties shall include any individual, firm, joint venture and corporation, and all references to persons shall include their legal successors and permitted assignees;
(e) words in singular only also include the plural and vice versa where the context requires;
(f) words in the masculine shall include the feminine and vice versa;
(g) any reference to a day, month or year shall be construed as reference to a calendar day, month or year, as the case may be, and all references to specific dates shall be to the day commencing on such date at 00:00 hours;
(h) the headings are for ease of reference only and shall not be deemed part of and shall neither affect nor be used in the interpretation or construction of this Metering Code;
(i) the word "include" or "including" shall be construed without limitation;
(j) the word "shall" refer to a rule, procedure, requirement or any provision of this Metering Code that requires mandatory compliance;
(k) all references to a numbered Schedule, Section or Condition is respectively a reference to the Schedule, Section or Condition bearing that number in this Metering Code as well as the case for a numbered table or section in a Condition or Schedule;
(l) references to the consent or approval of the Commission shall be references to the approval or consent of the Commission in writing, which may be given subject to such conditions as may be determined by the Commission, as that consent or approval may be amended, modified, supplemented or replaced from time to time and to any proper order, instruction or requirement or decision of Commission given, made or issued under it; and
(m) reference to any law, by-law, code, regulation made under any law, directive or other document issued by the Commission shall be construed to refer to such law, by-law, code, regulation made under any law, directive or other document issued by Commission as amended, modified or replaced from time to time. In particular, any reference to a licence shall be to that licence as amended, modified or replaced from time to time and to any rule, document, decision or arrangement promulgated or established under that licence.

2.2. DEFINITIONS

2.2.1. Any capitalised word or expression defined in the Electricity Act, 2023 ("EA" or the "Act"), or the Market Rules and that is not defined otherwise in this Metering Code shall have, unless the contrary intention appears, the same meaning and interpretation when used in this Metering Code, including its Schedules.

2.2.2. When applying the provisions contained in this Metering Code, and unless otherwise specified or the subject matter or context otherwise requires:

Accuracy Class means an index indicating the permissible error in measurements.

Act means the Electricity Act, 2023, as amended from time to time;

Active Energy means the integral with respect to time of the Active Power in units of watt-hours (Wh) or standard multiples thereof (for example, kWh, MWh).

Active Power means the product of voltage and the in-phase component of alternating current measured in units of watts (W) or standard multiples thereof (for example, kW, MW).

Advanced Metering Infrastructure (AMI) is a metering system capable of supporting a set of functionalities remote readings, tamper information, auto connection and disconnection, prepayment, post-payment, tariff changes, and customer information, etc. through a two-way communication.

Alarm means a short-lived audible and/or non-audible signal.

Alert means a warning generated in response to a problem or the risk of a potential problem.

Ambient Power means a power source already present within a given system.

Ambient Temperature is the air temperature of an environment or object.

Arm Load Switch means to establish a state whereby a load switch will close in response to a command to enable supply and "Arming" shall be construed accordingly.

Associated User means a User who does not own the assets at a connection point but has a contractual interest in the test results or data flowing from the Metering System.

Authentication means the method used to confirm the identity of entities or devices wishing to communicate and "Authenticated" and "Authenticity" shall be construed accordingly.

Authorisation means the process of granting access to a resource directly or indirectly and "Authorised" shall be construed accordingly.

Automatic Meter Reading (AMR) is the technology of automatically collecting consumption, diagnostic, and status data from energy metering devices. This data is transferred into a central database for billing, troubleshooting and analysis.

Battery means a component that produces electricity from a chemical reaction.

Block Counter means storage for recording consumption for the purposes of combined time-of-use and block pricing.

Block Pricing means a pricing scheme used in conjunction with time-of-use pricing where price varies based on consumption over a given time period.

Block Tariff means a tariff for block pricing.

Calibration Tests means a series of tests and checks performed by an authorised meter test station to determine that the accuracy of a metering instrument is within the specifications of the MC.

Check Meter means the meter which is used to cross-check the measurements of the main meter.

Check Metering means the metering and/or calculation process to determine metering data utilising the Check Metering System.

Check Metering System means the trading point metering system used in market settlement process, for the purpose of checking and validating the measurements provided by the Main Metering Systems, or to replace measured data in case of failure or malfunction of the Main Metering System.

Clock means a timing mechanism operating the UTC primary time standard which has a minimum resolution of 1 second.

Command means an instruction to perform a defined function.

Commercial Meter means the Meter which measures energy withdrawn from a distribution network, which will be used in the billing process

Commercial Metering System means the system is to measure and send to the Distribution Licensee the energy withdrawn from the distribution network by a Customer.

Commission means the Nigerian Electricity Regulatory Commission established by the Electricity Act, 2023.

Communications Link means a connection or pathway that allows the transfer of data, information, or signals between different devices or systems.

Competent Staff means an Electrical Engineer with over 15 (fifteen) years' experience, 10 (ten) of which must be in the field of electrical measurement and instrumentation. The personnel must have worked in a power utility/regulatory/policy environment and must be a COREN registered engineer.

Confidentiality means ensuring that information, in transit or at rest, is not accessible by unauthorised parties through either unintentional means or otherwise.

Connection Agreement means an agreement between a Generator, Distribution Company or Eligible Customer and the TSP; or an agreement between a Distribution Company and a customer, as the case may be, which specifies the terms and conditions pertaining to the connection of the Generation Company, Distribution Company or Customer system or equipment to the Transmission or Distribution System.

Connection Capacity means the maximum capacity of a connection as stated in the associated Connection Agreement.

Connection Point means a site or point of connection between a Generation Station or Load Facility and the System Operator Controlled Grid or Distribution System, where a Participant/Customer connects to the system to inject or extract energy, and which will be considered its Market trading point for Market Settlement or energy billing.

Consumer has the same meaning as in Section 232 of the Electricity Act, 2023.

Consumption means usage of electricity by means of connected electrical devices/appliances.

Credit Mode means a mode of operation of a SMS whereby customers are billed for some or all of their consumption retrospectively.

Cryptographic Algorithm means an algorithm for performing encryption, decryption; digitally signing or hashing of information, data, or messages; or exchange of security credentials.

Currency Units means the units of monetary value in major and minor units.

Current Limiter is a metering device that imposes a limit to the current that may be delivered to a load.

Current Transformer is a transformer used in metering which produces a safe current in its secondary that is proportional to the current in its primary.

Customer Device means an in-house display device ("IHD") or any other device incorporating a home area network ("HAN") interface with the means of providing customer access to the information stored in the smart metering system ("SMS") via that interface.

Data Collection System means the data collection system operated by the Market Operator for use in market settlement.

Data Collection Unit is the backbone of Advanced Metering Infrastructure that helps in data acquisition and transfer of energy data to the central database using automated meter reading ("AMR") in electronic energy meters.

Data Integrity means the state of data being unaltered by parties not authorised to access the data.

Data Registers means the equipment that receives, registers and stores the information received from the meter, and serves as a link to the remote reading. Data registers could be incorporated into the Meter itself or constitute a separate piece of equipment.

Data Store means a component of an SMS capable of storing data or information for future retrieval.

Day means a period of 24-hours as a unit of time reckoned from one midnight to the next.

Decryption means the process of converting encrypted information by an authorised party to recover the original information and like terms shall be construed accordingly.

Demand Response means changes in electric energy usage by customers from their normal consumption patterns in response to changes in the price of electricity or when system reliability needs to be preserved over time.

Designated Premises shall have the meaning given to that term in the terms and conditions for provision of service by a distribution licensee.

Device means a physically distinct part of a system.

Disable means the act of interrupting the flow of electricity by opening the load switch and like terms shall be construed accordingly.

Distribution Company or **DisCo** means an entity that has been issued a distribution licence pursuant to section 68 of the Electricity Act 2023.

Distribution Metering Code means Part 3 of this Code.

Distribution Network means any connection of cables, service lines and overhead lines, meters, electrical apparatus/equipment, having a design voltage of 33kV and below, used to transport electric power on a Distribution System.

Distribution System means any system consisting mainly of cables, service lines and overhead lines, meters, electrical apparatus/equipment having design voltage of 33kV and below, plus related systems used in the safe operation of an electricity network.

Distribution Licensee has the same meaning as Distribution Company.

Domestic Premises shall have the meaning given to that term in the terms and conditions for the provision of service by a distribution licensee.

Effective Date means the date on which this Code comes into force.

Electricity Network means any connection of cables, service lines and overhead lines, meters, electrical apparatus/equipment used to transport electric power on a transmission or distribution network or both.

Electromechanical Meter means a meter in which currents in fixed coils react with the currents induced in the conducting moving element, generally a disk, which causes their movement proportional to the energy to be measured.

Electronic Meter means a meter in which current and voltage act on solid state (electronic) elements to produce an output proportional to the energy to be measured.

Eligible Customer has the meaning assigned to it under section 39 of the Eligible Customer Regulations 2024.

Electricity Consumption means the active energy imported into the premises and consumed.

Electricity Meter means an instrument used to measure, store and display the amount of electrical energy passing through an electrical circuit or circuits.

Emergency Credit means credit (that can be made available) to ensure that the supply is not interrupted in circumstances (including situations of emergency) defined by the supplier to the premises.

Enable means the act of restoring the flow of electricity by closing the load switch.

Encryption means the process of converting information in order to make it unintelligible other than to authorised parties.

Energy Consumption means the amount of electricity in kWh or MWh supplied to the customer premises as recorded by the meter.

Export means the flow of electricity out of an energy source.

Firmware means the embedded software programmes and/or data structures that control electronic devices.

Generation Station means a facility with one or more power generating units.

Generation Substation means a substation in the transmission network or the distribution network, where power generators are connected.

Generator means a successor generation company, or an Independent Power Producer (IPP) that is licensed to generate electricity under section 65 of the Act.

Generator Group or **Generation Group** means a group of one or more similar generating units within a power plant, together with the associated plant and apparatus, whose energy output is separately identifiable and separately metered in the connection point. A powerplant will be considered a Generating Group if it has separate meters for each generating unit.

Generator Unit or Generation Unit means any equipment that produces energy, including the mechanical prime mover (e.g., turbine or engine) in the case of conventional hydro or thermal plant or the equivalent principle means of converting another form of energy to electricity, in the case of unconventional generating units such as wind and solar energy. In the case of a multi-generating unit

combined cycle block, a generating unit is an alternator plus its associated prime mover within the combined cycle block.

GPS means Global Positioning System.

Grid Code means the "Grid Code" as defined in section 232 of the Electricity Act, 2023.

Grid Metering Code means Part 2 of this Code.

High Voltage means a voltage, used for the supply of electricity, whose lower limit of nominal root-mean-square value is greater than 33kV.

Head End System (HES) means a system which provides means to access Smart Metering Systems by the sending commands and receiving responses and alerts across Wide Area Network (WAN) interfaces.

Home Area Network (HAN) Interface means component of SMS, IHD or other Customer Device that is capable of sending and receiving information to/from other customer devices.

IEC means International Electrotechnical Commission.

IHD means In-Home Display.

Import means the flow of electricity into a premises.

Instrument Transformers means CTs and VTs

Integrity means the state of a system where it is performing its intended functions without being degraded or impaired by changes or disruptions.

Large Connection means a connection where the connection capacity is greater than 4MVA or connections with generation facilities greater than 300kW.

Load Facility means a Distribution Company or a customer which is connected to the Transmission System.

Low Voltage (LV) means a voltage, used for the supply of electricity, whose upper limit of nominal root-mean-square value is less than 1kV.

Load Switch means a component that can close or open (including on receipt of a command to that effect) to enable or disable the flow of electricity.

Local Time means time corresponding to UTC+1.

Main Meter means a meter other than the Check Meter that is capable of and is used to measure the flow of active or reactive energy at a connection point.

Main Metering means the metering process to determine metering data utilising the Main Metering System.

Main Metering System means the trading point metering system utilised by the Market Operator as a prime reference for the measurement of the active or reactive energy interchanged at a connection point in the market settlement process.

Market Operator means the person licensed by the Commission to provide market administration services and responsible for registration of participants and trading point metering, collection and validation of meter data, the market settlement process and market payment system.

Market Rules means the Market Rules for the Nigerian Electricity Supply Industry.

Market Settlement means the process of calculating charges, due from Participants who are required to make payment, and to be paid to Participants who are due to receive payments, pursuant to the Market Rules.

Medium Connection means a connection where the connection capacity is greater than 50kVA and up to and including 4MVA where no generation facility greater than 50kW exists for an LV connection and no generation facility greater than 300kW exists for an MV connection.

Medium Voltage (**MV**) means a voltage, used for the supply of electricity, whose nominal root-means-square value ranges between 1kV and 33kV.

Meter means a device that measures and registers the integral active energy or reactive energy over a metering interval and may include a data recorder, but shall be deemed to exclude instrument transformers.

Metering Code (**MC**) or **Code** means Nigerian Electricity Metering Code.

Metering Code Review Panel means a panel constituted by the Commission for the review of the Nigerian Electricity Metering Code.

Metering Equipment means metering accessories like current transformers, voltage transformers, metering protection equipment including alarms and LV electrical circuitry, associated with a Meter.

Metering Installation, in the DMC, means a meter or meters and their associated metering equipment, which is located at a definite customer's location.

Metering Installation, in the GMC, means a meter or meters and their associated Metering Equipment, which is located at a trading point.

Metering Market Procedures has the meaning assigned to the term in the Market Rules.

Metering Services Provider (MSP) means an accredited metering company, entity or specialist that is conversant with the requirements of this Code and having the technical and infrastructural capability, which may be procured for the design, supply, installation, inspection, technical audit, or maintenance of metering systems.

Metering System means a Meter and the associated Metering Equipment.

Meter Test Station means an accredited test laboratory, which has the technical and infrastructural capability to perform mandatory tests for meters and metering equipment.

Meter Type means a particular design of meter manufactured by a manufacturer having similar meteorological properties, the same uniform construction of parts determining these properties and the same ratio of the maximum current to the reference current.

Miniature Circuit Breaker (MCB) means an automatically operated electrical switch to protect an electrical circuit from damage caused by overload or short circuit.

Microgeneration Meter means an electric energy measuring instrument used to measure energy from microgeneration which is designed to communicate with the SMS via the SMS's HAN Interface.

Open Standards means a standard openly accessible and usable by anyone. It is a standard that is freely available for adoption, implementation and updates.

Outcome means the result of executing a command, expressed as success or failure.

Payment-based Debt Recovery a means of recovering debt based on a percentage of a payment.

Participant or Market Participant has the meaning assigned to the term in the Market Rules.

Party means any person subject to the provisions of the Metering Code.

Point of Sale means a device for the remote purchase of electricity units to credit to a customer's meter.

Power Transformer means the transformer that interconnects the transmission network with the distribution networks, or the transmission network with an Eligible Customer.

Prepaid Meter means a Meter that requires the customer to pay for consumption in advance to allow a connection to the network.

Personal Data means any Personal information as defined in the Nigeria Data Protection Act, 2023.

Premises means any location to which electricity services is supplied.

Prepayment Mode means a mode of operation of a SMS whereby payment is generally made in advance of Consumption.

Price means the amount of money in currency units charged for 1 (one) kWh unit of electricity consumed.

Random Number Generator means a component used to generate a sequence of numbers that lack any predictable pattern.

Reactive Energy means the dissipated power resulting from either inductive or capacitive load with respect to time measured in units of volt-amperes reactive-hours (VArh) or standard multiples thereof (for example, kVArh, MVArh).

Replay Attack means a form of attack on a communications link in which a valid information transmission is repeated through interception and retransmission.

Response means a reaction sent containing information and/or the outcome from the execution of a command.

RMS means Root Mean Square.

Routine Test means a series of tests and checks performed by an authorised meter test station to determine that a new meter or metering equipment complies with the provisions of the MC.

Smart Meter means a meter that can carry out self-diagnostics and is capable of supporting a set of functionalities through a separate 2-way communication.

Smart Metering means a metering system consisting of **smart meters**, home area networks, 2-way communications systems, a set of functionalities and metering data management system. Also known as Advanced Metering Infrastructure (AMI).

Static Meter means the same as **Electronic Meter.**

Station Auxiliary Transformer means the transformer at any substation which feeds exclusively the auxiliary equipment of the substation.

Step Up Transformer means the transformer that connects a power generating unit with the transmission network.

System Operator means a person issued a system operation licence by the Commission in accordance with Section 67 of the Electricity Act, 2023.

System Operator Controlled Grid has the meaning assigned to the term in the Market Rules

Secure Perimeter means a physical border surrounding the SMS which is capable of preventing and detecting physical access from unauthorised persons.

Security Credentials means data used to identify and authenticate an individual or system.

Sensitive Event means a failed authentication or authorisation and/or, a change in the executing firmware version and/or, the detection of unauthorised physical access or any other occurrence that has the potential to put supply at risk and/or compromise the Integrity of the SMS and/or, unusual numbers of malformed, out-of-order or unexpected commands received and/or, a change of credit which is not reflective of normal consumption; and/or any other threat to its security detected by a SMS.

SMS means Smart Metering System.

Supply means the provision of electricity to a premises.

Susceptibility means the state of being likely or liable to be influenced.

Tamper Event means unauthorised physical access or any other occurrence that has the potential to put supply at risk and/or compromise the integrity of the SMS.

Tariff means the schedule of prices and other charges relating to electricity supply.

Tariff Register means a mechanism for recording and storing consumption in an SMS for the purposes of billing.

Time-based Debt Recovery means a way of recovering debt based on an amount in currency units per unit time.

Time-of-Use Band means a time period over which tariff prices in an SMS are constant.

Time-of-Use Pricing means a pricing regime with one or more Time-of-Use Bands.

Time-of-use Tariff means a schedule of tariffs for Time-of-Use Pricing.

TOU means Time-of-Use.

Trader means a person issued a trading licence by the Commission further to Section 69 of the **Act.**

Trading Point Meter means the Meter which measures the energy injected or withdrawn from the grid by a Participant, which will be used by the Market Operator in the Market Settlement process.

Trading Point Metering System means the system to measure and send to the Market Operator the energy injected or withdrawn from the grid by a Participant. This metering will be used for the market settlement process by the Market Operator.

Transmission Network means any connection of high voltage apparatus, equipment, lines, and stations, having design voltage of 132kV and above used in transporting electric power on a transmission system.

Transmission Service Provider (**TSP**) means a person issued a transmission licence by the Commission pursuant to section 66 of the **Act.**

Transmission System has the meaning assigned to it in the Grid Code.

Type Test means a series of tests and checks performed by an authorised Meter Test Station to determine that a new Meter Type complies with the provisions of this MC.

Trusted Source means a source whose identity is validated, such as an individual or system, where the identity is established either directly via a credential such as a password, or indirectly whereby a third party vouches for the identity of the individual or system.

User, in Part 1 General Conditions, means any person to whom this MC applies, or has any type of interest in the outcomes resulting from the implementation of this MC.

Urgent Metering Services means urgent unplanned work by a distribution licensee on a metering system as a result of actual or potential equipment failure, actual or suspected tampering or suspected theft.

Unauthorised Disclosure means the release of information from or to a person who is not authorised to receive or disseminate the information.

Unauthorised Physical Access means unauthorised access to the internal components of any device within an SMS through the physical outer casing.

Unique Transaction Reference Number (UTRN) means a cryptographic code used to convey credit to a SMS operating in prepayment mode.

User Interface/IHD means an interface for providing local human interaction with an SMS which supports input, visual and audible output.

UTC means Coordinated Universal Time.

VT means voltage transformer.

Week means the seven-day period commencing 00:00:00 Monday Local Time and ending at 00:00:00 on the following Monday.

Wide Area Network (WAN) Interface means a component that is capable of sending information to and receiving information from a head end system.

3. SECTION: REVIEW PROCESS AND DISPUTES

3.1. METERING CODE REVIEW PANEL

3.1.1. A Metering Code Review Panel ("MCRP") shall be appointed for the purpose of reviewing the Metering Code. The MCRP shall comprise of the following members:

(a) 1 member from Standards Organisation of Nigeria
(b) 1 member from Nigerian Electricity Management Services Agency or any other Commission accredited/approved Meter Test Stations
(c) 2 members representing Generation Companies
(d) 2 members representing Distribution Companies
(e) 1 member representing Meter Manufacturers
(f) 1 member from the Market Operator
(g) 1 member from Transmission Service Provider
(h) 1 member representing Electricity Traders
(i) 1 member from the Academia

3.1.2. Nominated representatives to the Metering Code Review Panel shall be competent staff of senior managerial status in the organization, which they are representing.

3.1.3. The "Metering Code Review Panel" shall perform the following functions:

(a) Keep the MC and its working under review.
(b) Review all suggestions for amendments to the MC which the Commission, Metering Code Review Panel member or User may wish to submit to the Metering Code Review Panel Chairman for consideration by the Metering Code Review Panel from time to time.
(c) Publish recommendations as to the amendments of the MC that the Metering Code Review Panel deems necessary or desirable and the reasons for these recommendations.
(d) Issue guidance in relation to the MC and its implementation, performance and interpretation upon the reasonable request of any User.
(e) Consider what changes are necessary to the MC arising out of any unforeseen circumstances or derogations approved.
(f) Resolve disputes that may arise from the implementation of this Code

3.1.4. The budget for funding and maintenance of the Metering Code Review Panel shall be approved by the Commission, and shall be the responsibility of the Market Operator, including the location of the Panel's Secretariat.

3.1.5. The Secretary of the MCRP shall consult in writing with users liable to be affected in relation to all proposed amendments to the MC and shall submit all proposed amendments to the MCRP for consideration prior to such amendment.

3.1.6. Members of the MCRP shall be appointed, from time to time, by the relevant Party or Parties concerned for a period of 2 years, with the possibility of renewal. As a general rule, each Party shall select its representative based on the provision of this MC. In the event of default in the appointment of representatives by the relevant Parties, the Commission shall appoint representatives from the Parties who have failed to appoint their own representatives. Members of the MCRP shall be required to enter into confidentiality commitments in favour of all Parties in a form specified by the Commission.

3.1.7. Decisions of the MCRP shall be made by voting of panel members attending any meeting. Each panel member shall be entitled to 1 vote. The Chairman shall have a casting vote in the event of a tie. Quorum for meetings of the MCRP shall be 7 members. All members of the MCRP shall be entitled to receive 5 Business Days' notice for meetings of the panel except in the case of emergency meetings where the notice requirements shall be waived by members.

3.1.8. The Chairman shall be elected by the MCRP from among their number.

3.1.9. The MCRP shall operate in accordance with such other rules and procedures as are laid down by it.

3.1.10. The Market Operator shall act as Secretary of the MCRP.

3.1.11. The MCRP decisions, except when it settles disputes, are not binding on the Commission. Any decision for amendment to the MC must be approved by the Commission and be published by the Secretary of the MCRP in a manner specified by the Commission.

3.2. DISPUTES

3.2.1. Any dispute relating to meters or metering equipment, which would affect the settlement and/or any payment to be made or received, shall be dealt with in accordance with the relevant dispute procedure in NESI.

3.2.2. Any dispute in relation to the following matters:

(a) Siting of the Trading Point Metering System;
(b) Technical specifications for Meters, Metering Equipment, or the Data Collection System;
(c) Sealing of Metering System;

(d) Compliance of Metering System with the technical specifications of this Metering Code;
(e) Compensation values;
(f) Such other matters that may arise from time to time;

shall be referred to the MCRP who shall act as experts and whose decision shall be final and binding on, and communicated to, the Parties concerned (giving reasons for the decision).

3.2.3. Any other dispute under this metering code shall be dealt with in accordance with the dispute procedure in the relevant connection agreement.

3.2.4. The MCRP shall request for any information it may properly and reasonably require to settle a dispute from any party and such party shall provide the relevant information on request within the time frame stipulated by the Panel.

3.2.5. The MCRP may make recommendations to the Commission on the payment of cost or/and expenses to any party in respect of any dispute referred to it.

3.3. UNFORESEEN CIRCUMSTANCES

3.3.1. If circumstances not envisaged in the provisions of the MC or divergent interpretations of any provisions included in the MC should arise, the Secretary of the MCRP shall, to the extent reasonably practicable in the circumstances, consult promptly with all affected Users in an effort to reach agreement as to what should be done. If agreement cannot be reached in the time available, the Secretary of the MCRP shall in good faith determine what is to be done, subject to approval of the Commission and notify all Users affected.

3.3.2. The Secretary of the MCRP shall promptly refer all such unforeseen circumstances and any determination to the MCRP for consideration.

3.4. ILLEGALITY AND PARTIAL INVALIDITY

3.4.1. If any provision of the MC should be found to be unlawful or wholly or partially invalid for any reason, the validity of all remaining provisions of the MC shall not be affected.

3.4.2. If part of a provision of the MC is found to be unlawful or invalid but the rest of such provision would remain valid if part of the wording were deleted, the provision shall apply with such minimum modification as may be:
(a) necessary to make it valid and effective; and
(b) most closely achieves the result of the original wording but without affecting the meaning or validity of any other provision of the MC.

3.4.3. The Secretary of the Metering Code Review Panel shall prepare a proposal to correct the default referred to in 3.4.1 and 3.4.2 for consideration by the Metering Code Review Panel.

PART 2: GRID METERING CODE

1. OBJECTIVES AND SCOPE

1.1. OBJECTIVE

The objectives of the Grid Metering Code are to establish:

(a) The technical, design and operational procedure for the Trading Point Metering System.
(b) The required accuracy and calibration of the Trading Point Metering System.
(c) The procedures for approval, certification and testing of the Meters and Metering Equipment.
(d) The metering standards to be met by TSP and Market Participants who have or plan to have access to the Transmission Network or MV Distribution Network, provided in the latter case they are, or expect to be, Participants trading in the Wholesale Market.
(e) The responsibilities of the Market Operator ensures compliance with the Grid Metering Code.

1.2. SCOPE

The Grid Metering Code applies to:

(a) The Market Operator
(b) Users, which in this part of the MC (the Grid Metering Code) are:
  (i) System Operator
  (ii) TSP
  (iii) Distribution Companies (Discos);
  (iv) Generators directly connected to the Transmission Network;
  (v) Customers with and without self-generation directly connected to the Transmission Network, whether they qualify or not as Market Participants;
  (vi) Eligible Customers with and without self-generation connected to the MV Distribution Network, provided that they qualify as Participants in the Market;
  (vii) Traders.

1.3. DEROGATIONS

1.3.1. If a User finds that an existing installation cannot comply with the standards contained in this GMC or cannot meet the required accuracy levels, it shall without delay report such noncompliance to the Market Operator stating the reasons for non-compliance and the proposed remedy for this situation. Where the costs of modifying existing equipment to meet the GMC standards are excessive and the equipment is expected to be changed or decommissioned within one (1) year, then application can be made to the Market Operator for a derogation.

1.3.2. Where a User has received professional technical advice that the proposed equipment or existing equipment, although not fully meeting the standards as listed in Condition 2.3, is capable of performing to the required levels of accuracy contained in Condition 2.5 then such advice and evidence of the performance of the equipment concerned, can be submitted to the Market Operator as due process for a derogation request if the User wishes.

1.3.3. Any request for derogations from any provision of the GMC by a User shall contain:

(a) the issue number and the date of the GMC provision against which the derogation applies;
(b) identification of the Meters or Metering Equipment in respect of which a derogation applies and, if relevant, the nature and extent to which the derogation applies including alternate compliance provisions;
(c) identification of the provision with which the derogation applies;
(d) the reason for the non-compliance requiring derogation;
(e) proposed remedial actions, if any; and
(f) the date by which the derogation ends if compliance will be achieved, or by which such derogation expires.

1.3.4. On receipt of any request for derogation, the Market Operator shall promptly consider such a request provided that it considers that the grounds for the derogation are reasonable. The Market Operator shall notify the Commission of the request, together with its opinion on:

(a) Whether the derogation would, or is likely to:
  (i) have a material adverse impact on the accuracy of the settlement system; or
  (ii) impose unreasonable costs on the operation of the Transmission System or on an Interconnected Party's System.

(b) Whether the derogation should be granted.

1.3.5. The Commission may grant derogation as requested or grant it subject to other provision or reject the request while taking into account the opinion of the Market Operator.

1.3.6. The Commission shall inform the Market Operator of its decision within 20 working days of receipt of the Market Operator´s notification.

1.3.7. To the extent of any derogation granted, the User shall be relieved from its obligation to comply with the applicable provision of the GMC and shall not be liable for failure to so comply but shall comply with any alternate provisions as set forth in the derogation.

1.3.8. The Market Operator shall:

(a) keep a register of all derogations which have been granted, identifying the name of the person and User in respect of whom the derogation has been granted, the relevant provision of the GMC and the period of the derogation; and
(b) on request from any User, provide a copy of such register of derogations to such User.
(c) Where a material change in circumstance has occurred, a review of any existing derogations, and any derogations under consideration, may be initiated by the Market Operator, the Commission or an Associated User.

2. SECTION: METERING REQUIREMENTS

2.1. TYPE OF CONNECTION POINTS

2.1.1. Trading Point Metering Systems comprise both the Main Metering System and the Check Metering System, when the latter is required. It shall be installed to measure active energy and reactive energy, at each Connection Point on the Transmission or Distribution Network, which corresponds to an interface that exists between two or more Participants. This will comprise both Import and Export metering as required by the Market Operator.

2.1.2. For the purposes of this GMC the Connection Points shall be classified as in Schedule E as follows:

(a) Type 1: Between a Generator Unit or Generator Group with a Connection Capacity equal to or higher than 20 MW and the Transmission Network
(b) Type 2: Between the Transmission Network and a Distribution Network
(c) Type 3: Between the Transmission Network and an Eligible Customer, with a Connection Capacity higher than 2MWh/h
(d) Type 4: International Interconnections
(e) Type 5: Interconnection between different Distribution Licensees
(f) Type 6: Between the Transmission Network and the 132kV (or higher Voltage) Customer.
(g) Type 7: All other connection Point.

2.1.3. Main and Check Metering Systems shall be installed as in Schedule E in all Connection Points of Type 1, 2, 3, 4 ,5 6 and 7.

2.1.4. Check Metering can be obtained through Redundant Metering or Verification Metering.

(a) Redundant Metering: Metering Equipment, installed at the same Connection Point where the Main Meter is installed. In principle, Main and Redundant Meters measurements shall be coincident.
(b) Verification Metering: Metering Equipment, or set of Metering Equipment installed in different locations than the Main Meter, whose measurements permits the verification of the Main Meter measurement through simple calculations that eliminates the effect of the network element that could exist between them.

2.2. LOCATION OF MAIN AND CHECK METERING SYSTEMS

2.2.1. As a general rule, both Main Metering System and Check Metering System, will be located as close as practicable to the Connection Point. Where there is a material difference in location, an adjustment for losses between the location of the Metering Systems and the Connection Point will be calculated by the Market Operator and agreed to by the User. Such loss adjustments may include transformer

and line loss compensation resulting from the distance of the Metering System to the physical location of the Connection Point.

2.2.2. Type 1 Connection Points

(a) Main Metering System at Generation Stations shall be located at the actual Connection Points:
(i) At the HV side of the Step-Up Transformer of the Generator Unit for energy exported;
(ii) At the HV side of the Station Auxiliary Transformer.

(b) Check Metering shall be obtained either:
(i) Through a Redundant Meter, located at the same point as the Main Metering System. In this case, Provision 2.2.2 (a) shall apply, or
(ii) Through Verification Metering, with Meters located at the Connection Points of each outgoing feeder of the Generation Substation

2.2.3. Type 2 Connection Points

(a) The Main Metering System shall be located at the LV side of the Power Transformers of the substation that connects the Transmission System with the Distribution System.
(b) Check Metering shall be obtained either:
(i) Through a Redundant Meter, located at the same point as the Main Metering System. In this case, Provision 2.2.3 (a) shall apply, or
(ii) Through Verification Metering, with Meters located at each of the outgoing MV distribution feeders, or
(iii) Exceptionally, in case neither (i) or (ii) could be applied, through Verification Metering, with Meters located at the HV side of the Power Transformers of the substation that connects the Transmission System with the Distribution System.

2.2.4. Type 3 Connection Points

(a) The Main Metering System shall be located at the actual Connection Point between the Transmission System and the Eligible Customer.
(b) Check Metering shall be obtained either:
(i) Through a redundant Meter, located at the same point as the Main Metering System. In this case, Provision 2.2.4 (a) shall apply, or
Through Verification Metering, with Meters located at each incoming Transmission Line into the Substation.

2.2.5. Type 4 Connection Points

(a) The Main Metering System shall be located at the Connection Point, in the Nigerian Substation, of the line that interconnects Nigeria with any neighbouring country.
(b) Check Metering shall be obtained either:
  (i) Through a Redundant Meter, located at the same point as the Main Metering System, in this case, Provision 2.2.5 (a) shall apply, or

  (ii) Through Verification Metering, with Meters located in the other extreme of the interconnection line (in the neighbouring country), if the Market Operator agrees with this possibility and the Interconnection Agreements allows adequate interchange of the information required in a timely manner.

2.2.6. Type 5 Connection Points

(a) The Metering Systems shall be located at the boundary/interconnection points between substations of different licensees.
(b) Each licensee shall consider the Metering System at the boundary/interconnection point substation as Main Metering. Verification Metering can be achieved by the use of metering systems at the same location.

2.2.7. Type 6 Connection Points

(a) The Main Metering System shall be located at the Primary Side of the Customer Transformer between the Transmission System and the 132kV (or higher Voltage) Customer.
(b) Check Metering shall be obtained either:
  (i) Through a redundant Meter, located at the same point as the Main Metering System. Or
  (ii) Through Verification Metering, with Meters located at each incoming Transmission Line into the Customer Substation.

2.2.8. Type 7 All other Connection Points

(a) The Main Metering System shall be located as close as possible to the actual Connection Point from the Transmission or Distribution System.

2.3. APPLICABLE STANDARDS

2.3.1. The accuracy of the various items of Metering Systems comprising Meters
and metering equipment shall conform to the relevant NIS/IEC standards. The following NIS/IEC standards approved for use with this GMC are:

i. General Requirements for Meters.
   (a) NIS/IEC Standard 62052-11:2021 General Requirements: Tests and Test Conditions.
   (b) NIS/IEC Standard 62056-21:2021 – Data exchange for meter reading, Tariff and Load Control – Direct local data exchange.

ii. Electromechanical Meters
   (a) NIS/IEC Standard 62053-11:2021 – Alternating current electromechanical meters for active energy (classes 0.5, 1, and 2).

iii. Static/Electronic Meters
   (a) NIS/IEC Standard 62053-22:2020 – Alternating current static meters for active energy (classes 0.1S, 0.2 S and 0.5 S).
   (b) NIS/IEC Standard 62053-21:2020 - Alternating current static meters for active energy (classes 0.5, 1, and 2).
   (c) NIS/IEC Standard 62053-23:2020 – Alternating current static meters for reactive energy (classes 2 and 3).

iv. Metering Equipment
   (a) IEC Standard 61869-1:2007 – Instrument transformers where the nominal voltage is more than 1kV AC or 1.5kV DC.
   (b) IEC Standard 61869-3:2011 – Voltage transformers.
   (c) IEC Standard 61869-4:2013 – Combined transformers.

2.3.2. Whenever the above-mentioned IEC Standards are followed, necessary corrections or modifications shall be made for nominal system frequency, nominal system voltage, ambient temperature, humidity and other conditions prevailing in Nigeria before actual adoption of the said Standards.

2.3.3. All Meters and Metering Systems shall comply with the relevant standards. Where relevant standards change from time to time, the Market Operator will review such changes and recommend to the Commission through the Metering Code Review Panel the extent to which any changes should be implemented.

2.3.4. Where a User proposes to utilise equipment that does not meet these standards, then a derogation submission must be made to the Market Operator in accordance with Section 1.3

2.4. CHARACTERISTICS OF THE METERING SYSTEM

2.4.1. Measuring Transformers characteristics and installation:

(a) Measuring transformer shall be always of inductive type.
(b) Main and Check Metering shall operate from separate current transformer (CT) and voltage transformer (VT) windings.
(c) As a general rule, CT and VT windings and cables connecting such windings to Main or Check Metering shall be dedicated for

such purposes and such cables and connections shall be securely sealed.

(d) Eventually, CT and VT windings and cables connecting such windings to Check Meters may be used for other purposes provided the overall accuracy requirements are met and evidence of the value of the additional burden is available for inspection by the Market Operator.

(e) Connection cables between VT and the metering equipment shall have a cross-sectional area enough to guarantee that the voltage drop will always be lower than 1V per 1000m. The maximum burden imposed by the cables that connect the current transformers with the metering equipment shall be lower than 4VA. In any case, the cross-sectional area of these cables shall not be lower than $4mm^2$.

(f) The Main Meter, Check Meter and additional burdens shall have separately fused VT supplies. Adequate devices shall be provided to immediately detect the absence of voltage to the metering equipment in any of the three phases.

2.4.2. Meters shall be static type, and relevant standard regarding the number of wires shall apply.

2.4.3. Meters shall be capable of measuring data at least half-hourly, and record them automatically on integral or separate Data Registers. In any case, all Meters shall have a display showing the accumulated values of the measured quantities.

2.4.4. Registers of active energy shall be done in all the ways the energy could flow. This may be achieved by using one or more metering equipment as may be convenient. Registers of reactive energy shall be done in all the four quadrants reactive energy could flow. This may be achieved by using one or more metering equipment as it is convenient.

2.4.5. In cases where separate Data Registers are used, each Data Register may store information from one or more Metering Equipment, provided that Redundant or Verification Meters shall have separate Data Registers from the Main Meters.

2.4.6. Data Registers shall have adequate capacity to store at least 3 (three) months of on-site data in non-volatile memories, to allow for any interruptions to the automatic Data Collection System.

2.4.7. The Meter and the Data Register shall have an adequate communication channel, either through a serial port RS-232, RS-485, opto-couplers according to IEC Standard 62056-21:2002. This communication channel will permit automatic download, including remote interrogation and batch download, by the Data Collection System.

2.4.8. For the purposes of remote interrogation of Meters or Data Registers, as the case may be, the Market Operator may use its own data communications network, or that of the System Operator. For redundancy purposes, it shall enter into, manage and monitor contracts to provide for the maintenance of all data links by which data is passed from the Meters or Data Registers, as the case may be, to the Data Collection System.

2.4.9. The Communication Protocol to be used shall be as specified in IEC standard 62056 or as may be defined by the MCRP, which shall be unique and of the type approved by the Commission in order to optimise the costs that shall be borne by the Users.

2.4.10. To prevent unauthorised access to the data in the Meters or Data Registers, a security scheme shall be incorporated for both local and remote access. Separate security levels shall be provided for the following activities:

(a) Level 1 - Password for read only of the following metering data, which shall be transferable on request during the interrogation process:
   (i) Meter or Data Register ID;
   (ii) Energy Metered Values;
   (iii) Cumulative measured quantities;
   (iv) Alarm indications; and
   (v) Meter or Data Register time and date.

(b) Level 2 - Password for corrections to the time and/or date and resetting of maximum values.

(c) Level 3 - Password for programming of:
   (i) Displays, tariff schemes and other functions; and
   (ii) The passwords for levels 1, 2, and 3.

(d) Level 4- Password for removal of Metering Equipment cover(s) necessitating the breaking of the seals for:
   (i) Testing of the Metering Equipment;
   (ii) Programming the level 3 password and the level 4 password.

In addition to the functions specified for each level, it shall be feasible to undertake the functions at the preceding or lower level.

2.4.11. Time synchronisation of Meters and Data Registers, as the case may be, shall be done preferably through GPS. Other synchronisation systems may be used, provided that they comply with the requirements regarding accuracy and security and do not distort the calculations of the energy balances. Such other methods shall be authorised by the Market Operator.

2.4.12. The Meter shall be enclosed in a cabinet or otherwise installed in a manner which shall conform to the manufacturer's stated

environmental conditions. The installation shall provide protection from moisture and dust ingress and from physical damage, including vibration. In addition, the cabinet or meter must be sealed to prevent unauthorised access.

2.5. ACCURACY OF METERING

2.5.1. The accuracy class or equivalent of various items of the Metering System, comprising of Meters and Metering Equipment, shall conform to the relevant IEC standards as listed in 2.3. Accuracy requirements for this GMC are defined by Type of Connection Point (as indicated in Section 2.2) and circuit capacity, rated in MVA. Circuit capacity shall be determined by the lowest rated primary equipment of the circuit, i.e., generator, transformer, lines, etc., and must be based on the primary equipment maximum continuous ratings. The rating and accuracy requirements of the Metering System should anticipate any future increase in rating of the primary equipment.

2.5.2. Accuracy class shall, as a minimum, be as shown in Table 1.

Table 1: Equipment Accuracy Classes

Equipment Type	**Equipment Accuracy Class**						
	For Connections						
	Type 1, 2, 3 and 6		**Type 4**	**Type 5**		**Type 7**	
Connection Capacity	**>50 MVA**	**< 50 MVA**	**all**	**> 10 MVA**	**< 10 MVA**	**>1MVA**	**<1 MVA**
Current Transformers (Note 1)	0.2S	0.2S/0.5	0.2S	0.2S/0.5	0.5	0.5	0.5
Voltage Transformers	0.2	0.5	0.2	0.5	0.5	0.5	0.5
Active Energy **Meters** (Note 2)	0.2S	0.2S/0.5	0.2S	0.2S/0.5	0.5	0.5	0.5
Reactive Energy **Meters**	2	2	2	2	2	2	2

Note 1: Current transformers shall meet the class accuracy requirements irrespective of CT secondary ratings.
Note 2: A Meter accuracy class of 0.5 may be used where energy transfers to be measured by the entry/exit Meter during normal operating conditions are such that the metered current will be above 5% of the Rated Measuring Current for periods equivalent to 10% or greater per annum (excluding periods of zero current).

For the measurement of active energy and reactive energy, the Metering Systems shall be designed and the metering equipment shall be tested and calibrated to operate within the overall limits of error set out in Table 2, after taking due account of CT and VT errors and the resistance of cabling or circuit protection.

2.5.3. If a contract between relevant Users has additional requirements for Metering Systems or requirements in relation to Meters, those requirements shall, so long as they do not prevent compliance with this GMC, apply in addition to the requirements of this GMC.

Table 2: Overall Accuracy of Metering System

Equipment Type		**Limits of Error at Stated Power Factor for Active Power and Energy Measurement**						
		For Connections						
		Type 1, 2, 3 and 6		**Type 4**	**Type 5**		**Type 7**	
Current Expressed as a Percentage of Rated Measuring Current	**Power Factor**	**>50 MVA**	**< 50 MVA**	**All**	**> 10 MVA**	**< 10 MVA**	**>1MVA**	**<1 MVA**
120% to 10% inclusive	1	±0.5%	±1.0%	±0.5%	±1.0%	±2.0%	±2.0%	±3.0%
Below 10% to 5%	1	±0.7%	±1.5%	±0.7%	±1.5%	±2.5%	±2.5%	±3.5%
Below 5% to 1% 120%	1	±1.5%	±2.5%	±1.5%	±2.5%	±3.5%	±3.5%	±4.0%
to 10% inclusive 120%	0.8 lag	±1.0%	±2.0%	±1.0%	±2.0%	±3.0%	±3.0%	±3.5%
to 10% inclusive	0.8 lead	±1.0%	±2.0%	±1.0%	±2.0%	±3.0%	±3.0%	±3.5%
Condition	**Power Factor**	**Limits of Error for Reactive Power and Energy at Stated Power Factor**						
120% to 10% inclusive	0	±4.0%	±4.0%	±4.0%	±4.0%	±4.0%	±4.0%	±4.0%
120% to 20% inclusive	0.8 lag	±5.0%	±5.0%	±5.0%	±5.0%	±5.0%	±5.0%	±5.0%
120% to 20% inclusive	0.8 lead	±5.0%	±5.0%	±5.0%	±5.0%	±5.0%	±5.0%	±5.0%

3. SECTION: OWNERSHIP AND ASSOCIATED OBLIGATIONS

3.1. OWNERSHIP

3.1.1. Unless something different is agreed among Users, and authorised by the Market Operator, Ownership of Metering Systems shall conform to the following rules:

(a) Generation Stations directly connected to the Transmission Network (Either Type 1 or 7)
  (i) Main Metering System shall be owned by the relevant Generation Company.
  (ii) Check Metering, if Redundant Metering shall be owned by the relevant Generation Company.
  (iii) Check Metering, if Verification Metering, shall be owned by the TSP

(b) Distribution Licensees Connected to the Transmission Network (Type 2)
  (i) Main Metering System shall be owned by the TSP:
  (ii) Check Metering, if Redundant Metering shall be owned by the TSP
  (iii) Check Metering, if Verification Metering, shall be owned by the relevant Disco

(c) Eligible Customers Connected to the Transmission Network (Either Type 3 or 7)
  (i) Main Metering System shall be owned by the TSP
  (ii) Check Metering shall be owned by the Eligible Customer

(d) International Interconnections (Type 4)
  (i) Main Metering System shall be owned by TSP, unless something different has been agreed in the relevant Interconnection Agreements
  (ii) Ownership of Check Metering Systems shall be governed by the relevant Interconnection Agreement.

(e) Interfaces among different Discos (Type 5)
  (i) Main and Check Metering System shall be owned by the relevant Discos.

(f) 132kV (or higher Voltage) Customers Connected to the Transmission Network (Either Type 6 or 7)
  (i) Main Metering System shall be owned by the TSP:
  (ii) Check Metering shall be owned by the 132kV (or higher Voltage) Customer.

3.1.2. The relevant owner shall be responsible for installing and maintaining his own metering equipment at the Connection Point, unless the User agrees with the Market Operator otherwise. For installations, site

inspections, technical audits and maintenance, the owner may utilise the services of any Metering Service Provider accredited by the Commission.

3.1.3. Regardless of ownership, the Market Operator shall be responsible for approving the initial design, and for the testing, commissioning and sealing of any Trading Point Metering System in Nigeria.

3.1.4. The User who owns the substation where the metering equipment is located shall provide the Market Operator with:

(a) 24-hour unrestricted access to the facilities where the Metering System is located;
(b) Adequate space for installing communications devices; and
(c) Reliable power supplies.

3.1.5. Any remote communications to the metering equipment, Meters, Data Registers, and connection equipment will be the responsibility of the Market Operator. The Market Operator may agree, either with the System Operator or the TSP, as it considers suitable, on the operation and maintenance of the communication equipment, as well as the services associated with the remote reading.

3.2. PROPER ORDER

3.2.1. Each owner shall at its own cost keep in good working order, repair and condition all Meters and Metering Equipment in respect of which it is responsible, to the extent necessary to ensure the correct registration, recording and transmission of the required data relating to active and reactive energy, measured by the relevant Meters.

3.3. METERING INFORMATION REGISTER

3.3.1. The Market Operator will maintain a register of all Trading Point Meters for settlement purposes at all Connection Points. This register will contain, but not be limited to:

(a) A unique meter identification/serial number.
(b) Location of the Trading Point Meters and Metering Systems.
(c) The owner of each Trading Point Meter.
(d) The identification of the Users concerned.
(e) Meter manufacturer, type and model.
(f) The specifications of metering equipment including accuracy.
(g) The adjustment factors including circuit losses to be applied.
(h) Metering System function (main, check, redundant or verification, export, import).
(i) Organisation which issues the certification of the Meter and Metering Equipment.
(j) Calibration and test performed on the Meters and/or the Metering Equipment at least during the last 5 years.

3.3.2. Where the data in the metering information register indicates that the Trading Point Meters or Metering Equipment do not comply with the requirements of this GMC, the Market Operator will advise the relevant owner of the non-compliance and such owner will rectify this situation forthwith unless a derogation is granted under the Section 1.3 of this GMC.

4. SECTION: CERTIFICATION, CALIBRATION AND TESTING OF METERING SYSTEM

4.1. CERTIFICATION

4.1.1. Each User shall ensure that all Meters and Metering Equipment for which it is responsible shall, at the Effective Date and thereafter, be certified, calibrated or compensated in accordance with this Grid Metering Code in order to meet the accuracy requirements stated in Section 2.5 of this GMC.

4.1.2. All electricity Meters and Metering Equipment used in Nigeria shall be certified to the required accuracy and the standards specified in this Code, by an approved Meter Test Station.

4.1.3. Electricity Meters may be purchased ready certified (in which case independent certification shall be provided by the manufacturer), and shall be further certified in Nigeria by an authorised Meter Test Station. The adequacy of any certification issued by a manufacturer shall require prior approval by Commission, which may require performing additional test or verifications by an authorised Meter Test Station before issuing it.

4.1.4. Existing uncertified Meters and metering equipment shall be replaced by certified meters, or tested to confirm that their accuracy conforms to this GMC within the permitted recalibration interval by an authorised Meter Test Station. In the latter case, the Meter Test Station which will perform the test will issue the required certification. All these tests shall be performed not later than 1 (one) year from the Effective Date the Code comes into effect.

4.1.5. Certifications of Meters issued by an authorised Meter Test Station or the approval issued by the Commission in case of certifications issued by the manufacturers, as the case may be, shall be issued for a pre-define period, which shall not be more than the life span of the meter. The life span of the meter shall be specified by the manufacturer, which in no case shall not be less than 15 (fifteen) years, and shall clearly indicate the minimum required calibration/certification tests and their frequency by an authorized Meter Test Station to maintain its validity. After that period the certification will expire, and the User shall replace the Meter, or ask for a new certification or an extension of the existing certification. This new certification or extension of the existing certification shall be issued by an authorised Meter Test Station, after the execution of tests and verifications the Meter Test Station considers relevant, and will contain different provisions regarding the frequency and characteristics of the calibration tests to be performed.

4.1.6. The minimum set of tests a manufacturer or an authorised Meter Test Station, as the case may be, shall perform to verify compliance with

this GMC, and issuing the corresponding certification shall be in accordance with Schedule A of this GMC.

4.1.7. The Market Operator shall be granted access to such Metering Equipment upon reasonable notice and at reasonable times, in order to make or inspect any adjustments thereto and to attend any tests or inspection thereof required pursuant to this Grid Metering Code.

4.2. INITIAL CALIBRATION/CERTIFICATION

4.2.1. All initial calibration/certification of Meters and Metering Equipment shall be performed by authorised Meter Test Station. These tests shall be performed in accordance with the relevant IEC standards and shall confirm that Meter and Metering Equipment accuracy is within the limits stated in Section 2.5. A unique identifiable calibration/certification record shall be provided before the connection is made live.

4.2.2. New voltage transformers and current transformers shall be certified by an authorised Meter Test Station prior to installation at any site. Meter owners shall provide manufacturer's test certificates to the Market Operator to show compliance with the accuracy standards.

4.3. COMMISSIONING TESTS

Where commissioning is required owing to the installation of new Metering Equipment or a modification of existing Metering Equipment, the relevant User must notify the Market Operator and any Users of the details of the new Metering System or changes to the existing system at least 1 (one) calendar month prior to the commissioning date. Where there is a change to a previously notified commissioning date, the User must notify the other parties of such change. The User will, prior to the completion of commissioning, undertake testing in accordance with this clause to ensure that the metering complies with the requirements of section 2.5 and that such testing is witnessed by the nominated representative of the Market Operator. Such testing shall be in accordance with Schedule B of this GMC.

4.4. PERIODIC TESTS

4.4.1. Meters shall be periodically checked in the presence of the Market Operator, as stipulated in sections 4.4.2. and 4.5 below, to ensure that Meters are operated within the acceptable accuracy limits specified in this GMC so that the Users are able to prepare, calculate, assess and validate, keep appropriate records of Meter readings and where appropriate, challenge invoices on a prompt, comprehensive and accurate basis.

4.4.2. In the presence of the Market Operator, the Owner/User(s) may carry out periodic, random inspection and or testing of any Metering

System and associated equipment for the purpose of ascertaining whether the Metering System complies with the requirements of this GMC for all Connection Types. In addition, in cases of unresolved dispute, the Commission may carry out its own unannounced inspection and or test, utilizing an authorised Meter Test Station if considered suitable, in which case the User(s) shall grant access to the Commission.

4.5. OTHER PERIODIC TESTS

4.5.1. The owner of a Check Metering System or a Trading Point Metering System will undertake other periodic testing upon request by the Market Operator, relevant User or Associated User.

4.5.2. Where a User or Associated User reasonably believes the Trading Point Metering System used for its data collection is operating outside the accuracy limits required by this GMC, it may request accuracy checks in accordance with **Table 1 (Equipment Accuracy Classes) and Table 2 (Overall Accuracy of Metering System)**.

4.5.3. The cost of other periodic testing must be met by the party requesting the test unless the test shows the accuracy of the Metering System does not comply with the requirements of this GMC, in which case the cost of the tests must be met by the owner of the Metering System, in addition to the costs that the owner must now incur to restore the Metering System to meet compliance with the GMC.

4.5.4. With regards to all disputes, such tests shall only be undertaken by an authorised Meter Test Station. Where a User undertakes testing of its own Trading Point Metering, then such testing shall be witnessed by a representative from the Market Operator and, if necessary, an Associated User. The User shall notify the Market Operator and the Associated User of its intention to undertake such test with at least 15 business days in advance.

4.5.5. Results of the tests that show the Trading Point Metering comply with this GMC will be sent to the Market Operator and the party that has requested the tests within 5 Business Days of the completion of such tests by the authorised Meter Test Station.

4.6. TEST FAILURE

4.6.1. Where, following a test, the accuracy of the Metering System is shown not to comply with the requirements of this GMC, the certification issued for the Meter or Metering Equipment which has failed the test will automatically expire, and a new one will be required.

4.6.2. The owner will at its own cost:

(a) consult with the Market Operator and the Associated Users in regard to the errors found and the possible duration of the existence of the errors; and
(b) make repairs or replacements to the Metering System to restore the accuracy to the required standards.

4.6.3. Where a Trading Point Metering System is found to be faulty, or non-compliant or outside the accuracy stated in Section 2.5, then the Market Operator and all Users and Associated Users that have an interest in this Metering System shall also be informed of the failure. Such notification shall include the plans by the owner to restore the Metering System to compliance with this GMC and the procedures to be followed to determine any estimated readings during the period, including any revised readings that were provided during the period that the Metering System was faulty or non-compliant.

4.6.4. In the event that a User cannot or does not comply with its obligations to repair, adjust or replace or renew any defective component, the Market Operator or the Associated User shall have the right to carry out such repair, adjustment, replacement or renewal and to recover its own costs, expenses and profit thereon from such User forthwith on demand (such profit to be based on a reasonable rate of return which shall be approved by the Commission).

5. SECTION: SECURITY AND DATA ACCESS

5.1. SEALING

5.1.1. Following the effective date of commissioning, or any test or inspection carried out according to Section 4, the Trading Point Meters shall be sealed by or on behalf of the Market Operator and, if necessary, the Associated User, except where sealing is impossible or impractical in the reasonable opinion of the Market Operator or the Interested User, having regard to the physical and electrical configuration at each Connection Point. Sealing shall be in accordance with the procedures stated in Schedule C.

5.1.2. Each User shall, following the effective date of commissioning, make arrangements for all Metering Equipment as are capable of being made secure, to be sealed by the Market Operator or on its behalf, in accordance with the procedures stated in Schedule B, except where impossible or impractical having regard to the physical and electrical configuration at each Connection Point.

5.1.3. No seal applied pursuant to this Grid Metering Code shall be broken or removed except in the presence of, or with the prior consent, of the owner, the Market Operator and, if appropriate, the Associated User affixing the seal, or on whose behalf the seal has been affixed, unless it is necessary to do so in circumstances where:

(a) Both main and check meters are malfunctioning or there occurs a fire or other similar hazard and such removal is essential and such consent cannot immediately be obtained (provided that the person which has affixed the seal and which has not given such consent shall be informed forthwith thereafter) or
(b) Such action is required for the purposes of Section 4.6.4. Where verbal consent is given, it must be confirmed in writing forthwith.

5.1.4. All relevant Users shall ensure, so far as they are able, that physical access to Meters and Metering Equipment is, where practicable, restricted to personnel who are required to have such access for the proper performance of their duties and have received permission for such access. A record of any such access shall be maintained by the Market Operator and the User on whose premises the Meters and Metering Equipment are positioned. Copies of such records shall be provided to the Associated User on request. In addition, all Meters and Metering Equipment, where practicable, must be made secure, if necessary, by making the lock and keys subject to similar access restrictions.

5.1.5. Each User, Associated User or Market Operator shall control the issue of its own seals, and shall keep an accurate register of all such seals and the authorised persons to whom they are issued. All such seals shall bear a distinctive mark.

5.2. ACCESS TO METERING DATA

5.2.1. With respect to any Trading Point Metering only the owner of the Metering System will change data and settings within its metering equipment and in:

(a) The presence of the Market Operator, or its authorised representative; or with the written agreement of the Market Operator

(b) The presence of the Associated User, or its authorised representative; or with written agreement of the Associated User.

5.2.2. With respect to any Trading Point Metering, the owner of the Metering Systems will allow reading of the Meters by the Market Operator and by the User whose consumption is measured by the Metering Systems.

5.2.3. Access to Meter data by any User of the Trading Point Metering Systems, including the provision of any remote access equipment required, will be at that User's cost, unless agreed otherwise in writing by the parties concerned.

PART 3: DISTRIBUTION METERING CODE

1. SECTION: INTRODUCTION

1.1. PURPOSE AND SCOPE

1.1.1. The purpose of this Distribution Metering Code (DMC) is to specify the technical and operational criteria, including the procedures to be complied with by the Distribution Licensee, in carrying out its obligation to provide metering services to users at each metering point. It also applies to users in so far as their equipment may affect the distribution system.

1.1.2. The Distribution Metering Code applies to the following:

(a) Distribution Licensees
(b) Users connected to, or seeking connection to the Distribution System which in this part of the MC (the Distribution Metering Code) are:

(i) Customers connected to the LV Distribution Network;
(ii) Customers connected to the MV distribution network, provided they are not Participants in the Market;
(iii) Generation Connected to Distribution, provided they are not Participants in the Market.

1.1.3. The Distribution Licensee shall:

(a) Own, install, verify, operate, maintain, inspect and replace all Metering Systems at Metering Points on the Distribution System. For installations, site inspections, technical audit and maintenance the owner may utilise the services of any Metering Service Providers accredited by the Commission;
(b) Ensure that each Metering System installed on its Distribution System meets the performance, functional and technical requirements and applicable standards set out in this DMC;
(c) Ensure that each Metering System installed on its Distribution System is certified, is in working condition and has been tested for accuracy where so required by this MC;
(d) Retrieve data from each Metering System, other than Prepaid Meters, installed on its Distribution System for the purposes of billing and settlement;
(e) Process data retrieved from each Metering System, other than Prepaid Meters, installed on its Distribution System for the purposes of billing and settlement; and
(f) Notify the Commission of all Metering Systems where the Distribution Licensee cannot comply with this Distribution Metering Code and shall seek derogation from the Commission, and the Commission may or may not grant such derogation and may impose any conditions as it reasonably deems fit.

1.2. DEROGATIONS

1.2.1. If a Market Participant finds that an existing installation cannot comply with the standards contained in this DMC or cannot meet the required accuracy levels, it shall within a period of less than one month from the date of discovery, report such non-compliance to the Commission stating the reasons for non-compliance and the proposed remedy for this situation. However, a Non-Market Participant can trigger an amendment to the Metering Code which shall be channelled through the Commission or Market Participants.

1.2.2. Where a Distribution licensee has received professional technical advice that the proposed equipment or existing equipment, although not fully meeting the standards as listed in Section 2.4 Technical Requirements and Accuracy of Meters is capable of performing to the required levels of accuracy contained in this DMC and/or then such advice and evidence of the performance of the equipment concerned, can be submitted to the Distribution Licensee or the Commission, as appropriate, as due process for a derogation request if the Distribution Licensee wishes.

1.2.3. Any request for derogations from any provision of the DMC by a Distribution Licensee shall contain:

(a) the issue number and the date of the DMC provision against which the derogation applies;
(b) identification of the Meters or Metering Equipment in respect of which a derogation applies and, if relevant, the nature and extent to which the derogation applies including alternate compliance provisions;
(c) identification of the provision with which the derogation applies;
(d) the reason for the non-compliance requiring derogation;
(e) proposed remedial actions, if any; and
(f) the date by which the derogation ends if compliance will be achieved, or by which such derogation expires.

1.2.4. On receipt of any request for derogation, the Commission shall promptly consider such a request provided that the Commission considers that the grounds for the derogation are reasonable. In its consideration of a derogation request, the Commission may contact the relevant users to obtain clarifications of the request or request additional information or to discuss changes to the request, and review possible remedial actions to achieve compliance as soon as reasonably practicable.

1.2.5. To the extent of any derogation granted, the Distribution Licensee shall be relieved from its obligation to comply with the applicable provision of the DMC and shall not be liable for failure to so comply but shall comply with any alternate provisions as set forth in the derogation.

1.2.6. The Commission shall:

(a) Keep a register of all derogations which have been granted, identifying the name of the Distribution Licensee in respect of whom the derogation has been granted, the relevant provision of the DMC and the period of the derogation; and
(b) On request from any User, provide a copy of such register of derogations to such User.
(c) Where a material change in circumstance has occurred, a review of any existing derogations, and any derogations under consideration, may be initiated by the Commission

2. SECTION: OBLIGATIONS

2.1. INSTALLATION AND REPLACEMENT OF METERING EQUIPMENT

2.1.1. The installation of Metering Equipment shall be made as close as practicable to the Connection Point, in accordance with the provisions of the Distribution Code.

2.1.2. The Distribution Licensee shall:

(a) Assign a unique identifier to the Metering System, cross-referenced to the location of the Metering System;
(b) Record the date of installation of the Metering System;
(c) Record the functionality of the Meter and the unit of measurement used to measure active or reactive Energy flowing through the Metering System or Maximum Load, as it corresponds;
(d) Record the identification of the ancillary equipment;
(e) Record any site-specific loss adjustment factors to be applied;
(f) Record redundancy details and sources of check metering data, where required by this Distribution Metering Code, and identification of the meters designated as the main Meter and as the Check Meter, if the latter exists;
(g) Record the initial Meter register reading.
(h) Ensure that the metering data stored in the Metering System is retrieved and, where a meter is removed, shall ensure that a final Meter reading is obtained.

2.1.3. The Distribution Licensee may replace metering equipment for which it is responsible at any time after it has been installed, subject to the provisions of this Distribution Metering Code. The Distribution Licensee shall notify the user in advance of any replacement, unless that replacement is provided as part of urgent metering services

2.1.4. The Distribution Licensee shall maintain the following information for each metering system:
(a) Location of the Metering System;
(b) A record of any calibration/certification of the Metering System including any test results made to the Metering System
(c) A record of any malfunction of the Metering System including any repairs made to the Metering System; and
(d) Documentation of Meter testing prior to installation.

2.1.5. The Distribution Licensee shall, on request, make available for each Metering System the information listed in DMC Sections 2.1.2 and 2.1.4 to:
(a) The User;
(b) The Commission.

2.2. STANDARD METERING SYSTEMS

2.2.1. Each Metering Point shall be situated as close as is reasonably practicable to the relevant Connection Point. However, User on dedicated lines Metering Equipment shall be located at the substation in accordance with the provisions of the Distribution Code.

2.2.2. Standard Medium Voltage Metering Systems:

(a) Shall contain a Meter or more than one Meter, each of which is certified and complies with the standards stated in this DMC;
(b) Shall record Active Energy (kWh);
(c) Shall record Reactive Energy (kVArh);
(d) Shall record Maximum Load in the cases the applicable tariffs specify that; and
(e) Shall have metering current and voltage transformers that are tested and comply with the standards stated in this DMC.

2.2.3. The rated short-time current rating shall not be less than

(a) 25kA for 3 seconds for MV Metering Points above 11kV; or
(b) 20kA for 3 seconds for MV Metering Points at 11kV and below. (IEC62052-11:2020)

2.2.4. For each circuit:

(a) Metering VT of accuracy class 0.50 or higher, with 110 volts secondary voltage and 100VA burden per phase for star-star shall be provided;
(b) Metering CT of accuracy class 0.5 or higher, with 5 amperes secondary current and 5VA burden shall be provided (IEC62052-11:2020).

2.2.5. Accuracy shall be as minimum class 1.0 (IEC62052-11:2020)

2.2.6. The Distribution Licensee may agree with the User on the use of more accurate Meters or Metering System in particular cases of Medium or Large Connections.

2.2.7. Standard Low Voltage Metering Systems:

(a) Shall contain a Meter or more than one Meter, each of which complies with the standards in this DMC, being either 1-phase 2-wire or 3-phase 4-wire type of accuracy class 1.0 for direct connected Meter, accuracy class 0.5 for CT operated maximum demand meter and metering current transformers, of accuracy class 0.5 with 5 amperes secondary current and 5VA burden;
(b) Shall record Active Energy (kWh);
(c) May record Reactive Energy (kVArh);

(d) Shall record Maximum Load in the cases the applicable tariffs specifies that;
(e) Shall contain, where necessary, metering current transformer(s) provided by the Distribution Licensee which are tested and comply with the standards stated in this DMC; and
(f) Shall contain a suitable facility (including all necessary pre-wiring), provided by the Distribution Licensee, in which to house the Metering System.

2.2.8. The Distribution Licensee may agree with the User the use of more accurate Meters or Metering Systems in particular cases of Medium or Large Connections.

2.2.9. Meters and Metering Equipment shall have a minimum service life of 15 years without maintenance from date of manufacture. The maximum service life of Meters and Metering Equipment shall be as specified by the manufacturer of such equipment, but in any case, not longer than 20 years unless a larger value will be authorized by the Commission.

2.3. ALTERNATIVES TO STANDARD METERING SYSTEMS

Upon the request of a User, the Distribution Licensee may arrange for a Metering System to install a check meter, or to contain features or equipment in addition to those specified in this Distribution Metering Code provided that:

(a) The User agrees to pay the full costs of the additional features or equipment, including the costs of installation, operation, maintenance, repairs and replacement; and
(b) The additional features or equipment are compatible with the rest of the Metering System and do not lead to any degradation of the capability of the Metering System that would cause the Metering System to fail to meet any standards contained in this Distribution Metering Code.

2.4. TECHNICAL REQUIREMENTS AND ACCURACY OF METERS

2.4.1. The Distribution Licensee shall ensure that the accuracy of each Meter in each Metering System is certified by an authorised Meter Test Station and meets the applicable accuracy limits.

2.4.2. The limits of accuracy for the following classes of Meters shall be as defined by the NIS/IEC 62053-22:2020, NIS/IEC 62053-21:2020 and NIS/IEC62053-24:2020:

(a) ± 0.2% for class 0.2 S static watt-hour meters.
(b) ± 0.5% for class 0.5 S static watt-hour meters.
(c) ± 0.5% for class 0.5 watt-hour meters.
(d) ± 1.0% for class 1.0 watt-hour meters.
(e) ± 2.0% for class 2.0 watt-hour meters.

2.4.3. The accuracy of the various items of Metering System comprising Meters and metering equipment shall conform to the relevant IEC standards or any equivalent Nigerian standards. The following IEC standards which are considered the minimum approved for use with this DMC are:

i. General requirements for Meters
   (a) IEC Standard 62052-11:2020 - Electric Metering Equipment (AC). General requirements, tests and test conditions

ii. Static/Electronic Meters
   (a) IEC Standard 62053-22:2020 - Alternating Current Static Watt-Hour Meters for Active Energy classes 0.2S and 0.5S
   (b) IEC Standard 62053-21:2020 - Alternating Current Static Watt-Hour Meters for Active Energy classes 1 and 2
   (c) IEC Standard 62053-23:2020 - Alternating Current Static Var-Hour Meters for Reactive Energy (Class 2 and 3)
   (d) IEC Standard 62055-41:2018 Electricity Metering Prepayment Systems. Standard Transfer Specification. Application Layer protocol for one-way token transfer system.
   (e) IEC Standard 62055-52:2008 Electricity Metering Prepayment Systems. Standard Transfer Specification- Physical protocol for two-way virtual token carrier for direct local connection.

iii. Metering Equipment
   (a) IEC Standard 61869-2:2012 – Current transformers.
   (b) IEC Standard 61869-3:2011 – Voltage transformers.
   (c) IEC Standard 61869-4:2013 – Combined transformers.
   (d) IEC Standard 60186 – Inductive voltage dividers (Only for Metering Systems installed before the Effective Date of this MC).

iv. Smart Meters
   (a) IEC Standard 62054 – 21:2017: Electricity metering (a.c.) - Tariff and load control: Particular requirements for time switches;
   (b) IEC Standard 62056 – 6-1:2017 Electricity metering (a.c.) - Data exchange for meter reading, tariff and load control -: Direct local data exchange.
   (c) IEC Standards 62056-6-1:2017 Electricity metering - Data exchange for meter reading, tariff and load control -: Object identification system OBIS-For G, H, W, meters OBIS codes are specified in EN 13757-1 (CEN TC 294), interface objects are common.

3. SECTION: CERTIFICATION AND TESTS

3.1. CERTIFICATION OF NEW METERING INSTALLATIONS

3.1.1. The Commission will approve and issue recommendations for Meters and Metering Equipment procurement in line with this DMC. These procurement recommendations/approvals shall be used by the operators in order to purchase Meters and Metering Equipment of acceptable quality and performance. Regardless of the above-mentioned recommendations, it is the responsibility of the Distribution Licensee to select the Meters and Metering Equipment which meet the accuracy and performance requirements contained in this DMC.

3.1.2. Every meter model intended to be used in a Metering Installation shall be certified (type-tested) by an authorised Meter Test Station (MTS) or any other body as may be approved by the Commission to perform this Type Tests, to confirm its specific characteristics and to prove that it complies with the requirements of relevant standards and accuracy class as outlined in Section 2 of this DMC. The Commission shall permanently maintain registers with the list of certified Meter Types. The validity period of the type-test certificate issued by the MTS shall be 2 (two) years for importers and 5 (five) years for local manufacturers of metering systems respectively subject to renewal.

3.1.3. Prior to the installation, every Meter or Metering Equipment shall be:

(a) Submitted by the Distribution Licensee to a Meter Test Station, which has been accredited by the Commission to perform Routine Tests and certification; or
(b) Received by the Distribution Licensee directly from a manufacturer with a test certificate endorsed by a Meter Test Station accredited by the Commission to endorse manufacturer's certifications.

3.1.4. Certifications of Meters issued by an authorised Meter Test Station or the approval issued by the Commission in case of certifications issued by the manufacturers, as the case may be, shall be issued for a pre-define period, which shall not be more than the life span of the Meter. The life span of the Meter shall be specified by the manufacturer, which in no case shall not be less than 15 (fifteen) years and shall clearly indicate the minimum required calibration/certification tests and their frequency by an authorized Meter Test Station to maintain its validity. After that period the Distribution Licensee shall replace the Meter, or ask for a new certification or an extension of the existing certification. This new certification or extension of the existing certification shall be issued by an authorised Meter Test Station, after the execution of tests and verifications as contained in this DMC.

3.1.5. Certification shall be confirmed by the affixing of a seal or certification sticker for the individual Meters and Metering Equipment. Certification of a Metering Installation will be valid as long as the certifications of all components of the Metering Installation remain valid.

3.1.6. Test certificates shall be retained by the Distribution Licensee whilst the Metering Equipment is in use, and for Metering Equipment that is no longer in use, for a minimum period of 5 (five) years after the Metering Equipment has been de-commissioned. The Distribution Licensee shall submit copies of these certificates upon notice from the Commission.

3.1.7 Meter Testing Arrangements: The test facilities of the authorised Meter Test Stations shall be as follows:

(i) Automatic Test Bench with high accuracy static source and 0.02 Class electronic reference standard meter shall be used for testing and calibration of portable test sets;
(ii) Portable Meter test equipment with static source and electronic reference meter of 0.025 Class shall be used for testing of meters on site;
(iii) The reference standard of class 0.02 meter of the test bench shall be bi-annually calibrated by an International Laboratory Accreditation Cooperation accredited laboratory to ensure traceability of measurement results.

3.1.8. Authorised Meter Test Stations shall comply with the following standards.

(i) ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories for energy meters.
(ii) IEC 62058-21:2008 Framework for the Testing and Calibration of Metering Testing Equipment.

3.1.9. The Commission shall permanently maintain a register of authorized Meter Test Stations, accredited to perform either or a combination of:

(a) Type Tests certification
(b) Routine Tests certification
(c) Endorsement of manufacturer's certifications
(d) Calibration Test certifications

3.1.10. On request from any Distribution Licensee or User, the Commission shall provide a copy of such register to such Distribution Licensee or User. Schedule A states the minimum tests and checks to be conducted by a manufacturer or a Meter Test Station for the issuance of:

(a) A Type Test certification
(b) A Routine Test certification
(c) An Acceptance Test
(d) Endorsement of a manufacturer's certification

These directives could specify that, in cases of sampling ISO 3951-2:2013 testing criteria shall apply.

Calibration reports will be required as part of the input to certification reports for Metering Installations, which should demonstrate that the overall accuracy requirements stated in this MC are met.

3.2. CERTIFICATION OF EXISTING INSTALLATIONS

3.2.1. Meters and Metering Equipment already installed in the Distribution System at the Effective Date shall be considered certified, if the installed Meter and Metering Equipment have undergone calibration or verification tests which are in line with the provisions of this MC, otherwise not certified.

3.2.2. For uncertified Meters or Metering Equipment, the Distribution Licensees shall replace the involved equipment or obtain a valid certification according with the procedures stated in Section 3.3 Re-certification.

3.3. RE-CERTIFICATION

3.3.1. Before the certification of a Metering Installation, or any of its components, expires, the Metering Installation shall be re-certified, by an authorized Meter Test Station.

3.3.2. Certification of the overall Metering Installation expires when the individual certification of any one of its components expires.

3.3.3. Any such component in 3.3.2 shall be recertified by removal to test, testing onsite, or replacement, as appropriate. If any part of the wiring of the Metering Installation is modified, or if additional components are connected to the Metering Installation (other than testing or monitoring equipment temporarily connected via the test block), the certification of the Metering Installation shall be deemed to be cancelled until the tests and checks prescribed by this MC have been satisfactorily carried out by an authorized Meter Test Station.

3.4. INSPECTION AND PERIODIC TESTS

3.4.1. The **Distribution Licensee** shall ensure that each **Metering System** is inspected according to the minimum frequencies specified in the Table 3.4.1:

Table 3.4.1: Frequency of Inspection

Type of Metering System	Frequency
Medium Voltage	User defined for revenue protection at least once every year
Low Voltage (including prepayment)	As frequent as possible at least once every three years

3.4.2. The Distribution Licensee may carry out periodic, random and unannounced inspection and or testing of any Metering System and associated data for the purpose of ascertaining whether the Metering System complies with the requirements of this DMC. The User may request the Distribution Licensee to carry out such inspection and or testing, provided that the User pays the cost, unless the test shown overall accuracy of the Metering Installation is not within the limits specified in this DMC, or malfunction not caused by the User is discovered. In addition, the Commission may carry out its own unannounced inspection and or test, utilizing an authorised Meter Test Station if considered suitable, in which case the User shall grant access to the Commission.

3.4.3. The Distribution Licensee shall, as soon as practicable, make the results of any inspection and or tests conducted pursuant to this section available to the requesting party and to the User associated with the Metering System.

3.5. FAULTY METERING EQUIPMENT

3.5.1. A Metering System shall be considered faulty and not in compliance with this Distribution Metering Code if it is determined that any part of that Metering System does not comply with this Distribution Metering Code.

3.5.2. If a Metering System fault occurs, the Distribution Licensee shall provide Urgent Metering Services to repair or replace upon removal of an obsolete or faulty Meter and under no circumstances shall the customer be placed on estimated billing.

3.5.3. The User shall use Metering Equipment in a safe and prudent manner and shall take due care to avoid damage. The User shall notify the Distribution Licensee of any damage to the Metering Equipment, however caused. The cost of repairs or replacement shall be borne by whoever is responsible for the damage determined through an investigation by the Distribution Licensee. In the case of a dispute as to who is responsible, the matter shall be referred to the Commission.

3.5.4. The Distribution Licensee shall ensure that suitable data is obtained or estimated for the period of time commencing when a Meter or Metering Equipment becomes faulty until the completion of the repair or replacement.

3.5.5. The Distribution Licensee shall record all relevant Meter parameters for a replacement Meter in that Metering System.

4. SECTION: ACCESS AND SECURITY

4.1. ACCESS TO METERING SYSTEMS

4.1.1. The User shall grant access to the Distribution Licensee to enable the Distribution Licensee to fulfil its obligations under this Distribution Metering Code. This right of access is conditional upon:

(a) Where practicable, prior notice by the Distribution Licensee; and
(b) The production of identification by the Distribution Licensee's staff or contractor.

4.1.2. Prior arrangement by the Distribution Licensee shall not be required in respect of routine Meter reading, or periodic, random and unannounced audits required by DMC Section 3.4.3, or when the Distribution Licensee is performing Urgent Metering Services.

4.2. SECURITY OF METERING SYSTEMS

4.2.1. The Distribution Licensee shall, so far as is reasonably practicable, maintain the security of the metering data stored in or obtained from each Metering System.

4.2.2. Appropriate serialized security seals shall be applied to each Metering System. Seals shall be replaced following works requiring the removal of any seals. The Distribution Licensee's procedures for the control of seals shall be in accordance with Section 3.3 of Schedule C of this MC.

4.2.3. The Distribution Licensee shall, so far as is reasonably practicable, ensure that physical access to each Meter contained in each Metering System is protected by:

(a) Sealing all associated links, circuits, data storage and data processing systems;
(b) Ensuring that the Metering System meets the requirements for the security of Metering Systems set out in this Distribution Metering Code;
(c) The Distribution Licensee shall use reasonable endeavours to ensure that all metering data within each Metering System is secure.

5. SECTION: METER READING AND DATA MANAGEMENT

5.1. METER READING

5.1.1. The Distribution Licensee shall schedule at least once in 4 (four) months reading for all manually read meters.

5.1.2. For kilowatt-hour meters, the Distribution Licensee shall verify at each Meter reading that the Meter identification number on the Meter matches the Meter identification number on the Meter reading schedule.

5.1.3. The Distribution Licensee shall record:

(a) The Meter identification number;
(b) The Meter reading and read date at the beginning of the Meter reading period;
(c) The Meter reading and read date at the end of the Meter reading period;
(d) The cumulative Active Energy (kWh) recorded during the Meter reading period;
(e) Where the User is billed for Reactive Energy, the cumulative Reactive Energy (kVArh) recorded during the Meter reading period;
(f) Where the User is billed for maximum Active Power, the maximum Active Power recorded during the Meter reading period;
(g) Where the User is billed for maximum Reactive Power, the maximum Reactive Power recorded during the Meter reading period; and
(h) Details of any Meter alarms that were recorded during the period (e.g., system outages, VT failure).

5.2. REMOTE METERING EQUIPMENT

5.2.1. The Distribution Licensee shall specify the type of equipment to be used for communication with remote meters.

5.2.2. The Distribution Licensee shall conduct such tests as it deems necessary to verify production or consumption recorded at each Metering Point.

5.3. DATA MANAGEMENT

5.3.1. The Distribution Licensee shall:

(a) Maintain a metering data registry that contains usage data for each User and data required for settlement purposes in respect of each Metering System;
(b) Validate metering data for each Metering System;
(c) Estimate usage when Meter readings are not available, inaccurate, or otherwise not suitable for settlement purposes;

(d) Apply adjustments to metering data to account for system losses and energy unaccounted for;
(e) Aggregate metering data for settlement and loss calculation purposes; and
(f) Use reasonable endeavours to maintain the security and confidentiality of the metering data.

5.4. DATA REGISTRATION

5.4.1. The Distribution Licensee shall establish and maintain a register that contains the following information for each Metering System:

(a) A unique identifier assigned by the Distribution Licensee to the Metering System cross-referenced to the location of the Metering System and cross referenced to the User's account;
(b) The date of installation of the Metering System;
(c) The functionality of the Meter and the unit of measurement used to measure Energy flowing through the Metering System (e.g., kWh meter, kVArh meter);
(d) The Meter Type installed
(e) Identification of the ancillary equipment;
(f) Any site-specific adjustment factors to be applied, including a cross reference to the unique identifier specified in (a) above;
(g) The existence of redundancy and sources of check metering data, where required by this DMC, and identification of the meters designated as the Main Meter and as the Check Meter;
(h) Data for each Meter following completion of the validation and estimation procedures;
(i) Billing data for each Meter following completion of adjustments for losses and energy unaccounted for; and
(j) The data covering a period of not less than twelve months which shall be immediately accessible in electronic form.

5.5. DATA VALIDATION AND LOSS ADJUSTMENT FACTORS

5.5.1. The Distribution Licensee shall:
(a) Have in place data validation procedures and loss adjustment calculation methodologies approved by the Commission;
(b) Where necessary, determine site-specific loss adjustment factors for each Metering System;
(c) Multiply each valid reading by the appropriate loss adjustment factor to produce loss adjusted production or consumption; and
(d) Maintain both unadjusted and loss-adjusted values in the metering data registry in respect of each Metering System.

INHERENT POWERS OF THE COMMISSION

(a) The Commission may from time to time amend or repeal the provisions of this Metering Code and the Schedules thereto as it may determine.

(b) Nothing in this Metering Code shall prohibit the Commission from adopting in conformity with the provisions of the Act, any procedure which is at variance with any of the provisions of herein, provided that the Commission is of the opinion that in the special circumstances of the matter and for reasons to be recorded in writing, it deems it just or expedient that such procedure is proper for dealing with the matter.

The common seal of the Nigerian Electricity Regulatory Commission was affixed pursuant to the order of the Commission.

On this ----------17TH----------day of ----------MARCH---------- 2026.

Musiliu O. Oseni, Ph.D.
Chairman

METERING CODE – SCHEDULES

1. SCHEDULE A – CERTIFICATION TESTS

1.1. GENERAL

This Section sets out those tests and checks that shall be performed by a manufacturer or an Authorised Meter Test Station to the Meters and Metering Equipment in order to certify compliance with this MC.

1.2. MEASUREMENT TRANSFORMERS

1.2.1. Current transformer (CT)

The following tests shall be conducted in compliance with IEC 61869-2:2012

(a) Verification of marking and polarity wiring
(b) Impulse withstand test
(c) Power frequency voltage withstand test
(d) Inter-turn over-voltage test (injection 1 Amp on secondary)
(e) Partial discharge in accordance with IEC 60270:2015
(f) Short time over current test
(g) Limits of error test

1.2.2. Potential Transformer (PT)

The following tests shall be conducted in compliance with IEC 61869-3:2011

(a) Verification of marking and polarity wiring
(b) Impulse withstand test
(c) Power frequency voltage withstand test
(d) Partial discharge in accordance with IEC 60270:2015
(e) Induced over-voltage test by injecting 234V at 150c/s on secondary winding for 40 seconds
(f) Limits of error test

1.2.3. Combined PT/CT

The following tests shall be conducted according to IEC 61869-4:2013

1.2.3.1 TYPE TEST

(i) Short time over-current test.
(ii) Temperature rise test.
(iii) Lightning Impulse test.
(iv) Switching Impulse test.
(v) Wet Test for outdoor transformer.
(vi) Short CCT withstand capability on PT.
(vii) Limits of error test.
(viii) Measurement of the radio interference voltage.

1.2.4. Routine Test

(i) Verification of terminal marking.
(ii) Power frequency withstand test on the primary.
(iii) Partial discharge measurement for PT in accordance with IEC 60270:2015.
(iv) Power frequency withstand test on secondary.
(v) Power frequency withstand test between sections.
(vi) Inter-turn over-voltage test for CT.
(vii) Limits of error test.

1.3. METERS

In accordance with standards mentioned in this code, samples of all meters shall satisfactorily fulfil the requirements of the Type Tests.

The Type Tests required to be carried out are as listed below:

No.	Tests	Electro-mechanical meters	Electronic /Smart Meters
1	**Test of insulation properties**		
	Impulse voltage tests	x	x
	AC voltage tests	x	x
2	**Tests of accuracy requirements**		
	Test of meter constant	x	x
	Test of starting condition	x	x
	Test of no-load condition	x	x
	Test of influence quantities	x	x
	Repeatability of error test	x	x
3	**Tests of electrical requirements**		
	Test of power consumption	x	x
	Test of influence of supply voltage	x	x
	Test influence of short-time over-currents	x	x
	Test of influence of self-heating	x	x
	Test of influence of heating	x	x
	Test of immunity to earth fault	x	x
4	**Test for Electromagnetic Compatibility (EMC)**		
	Radio interference suppression		
	Fast transient burst test		
	Damped oscillatory waves immunity test		x
	Test of immunity to conducted disturbances, induced by radio-frequency fields		x x x
	Test of immunity to electrostatic discharges		x
	Surge immunity test		x
5	**Tests of the effect of the climatic environments**		

	Dry heat test	x	x
	Cold test	x	x
	Damp heat, cyclic test	x	x
	Solar radiation test	x	x
		x	x
6	**Mechanical Test**		
	Vibration test	x	x
	Shock test	x	x
	Spring hammer test	x	x
	Tests of protection against penetration of dust water	x	x
	Test of resistance to heat and fire	x	x

ACCEPTANCE TESTS

The following tests shall be conducted for meter samples for the purpose of Acceptance Test Certification:

(a) Test of Starting Condition
(b) Test of No-Load Condition
(c) Test of Power Consumption Voltage Variation
(d) Test Frequency Variation Test
(e) Test of Influence Quantities
(f) Repeatability of Error Test
(g) Power Frequency and Impulse Voltage Withstand Tests

Samples of meters shall be selected from the lot (batch) using the Single Plan Method below using the ISO 3951-2:2013

Batch Size	Sample Size	Acceptance Criterion	Rejection Criterion
1-50	All	0	1
51-150	13	0	1
151-500	50	1	2
501-1200	80	2	3

ROUTINE TESTS

Upon supply, all Meters are required to fulfil requirements of Routine Test comprising the following;

(a) A.C High Voltage Test
(b) Test of Meter Constant
(c) Test of Starting Condition
(d) Test of No-Load Condition
(e) Test of Influence Quantities

2. SCHEDULE B – COMMISSIONING TESTS

2.1. GENERAL

This Section sets out those tests and checks that shall be included in the metering commissioning programme. Metering equipment shall in addition have basic tests carried out on earthing, insulation and continuity, together with such other tests that would normally be conducted in accordance with Prudent Utility Practice. In addition, during the commissioning of new or modified parts of the installation including the meter, voltage transformer, current transformer and data recorders then these shall be confirmed as being in accordance with the approved drawings to avoid equipment with for example a wrong ratio or a wrong specification being inadvertently connected.

2.2. INSTRUMENT TRANSFORMERS

2.2.1. For all installations with new/replaced Instrument Transformers the Market Operator and/or User(s) shall ensure that from site and/or factory tests and inspections the following are confirmed and recorded:

(a) Details of the installed units, including serial numbers, rating, accuracy classes, ratio(s).
(b) CT ratio and polarity for selected tap.
(c) VT ratio and phasing for each winding.

2.2.2. For installations with existing Instrument Transformers the Market Operator and/or User shall ensure that, wherever practically possible, items a, b and c above are implemented but as a minimum must confirm and record VT and CT ratios. If it is not possible to confirm the CT ratio on site, then the reason must be recorded on the commissioning record and details must be obtained from any other relevant party.

2.3. INSTRUMENT TRANSFORMERS LEADS AND BURDENS

For all installations the Market Operator and/or User(s) shall wherever practically possible:

(a) Confirm that the VT and CT connections are correct.
(b) Confirm that the VT and CT burden ratings are not exceeded.
(c) Determine and record the value of any burdens (including any non-Trading Point Metering burdens) necessary to provide evidence of the overall metering accuracy.

2.4. METERING

2.4.1. GENERAL TESTS AND CHECKS

The following may be performed on-site or elsewhere (for example, factory, Meter Test Station, laboratory, etc.):

(a) Record the Metering System details required by the Data Collection System.
(b) Confirm that the VT/CT ratios applied to the Meter(s) agree with the site measurement transformer ratios.
(c) Confirm correct operation of Meter test terminal blocks where these are fitted (for example, CT/VT operated metering).
(d) Check that all cabling and wiring of the new or modified installation is correct and is clearly marked and or colour coded.
(e) Confirm that meter registers advance (and that output pulses are produced for Meters which are linked to separate outstations) for import and where appropriate export flow directions.
(f) Confirm Meter operation separately for each phase current and for normal polyphase current operation.
(g) Where separate outstations are used, confirm the Meter to outstation channel allocations and that the Meter units per pulse values or equivalent data are correct.
(h) Confirm that the local interrogation facility (Meter or outstation) and local display etc., operate correctly.

2.4.2. SITE TESTS

The following tests shall be performed on site:

(a) Check any site cabling, wiring, connections not previously checked under clause the General Tests above.
(b) Confirm that Meter/outstation is set to UTC + 1 within ± 5 seconds.
(c) Check that the voltage and the phase rotation of the measurement supply at the Meter terminals are correct.
(d) Record Meter starts readings (including date and time of readings).
(e) Wherever practicable, a primary prevailing load test (or where necessary a primary injection test) shall be performed which confirms that the Meter(s) is registering the correct primary energy values and that the overall installation and operation of the Metering System is correct.
(f) Where for practical or safety reasons the previous site test (e) above is not possible then the reason shall be recorded on the commissioning record and a secondary prevailing load or injection test shall be performed to confirm that the Meter registration is correct including, where applicable, any Meter VT/CT ratios. In such cases the VT/CT ratios shall have been determined separately as detailed.

(g) Record values of the Meter(s)/outstation(s) displayed or stored data (at a minimum one complete half-hour value with the associated date and time of the reading) on the commissioning record.
(h) Confirm the operation of metering equipment alarms (not data alarm or flags in the transmitted data).

3. SCHEDULE C – SEALING PROCEDURES

3.1. SEALING PROCEDURE AT THE LABORATORY

3.1.1. Every meter cover shall be sealed after certification at the laboratory by the Meter Test Officer.

3.1.2. All chemically bonded meter covers shall be sealed with hologram seal after certification by the Meter Test Officer.

3.1.3. The Meter Test Station shall keep records of the seals fixed on meters certified by the Station.

3.2. SEALING PROCEDURE AT POINT OF INSTALLATION

3.2.1. Every meter terminal cover shall be sealed after installation at the customer premises in the case of Single-phase, Three-phase and Maximum Demand Meters.

3.2.2. In the case of MD meters, the terminal covers, test terminal block, CT terminal, VT terminals, voltage fuse holders, meter boxes/cubicle shall be sealed by the meter installer.

3.2.3. The sealing procedure described in 3.2.1 and 3.2.2 above shall be witnessed by the representative of the customer.

3.2.4. A certificate duly signed by the Meter Installer and the customer or his representative shall be issued by both parties

3.2.5. For meters at the electricity trading points, a copy of the certificate shall be forwarded to the Market Operator to update his records.

3.2.6. The sealing certificate shall contain the following information: -

(a) Present seal serial number,
(b) Previous seal serial number
(c) Date of sealing
(d) Purpose of sealing
(e) Meter serial number
(f) Name of the Installer
(g) Name and signatures of Meter Installer
(h) Name and signature of Customer or his representative.

3.3. SEALING PROCEDURE AT POINT OF MAINTENANCE, RECALIBRATION/ RECERTIFICATION, INSPECTING, SITE TESTING OF METERS ETC

3.3.1. For any of the above-mentioned purposes, breaking of seals shall be done in the presence of the customer or his representative.

3.3.2. All the sealable points where seals were broken for any of the above-mentioned purpose shall be resealed in the presence of the

customer or his representative and an updated seal certificate issued.

3.3.3. For meters at the electricity Trading Points the following procedure shall be followed:

(i) The sealing of all Trading Point Meters must be done in the presence of the Market Operator and the associated Users.
(ii) The breaking of seals shall be done in the presence of the Market Operator and the associated Users.

3.3.4. A sealing certificate for this purpose shall contain information listed on 3.2.6 above.

3.4. SEALS SPECIFICATIONS

Type.	-	Compressible or non-compressible type
Material	-	Plastic with embossed serial number
Temperature Range	-	To withstand operating temperature of up to 70^{o}C
Colour	-	To be of any colour
Wire Dimension	-	Not more than 2.5mm^2 cross-sectional area.

Average Break Strength - Reasonably large break strength

3.5. SEALING POINTS

Every metering system shall be sealed at the following sealing points: -

(i) Meter cover
(ii) Meter terminal cover
(iii) Meter battery cover
(iv) Test terminal cover
(v) Voltage fuses & Links
(vi) CTs and VTs terminals
(vii) Associated circuits, and
(viii) Metering box or cubicles

4. SCHEDULE D - TECHNICAL SPECIFICATIONS FOR METERS AND METERING ACCESSORIES

4.1. GENERAL

The technical specifications enunciated herein are a summary of minimum requirements for energy Meters and metering accessories approved for use in Nigeria's electricity network. It is aimed at promoting the quality of energy metering in Nigeria to ensure fair play in energy transactions among utilities and customers and safety of all Meter Users.

The specifications cover the following:
(i) Electromechanical Meters
(ii) Electronic Meters
(iii) Prepayment Meters
(iv) Smart Metering
(v) Current Limiters
(vi) Metering Accessories
(vii) Metering Panels

4.1.1. This Code recognizes all the existing meter technologies, however the framework for deployment of meters shall be smart metering and shall commence on the date of approval of this Code.

4.1.2. The specifications are prepared in accordance with the following International Standards and relevant equivalent Nigerian Standards:

(i) NIS/IEC 62052-11:2020
(ii) NIS/IEC 62053-11:2016
(iii) NIS/IEC 62053-21:2020
(iv) NIS/IEC 62053-22:2020
(v) NIS/IEC 62053-23:2020
(vi) IEC 62055-41:2018 and
(vii) IEC 62055- 52:2008
(viii) IEC 62056-3-1:2021
(ix) IEC 62054-21:2017
(x) IEC 62056-21:2002
(xi) IEC 62056-6-1:2013
(xii) IEC 61869-2:2012
(xiii) IEC 61869-3:2011
(xiv) IEC 61869-4:2013
(xv) Meters OBIS Codes as specified in EN 13757-1:2014

4.1.3. ATTRIBUTES OF COMMUNICATION MEDIA

(i) The communication media shall be immune to environmental/man-made disturbances.
(ii) The communication media shall be tamper resistant.
(iii) Shall have sufficient security at the physical and data level.
(iv) The communication media shall be reliable with very high up-time.

(v) The cost of infrastructure and variable cost of the communication media shall be relatively low.

4.2. CERTIFICATION AUTHORITY

The calibration/certification of Meters shall be done at any Authorised Meter Test Station.

4.3. TECHNICAL SPECIFICATIONS FOR ELECTRO-MECHANICAL METERS

4.3.1. SINGLE PHASE ELECTRO-MECHANICAL METER

	PARAMETERS	TECHNICAL REQUIREMENT
1	Nominal Voltage	230V AC,2 Wire System
2	Operating Voltage	-40% to +10% Nominal voltage
3	Accuracy Class	2
4	Current Rating	5(60)A
5	Frequency	50Hz ±2%
6	Relative Humidity	95% at 450C Non-Condensing
7	Operating Temp.	Up to 60^0C
8	Storage Temp.	Up to 70^0C
9	Energy Register	Cyclometer type with at least 5 No Wheels. Bold digits of not less than 9.0 x 4.5mm size, clearly marked in kWh
10	Graduation of Roller scale	10,000; 1,000; 100; 10; 1
11	Terminal	Hole of 8.5mm - 9mm diameter. Extended transparent terminal cover with provision for adequate sealing. External connection diagram on the terminal Cover
12	Rotor Type	Bottom bearing of magnetic edge and upper surface of the disc shall be graduated or marked
13	EMC Susceptibility	According to IEC 62052-11:2020 & 62053-21:2016

14	Connection	Ph, Neutral, Neutral, Ph (Symmetrical)
15	Name Plate	Provision of the inscription of Utility Property & serial number
16	Casing/Cover Material	Fire retardant-Bakelite or Polycarbonate
17	Carrying Handle	Must be provided
18	Meter Constant	Must be stated
19	Surge withstand voltage	Not less than 6kV
20	Insulation resistance	2V for 1 min
21	Mounting hook	Must be provided
22	Burden	≤ 2VA
23	Sealing	Provision must be adequate to prevent tampering
24	Life Span	15 years

4.3.2. POLY-PHASE ELECTRO-MECHANICAL METER

	PARAMETERS	**TECHNICAL REQUIREMENT**
1.	Nominal Voltage	3 x 230/400V AC, Three –phase four Wire System for use in balanced or unbalanced load conditions incorporated with anti-reverse device
2.	Operating Voltage	-40% to +10% Nominal voltage
3.	Accuracy Class	2
4.	Current Rating	3 x 10(60)A
5.	Frequency	50Hz±2%
6.	Relative Humidity	95% at 450C Non- Condensing
7.	Operating Temp.	Up to 60°C
8.	Storage Temp.	Up to 70°C
9.	Energy Register	Cyclometer type with at least 6 No Wheels. Bold digits of not less than 9.0 x 4.5mm size, clearly marked in kWh
10.	Graduation of Roller scale	100,000,10,000;1,000;100;10;1
11.	Terminal	Hole of 8.5-9mm diameter. Extended transparent terminal cover with provision for adequate sealing. External connection diagram on the terminal cover.

12.	Rotor Type	Bottom bearing of magnetic edge and upper surface of the disc shall be graduated or marked.
13.	EMC Susceptibility	According to IEC 62052-11:2020 & 62053-21:2016
14.	Connection	Ph, Load, Ph, Load, Ph, Load: N, N
15.	Name Plate	Provision of the inscription of Utility name & serial number
16.	Casing/Cover Material	Fire retardant-Bakelite or Polycarbonate
17.	Carrying Handle	Must be provided
18.	Meter Constant	Must be stated
19.	Surge withstand voltage	Not less than 6kV
20.	Insulation resistance	2kV for 1 min
21.	Mounting hook	Must be provided
22.	Burden	2VA/Phase, maximum
23.	Sealing	Provision must be adequate to prevent tampering
24.	Life Span	15 years

4.4. TECHNICAL SPECIFICATIONS FOR STATIC/ELECTRONIC METERS

4.4.1. GENERAL CONSTRUCTION COMPONENT SPECIFICATIONS FOR STATIC ENERGY METERS

	PARAMETERS	TECHNICAL REQUIEMENTS
1.	Body of Meter	Bakelite or Polycarbonate
2.	Terminal Block	Made of polycarbonate grade and shall form integral part of the Meter base, brass or copper current terminals with star head brass screws as well as bimetallic contacts.
3.	Terminal cover	Transparent terminal cover with external provision of sealing through sealing screws.
4.	Diagram of connections	Diagram of external connections to be shown inside the terminal cover. Terminal Connection Configuration: Ph-N, N-Ph (Symmetrical Single Phase Terminal Configuration) PhR1- PhR2, PhY1- PhY2, PhB1- PhB2, N- N (Asymmetrical Three Phase Terminal Configuration
5.	Marking on name plates	Meter shall have clearly visible, indelible and distinct name plate.

6.	Meter Sealing	One seal shall be affixed on one side of Meter body
7.	Guarantee/Warranty	5 years
8.	Resistance to heat and fire	The terminal block of Meter case shall be protected against the spread of fire. They shall not be ignited by thermal overload of live parts in contact with them.

4.4.2. OTHER GENERAL COMPONENT SPECIFICATIONS

	COMPONENT FUNCTION	REQUIREMENT
1.	Measurement or computing chips	The Measurement or computing chips used in the Meter shall be with the Surface mount type along with the ASCII's.
2.	Memory Chips	The memory chips shall not be affected by the external parameters like sparking, high voltage spikes or electrostatic discharges.
3.	Display Modules	a) The display modules shall be well protected from the external Ultra-Violet (UV) radiations. b) The display visibility shall be sufficient to read the Meter mounted at a height of 0.5 metre as well as at the height of 2 metres.
4.	Communication Modules	Communication modules shall be compatible for the two RS 232/485 ports one for optical port for communication with Meter reading instruments & the other, for the hardware. RS 232/485 port to communicate with various modems for AMR such as mobile telephony, radio frequency, fixed line, satellite, or power line communication technology with IEC 62056-21:2002 DLMS/COSEM Protocol or any standard data protocol such as MQTT or MQTTS may be used. Meter may be interrogated wirelessly from a local wireless device linked to the wireless network.
5.	Optical Port	Optical port shall be used to transfer the Meter data to Meter reading instrument. The mechanical construction of the port shall be such to facilitate the data transfer easily.
6.	Power Supply	The power supply shall be with the capabilities as per the relevant standards. The power supply unit of the Meter shall not be affected in case the maximum voltage of the system appears at the terminals due to faults or due to wrong connections.
7.	Electronic Components	The active and passive components shall be of the surface mount type to be handled and soldered by

		the state-of-the-art assembly processes. The components shall be positioned in such a way that the leads of components shall not be under stress and not touching the internal wires.
8.	Mechanical Parts	The internal electrical components shall be of electrolytic copper and shall be protected from corrosion, rust, etc. The other mechanical components shall be protected from rust, corrosion, etc.by suitable plating and painting methods.
9.	Battery	Lithium with minimum guaranteed life of 15 years and can last without recharging for 60 days.
10.	RTC & Micro Controller	The accuracy of Real Time Clock shall be as per relevant IEC standards
11.	P.C.B	Glass Epoxy, fire resistance grade FR4, with minimum thickness of 1.6mm
12.	Remote communication interface	Meter Shall be able to communicate with Head end system through Gateway/Modem. Two-way communication between meter and HES or via DCU through RF, PLC, LoRa and GPRS. DCU shall support TCP/IP, G3 PLC, Radio Frequency, Fiber, 3G or 4G
13.	HAN/WAN interface	It shall be capable of: Being replaced without also requiring the replacement of the electricity meter Supporting communications base on Open Standards

4.4.3. GENERAL TAMPER AND ANTI-FRAUD DETECTION /EVIDENCE FEATURES

The Meter shall log minimum of 225 tamper events, compartment-wise division of each event and their persistence time shall be indicated. The meter shall not be affected by any remote tamper control device and shall continue recording energy under any one or combinations of the following conditions:

(i) **Phase sequence reversal**: The Meters shall work accurately irrespective of the phase sequence of the supply.

(ii) **Detection of missing potential**: In case someone intentionally takes out a potential lead, the date and time of such occurrence shall be recorded by the Meter. The restoration of normal supply shall also be similarly recorded. The threshold for the voltages shall be programmable as specified.

(iii) **Reversal of current coil polarity**: Meter shall record the reversal of current coil polarity with time and date, and also the time of restoration. Meter shall, however, register the energy consumed

correctly with any one, two or all three-phase current coil reversal.

(iv) **Phase association disturbance**: Meter shall record any disturbance to the association of voltage and current coil with time and date and also the time of restoration. Meter shall however, register the energy consumed correctly with two or three misaligned phases.

(v) **Current coil shorting**: Meter shall record time and date of current coil terminal short and restoration. The threshold of the current shall be programmable.

(vi) **Power on/off:** Meter shall detect power OFF (minimum power off period of 5 minutes) if any of phase voltages are not present. This event shall be recorded at the time of each power OFF. At the same time power 'ON' event shall be recorded. This logging shall be available in Tamper details along with cumulative time of failure.

(vii) **Recording of neutral disturbance:** Meter shall log all events when AC/DC current or voltage is injected in neutral circuit without disturbing the recording of energy.

(viii) **Snap-on parameters:** Meter shall log all three-phase voltage, current, power factor etc. at the time of tamper attempt for all such occurrences.

(ix) **Influence quantities:** The Meter shall work satisfactorily with guaranteed accuracy limit under the presence of the following influence quantities as per IEC 62052-11:2020 and 62053-21:2016.

The influence quantities are:
(a) External Magnetic field – 0.5 Tesla (with log-on feature)
(b) Electromagnetic field induction
(c) Radio frequency interference
(d) Unbalanced load
(e) Vibration
(f) Wave form 10% of 3rd harmonics
(g) Phase sequence
(h) Voltage unbalance
(i) Electro Magnetic High Frequency Field, and
(j) D.C immunity test

4.4.4. GENERAL REQUIREMENTS

i. On the Meter name-plate:
(a) Indelible Meter serial number shall not be less than eleven (11) digits and legibly printed.

(b) Size of the digit of the Meter serial number shall be a minimum of 5mm x 3mm.
(c) Bar code and/or QR Code shall be printed below the Meter serial number
(d) Manufacturer's Name and Trademark.
(e) Place of manufacture.
(f) Year of manufacture.
(g) Reference Voltage, Current and Frequency.
(h) Class index.
(i) Meter Constant.
(j) Owner/Utility's Identity.
(k) Type and Make of Meter.

ii. The meter shall have two provisions for sealing, the manufacturer shall affix one serialised seal on one side of the meter while the authorised Meter Test Station shall seal the other side, and the meter with ultrasonic welding or chemical bonding shall be sealed with hologram seals.

iii. The internal potential links shall be in closed position or link- less. Meters will be preferred and there shall not be any external link.

iv. Terminal cover shall be fixed on Meter before dispatch.

v. The operation manual and the inscriptions on the name plate shall be provided in English Language.

4.4.5. SINGLE PHASE (2-WIRE) 5(60) AMPS CREDIT STATIC METER

	FUNCTION/FEATURE	TECHNICAL REQUIREMENTS
1.	Standards	IEC 62052-11:2020,62053-21:2016
2.	Accuracy Class	1.0
3.	Frequency	50Hz ± 2%
4.	Operating Temp.	Up to 60^0C
5.	Storage Temp.	Up to 70^0C
6.	Relative Humidity	95% at 45^0C non-condensing
7.	Life Span	Minimum of 15 years
8.	Impulse withstand voltage	Not less than 6kV
9.	Reference Voltage	230 volts (P-N), -40% to +10% Vref, however the Meter shall withstand the maximum system voltage i.e. 400 Volts continuously
10.	Display	LCD (Six digits) Height:9mm x 4.5mm minimum

		Viewing angle 160 degrees minimum
11.	Power factor range	Zero lag – unity – zero lead
12.	Display parameters	Display Parameters: LCD test, kWh, Date & Time (Cumulative kWh will be indicated continuously by default and other parameters through push-button) Display order shall be as shown on S/N 23 below.
13.	Burden	Less than 2VA in voltage circuit and 1VA for current circuit
14.	Starting current	0.4% of Ib.
15.	Test Output Device	Flashing LED visible from the front
16.	Billing data	Meter serial number, Date and time, kWh and history for last 6 months. All these data shall be accessible for reading, recording and spot billing by downloading through IR port on universal CMRI or Laptop computers at site.
17.	Terminal Configuration	Ph-N, N-Ph (Symmetrical)
18.	Security feature	Programmable facility to restrict the access to the information recorded at different security levels such as read communication, communication write etc.
19.	Memory	Non-volatile memory independent of battery backup. Information stored in the memory shall be retained for a minimum of 15 years in case of power failure
20.	Software & communication compatibility	IR port to transfer locally through Common Meter Reading Instrument (CMRI) or laptop. The MSP shall supply Software required for CMRI. He shall also provide training for the use of software. The software shall be compatible to Microsoft Windows systems latest version. The MSP shall provide Meter-reading protocols and jointly work with the Utility to develop CMRI software for downloading and further uploading on computer. The MSP has to give an undertaking in this regard.
21.	Terminal hole Diameter	Shall be 8.5mm - 9mm.
22.	Tamper Events	Meter Behaviour
	I/C & O/G Interchanged	Meter shall record forward energy
	Phase & neutral interchanged	Meter shall record forward energy

	I/C neutral disconnected, O/G Neutral & load connected to earth	Meter shall record forward energy
	I/C neutral disconnected, O/G neutral connected To earth through a resistor.	Meter shall record forward energy
	I/C neutral connected O/G neutral connected to earth through resistor.	Meter shall record forward energy
	I/C phase & neutral interchanged, load connected to earth	Meter shall record forward energy
	Influence parameters	The Meter shall work satisfactorily with guaranteed accuracy limit under the presence of following influence quantities as per IEC62052-11:2020. External magnetic fields Electromagnetic field induction Radio frequency interference Vibration etc Waveform 10% of 3rd harmonics Electromagnetic High Frequency (H.F) Fields DC Immunity test
23.	Display Sequence for Parameters	
	1. Default Display	
	Cumulative kWh (cumulative kWh to be displayed continuously without decimal)	
	2. On Demand Display	
	After pressing the push button, the following parameters shall be displayed	
	LCD Test	
	Date	
	Real time	
	Last month billing date	
	Last month billing kWh reading	
	Meter serial number	

4.4.6. THREE PHASE 4-WIRE 5(100) AMPS ELECTRONIC CREDIT METER

	FUNCTION/FEATURE	TECHNICAL REQUIREMENTS
1.	Standards	62052-11:2020, 62053-21:2016
2.	Accuracy Class	1.0
3.	Frequency	50Hz ± 2%
4.	Operating Temp.	Up to 60^0C
5.	Storage Temp.	Up to 70^0C
6.	Relative Humidity	95% at 45^0C non-condensing
7.	Life Span	Minimum of 15 years
8.	Impulse withstand voltage	Not less than 6kV
9.	Reference Voltage	230/400Volt – 40% to +10% Vref
10.	Display	• LCD (Seven digits) • Height: 9mm x 4.5mm minimum • Viewing angle 160 degrees minimum
11.	Power factor range	Zero lag – unity - zero lead
12.	Display parameters	Display parameters: LCD test, date & time, (Cumulative kWh continuous and other parameter with push button. All the energies are without decimal).
13.	Burden	Less than 2VA voltage circuit, 1VA in current circuit.
14.	Starting current	4% of Ib
15.	Test Output Device	Flashing LED visible from the front
16.	Billing data	Meter serial number, Date and time, kWh and history for last 6 months. All the above quantities shall be accessible for reading, recording and spot billing by downloading through optical port on CMRI/HHU or Laptop computers at site.
17.	Security feature	Programmable facility to restrict the access to the information recorded at different security levels such as read communication, communication write etc.
18.	Memory	Non-volatile memory (NVM) independent of battery backup. Information stored in the memory shall be retained for a minimum of 15 years in case of power failure.

19.	Software & communication compatibility	(a) IR port to transfer locally through Common Meter Reading Instrument (CMRI) or laptop (b) The MSP shall provide Software required for CMRI & for the connectivity to AMR modules. The MSP shall also provide training for the use of software. The software shall be compatible to Microsoft Windows systems latest Version. (c) There should be provided Meter reading protocols and developed customized CMRI software for Meter downloading and further uploading on computer covered by an undertaking.
20.	Terminal Hole Diameter	Shall be 8.5mm - 9.0mm
21.	Tamper Events	Meter Behavior
	In-coming(I/C) & Out-going (O/G) interchanged.	Meter shall record forward energy
	Phase & neutral interchanged	Meter shall record forward energy
	I/C neutral disconnected, O/G neural & load connected to earth	Meter shall record forward energy
	I/C neutral disconnected, O/G neutral connected to earth through a resistor	Meter shall record forward energy
	I/C neutral connected, O/G neutral connected to earth through a resistor	Meter shall record forward energy
	I/C phase & neutral interchanged, load connected to earth	Meter shall record forward energy
22.	Influence parameters	The Meter shall work satisfactorily with guaranteed accuracy limit under the presence of following quantities as per IEC 62053-23:2020 • External magnetic fields • Electromagnetic field induction • Radio frequency interference

		• Vibration etc • Waveform 10% of H.F Fields • D.C Immunity test
23.	Display Sequence for parameters	Default display Cumulative kWh (cumulative kWh to be displayed continuously without decimal. On Demand Display After pressing the push button, the following parameters shall be displayed: • LCD test • Date • Real time • Last month billing date • Last month billing kWh reading • Meter serial number

4.4.7. THREE PHASE 4-WIRE 10(100) AMPS (WHOLE CURRENT) ELECTRONIC CREDIT METER

	FUNCTION/FEATURES	TECHNICAL REQUIREMENTS
1.	Standards	IEC 62052-11:2020,62053-21:2020
2.	Accuracy Class	1.0 active 2.0 reactive
3.	Frequency	50Hz ± 2%
4.	Operating Temp.	Up to 60^0C
5.	Storage Temp.	Up to 70^0C
6.	Relative Humidity	95% at 45^0C non condensing
7.	Life Span	Minimum of 15 years
8.	Impulse withstand voltage	Not less than 6kV
9.	Reference Voltage	230/400Volt, - 40% to +20% Vref
10.	Display	• LCD (Seven digits) • Height: 9mm x 4.5mm minimum • Viewing angle 160 degrees minimum **Display parameters:** LCD test, date & time, cumulative kWh, cumulative kVAh and kVarh, MD in kW and kVA, PF, V, I (cumulative kWh continuous and other parameter with push button). All the energies are without decimal). Display order shall be as below**:** a) LCD test b) Date c) Real time d) Cumulative kVarh e) Cumulative kVAh f) Current MD in kVA g) Instantaneous power factor h) Instantaneous Voltage R phase i) Instantaneous Voltage Y phase j) Instantaneous Voltage B phase k) Instantaneous Current R phase l) Instantaneous Current Y phase m) Instantaneous Current B phase n) Last month billing date o) Last month billing kWh reading p) Last month billing kVarh reading q) Last month billing kVAh reading r) Last month billing maximum demand MD in kVA s) Demand in kVA t) Demand in kVA occurrence Date
11.	Power factor range	Zero lag – unity – zero lead
12.	Burden	Less than 2 VA/phase voltage circuit, 1 VA in current circuit
13.	Starting current	0.4% of Ib.

14.	Test Output Device	Flashing LED visible from the front.
15.	Billing data	a) Meter serial number, Date and time, kWh, kVAh, kVarh and kVA. b) No of tamper counts, tamper occurrence with date & time, tamper restoration date & time with snap shots. c) No of tamper counts, tamper occurrence with date & time, tamper restoration date & time with snap shots d) History of kWh, kVAh, kVarh & MD for last 6 months along with Time-of-Day readings. e) All the above parameters (namely kWh, kVAh, kVarh & kVA) are meter readings. f) All the above quantities shall be accessible for reading, recording and spot billing by downloading through optical port IR or Laptop computers/CMRI at site.
16.	MD Registration	a) Meter shall store MD in every 30min period along with date and time. b) It shall possible to reset MD automatically at the defined dated (period)
17.	Auto Reset of MD	Auto reset date of MD shall be indicated at the time of commissioning and provision shall be made to change MD reset date through CMRI even after installation of meter on site
18.	Time of Day Metering	Meter shall be capable of doing TOD Metering for kWh, kVArh, kVAh, and MD in kW and kVA for minimum of 36 days
19.	Load survey	30 minutes integration period, load profile of average voltage and current, kW and kVA for minimum of 36 days
20.	Data reading from the meter and downloading on desktop PC	Meter data consisting of all parameters and 36 days load survey for 4 parameters shall be read by CMRI and downloaded on desktop PC
21.	Security feature	Programmable facility to restrict the access to the information recorded at different security levels such as read communication, communication write etc.

22.	Diagnostic feature	Self-diagnostic for time, calendar, RTC, battery with display segments and NVM
23.	Memory	Non-volatile memory (NVM) independent of battery backup. Information stored in the memory shall be retained for a minimum of 15 years in case of power failure.
24.	Software & communication Compatibility	a) Optical port with RS 232/485 compatible to transfer the data locally through CMRI and remotely through modems such as mobile telephony, radio frequency, fixed line, satellite, or power line communications technology. b) The MSP shall provide Software required for CMRI and IEC 62056-21:2020 DLMS/COSEM for the connectivity to AMR/AMI modules. The MSP shall also provide training for the use of software. The software shall be compatible to Microsoft Windows systems latest Version. The software shall have polling feature with optical selection of parameters to be downloaded for AMR/AMI application. c) Necessary provision shall be made in the software for converting all the parameters available for new and old meters if supplied earlier. Operation manual shall be in English language. d) The meter shall have capability to store the tamper status in the memory in the form of status word. Any change in the status word (selectable basis) the meter shall generate the interrupt to initiate the communication with the AMR/AMI module through RS 232/485 port if is connected.
25.	Terminal Hole Diameter	Shall be 8.5mm - 9.0mm

4.4.8. THREE PHASE 4-WIRE CT OPERATED STATIC ENERGY METER

	FUNCTION/FEATURES	TECHNICAL REQUIREMENTS
1.	Standards	IEC 62052-11:2020, 62053 – 22:2020, 62053-23:2020
2.	Accuracy Class	0.5
3.	Frequency	50Hz ± 2%
4.	Operating Temp.	Up to 60^0C
5.	Storage Temp.	Up to 70^0C
6.	Relative humidity	Up to 95% at 45^0C non-condensing
7.	Life Span	Minimum of 15 years
8.	Reference Voltage	230/400 Volt – 40% to +10% Vref
9.	Current (I_n)	-/5A
10.	Current (I_{max})	$200I_n$
11.	Minimum starting current	0.2% of I_n
12.	Display	a) LCD (seven digits) b) Height, 10mm × 5mm minimum c) Viewing angle, 1600 minimum
13.	Burden	Less than 2VA per phase in voltage circuit and 1VA in current circuit
14.	Impulse withstand voltage	Not less than 6kV
15.	Type of energy Registration mechanism	Backlit-LCD Display
16.	MD Reset mechanism	a) Automatic on 00.00hrs of the first day of the month b) Manual reset
17.	Insulation test	IEC62052-11:2020
18.	Type of load	All types of load (linear, nonlinear, balanced/unbalanced at any P.F)
19.	Display details (Descriptive in order of display)	a) Display test b) Real time and date c) Rising demand with elapsed time d) Active energy e) Reactive energy (both lag & lead) f) Apparent energy g) Maximum Demand (both kW & kVA) h) MD reset count i) Instantaneous power factor with sign for leg/lead j) Instantaneous frequency k) Instantaneous voltage (phase wise) l) Instantaneous current (phase wise) m) Instantaneous Active load n) Instantaneous reactive load (with sign for lag/lead) o) Instantaneous apparent load p) Billing in kWh q) TOD energy kWh

		r) TOD Max demand in kVA s) Cumulative maximum demand t) Present status of tamper u) Latest occurrence of abnormality with date & time. Latest restoration of abnormality with date & time
	(ii) Process of display.	a) Automatic in cyclic manner (No 1….9) of 19(i) b) Through push button
	(iii) Digits	8
	(iv) Time for display of one reading	8 seconds
20.	Memory	a) Non-volatile memory without battery back for a minimum of 15 years. b) Sufficient to store data (MD & energy) of consecutive 12 billing period in addition to tamper details, TOD Zones, tamper information as described in detailed technical specification.
21.	Battery	a) Meter can be powered by means of external and internal battery in the absence of supply voltage. b) It shall be possible to replace defective battery without opening the meter cover. c) The battery compartment shall be sealable.
22.	Tamper data preservation capacity	Able to store at least 225 events (occurrence & restoration as separate events) with roll over facility: Loss of potential Loss of current Change in error due to: a) Variation in frequency b) Variation in temperature c) Variation in voltage
23.	Load survey capability	a) Parameter logged: kW import, kVA etc. b) Logging interval:30 minutes c) No. of days load survey:36 days at interval of 30 minutes.
24.	Earthing terminals	As per IEC 62052-11:2020
25.	Time of day	As per utility's request
26.	Capacity for fraud prevention & detection	The Meter shall store in its memory, occurrence and restoration of the following tampers: a) Missing potential b) CT short/CT Open c) Current reversal d) Current unbalance

		e) Current missing with date, time and also log the events.
27.	Sealing and Locking arrangement	2 sealing screws on the Meter cover and 2 sealing screws on terminal cover shall be provided. Separate sealing arrangements shall be provided for MD reset button & optical port.
28.	Type of communication	Data can be transferred to and from a CMRI through optical port conforming to IEC 62056-21:2002 provided in front of the Meter. Also, data can be transferred through central based computer using modems such as mobile telephony, radio frequency, fixed line, satellite, or power line communications technology with IEC 62056-21:2002 DLMS/COSEM protocol. The data element size and its overhead speed of transmission shall be less than 10 minutes.
29.	Others	Meter shall record energy correctly a) In case of current reversal b) In case of neutral failure c) In case of neutral disturbance d) Meter shall record at I_{max} in any tamper event due to magnetic influence
30.	Real Time Clock	Time drift of Real Time Clock in the Meter shall be less than ± 7 minutes per year.

4.4.8.1. The LV CT operated M.D Meter shall record Active Energy in forward direction even if one or more CTs are reversed. For Customer metering application, current vector direction should always be considered as positive (import) for the computing of three phase active energy, which shall be added to the main active energy (import) register.

4.4.8.2. The M.D Meter shall record apparent energy in forward direction even if one or more CTs are reversed. kVA shall be computed as:

$kVA = \sqrt{(kW^2 + kVar^2)}$ for lagging reactive energy and kVA = kW for leading reactive energy.

4.4.9. THREE PHASE 4-WIRE CT/VT HIGH VOLTAGE OPERATED STATIC ENERGY METER

	FUNCTION/FEATURE	TECHNICAL REQUIREMENTS
1.	Standards	IEC 62052-11:2020, 62053 – 22:2020, 62053-23:2020
2.	Accuracy Class	0.5
3.	Frequency	50Hz ± 2%
4.	Operating Temp.	Up to 60^0C
5.	Storage Temp.	Up to 70^0C
6.	Relative humidity	Up to 95% at 45^0C non-condensing
7.	Life Span	Minimum of 15 years
8.	Current	-/5A,(for 11kV) and -/1A(33kV and above)
9.	Rated Voltage	63.5V
10.	Operating voltage range	(50 – 70) V
11.	Minimum starting current	0.1% of Ib
12.	Burden	Less than 2VA per phase in voltage circuit and 1VA in current circuit.
13.	Impulse Withstand Voltage	Not less than 6kV
14.	Type of energy Registration mechanism	Back-lit LCD
15.	MD Reset mechanism	Automatic on 00.00hrs of the first day of the month Manual reset
16.	Insulation test	As per IEC 62056-11:2020
17.	Type of load	All types of load (linear, balanced/unbalanced at any P.F) nonlinear
18.	(i) Display details (Descriptive in order of display)	a. Display test b. Real time and date c. Rising demand with elapsed time d. Active energy e. Reactive energy (both lag & lead) f. Apparent energy g. Maximum Demand (both kW & kVA) h. MD reset count i. Instantaneous power factor with sign for j. lag/lead

		k. Instantaneous frequency l. Instantaneous voltage (phase wise) m. Instantaneous current (phase wise) n. Instantaneous Active load o. Instantaneous reactive load (with sign for p. lag/lead q. Instantaneous apparent load r. Billing power in hours s. TOD energies t. TOD Max demand in kVA u. Cumulative maximum demand v. Present status of tamper w. Latest occurrence of abnormality with date & time x. Latest restoration of abnormality with date & time
	(ii) Process of display	a. Automatic in cyclic manner (No1….9,) as in 18(i) b. Through push button
	(iii) Digits	9
	(iv) Time of display of one reading	8 seconds
19.	Memory	a. Non-volatile memory without battery back for a minimum of 15 years. b. Sufficient to store data (MD & energy) of consecutive 12 billing period in addition to tamper details, TOD Zones, tamper information as described in detailed technical specification
20.	Battery	a. Meter can be powered by means of external and internal battery in the absence of supply voltage. b. It shall be possible to replace defective battery without opening the meter cover.
21.	Tamper data preservation capacity	Able to store at least 225 events (occurrence & restoration as separate events) with roll over facility: Loss of potential Loss of current Change in error due to a. Variation in frequency b. Variation in temperature c. Variation in voltage
22.	Load survey capability	a. Parameters logged: kW import, kVA b. Logging intervals: 30 minutes c. No of days of load survey: 36 days at interval of 30 minutes

23.	Earthing terminals	As per IEC 62052-11:2020
24.	Time of Day	As per utility's request
25.	Capability for fraud prevention and detection	The meter stores in its memory occurrence and restoration the following tampers a. Missing potential b. CT short/CT open c. Current reversal d. Current unbalance e. Current missing with date, time and also log of event
26.	Sealing and locking arrangement	2 sealing screws on the Meter cover and 2 sealing screws on terminal cover shall be provided. Separate sealing arrangements shall be provided for MD reset button and optical port
27.	Type of communication	Data can be transferred to and fro from a CMRI through optical port conforming to IEC 62056-21:2002 provided in front of the Meter, data can also be transferred through central based computer using modems such as mobile telephony, radio frequency, Fixed line, satellite, or power line communications technology with IEC 62056-21:2002 DLMS/COSEM protocol. The data element size and its overhead speed of transmission shall be less than 10 minutes
28.	Others	Meter shall record energy correctly a. In case of current reversal b. In case of neutral failure c. In case of neutral disturbance d. Meter shall record at I_{max} in any tamper event due to magnetic influence
29.	Real Time Clock	Time drift of Real time clock in the Meter shall be less than ± 7 minutes per year

4.4.9.1. The HV CT operated M.D Meter shall record Active Energy in forward direction even if one or more CTs are reversed. For Customer Metering application, current vector direction should always be considered as positive (import) for the computation of three phase Active Energy, which shall be added to the main Active Energy (import) register.

4.4.9.2. The M.D Meter shall record apparent energy in forward direction even if one or more CTs are reversed. kVA shall be computed as $kVA = \sqrt{(kW^2 + kVar^2)}$ for lagging reactive energy and kVA = kW for leading reactive energy.

4.4.10. STATIC GRID ENERGY METER (33KV and above)

	FUNCTION/ FEATURE	TECHNICAL REQUIRMENTS
1.	Voltage	3x-/110/63.5V
2.	Current	3x-/1A
3.	Frequency	50Hz ±2%
4.	System	3-Ph, 3-Wire/3-Ph, 4-Wire
5.	Secondary voltage variation	(85 – 120)V/ (50 – 70)V
6.	Internal battery	Lithium CR2025 -1HF or an equivalent giving a total standby life of 10years (minimum)
7.	Auxiliary battery	Shall be 12V d.c supply for downloading stored data
8.	Accuracy Class	0.5S for 33kV, 0.2S for 132kV and 330kV
9.	Operating Temperature Range	Up to 60°C
10.	Storage Temperature Range	Up to 70°C
11.	Relative Humidity	Up to 95% at 45°C non-condensing
12.	Burden	2VA/Phase in Voltage circuit and 1VA/Phase in Current circuit
13.	Casing material	The casing shall be for wall mounting and fire-retardant type Bakelite or polycarbonate
14.	Screws Current Terminals Cable size/Type Voltage Terminals Cable size/Type Auxiliary Terminal Cable size/Type	All screws shall be stainless steel or nickel-plated brass 2 per terminal (6mm) 4mmsq /multi strand 1 per terminal (4mm) 2.5mmsq/multi strand 3mm 1.5mmsq/multi strand
15.	Insulation	a. 2.0kV for 1 min for current circuit b. 2.0kV for 1 min for voltage circuit c. 4.0kV for 1 min for current, voltage, all relay contacts plus auxiliary inputs plus RS485 port together d. 4.0kV for 1 min between all relay contacts and the

		auxiliary input plus communication port (RS485) e. 4.0kV for 1min between one set of relay contacts and the other relay
16.	Name plate	a. Indelible Meter serial number shall not be less than seven (7) digits and legibly printed b. Size of the digit of the Meter serial number shall be a minimum of 5mm x 3mm c. Bar code shall be printed below the Meter serial number d. Manufacturers name and Trade mark e. Place of manufacture f. Year of manufacture g. Reference Voltage, Current and frequency h. Class index i. Meter constant j. Owner/Utility's identity
17.	Measured quantity	a. Import kWh b. Export kWh c. Import kVarh d. Export kVarh e. Maximum Demand in kVA f. Four Quadrant kVarh g. Load profile (180 – 450) days
18.	Tariffication	a. Time of use register b. MD register c. Programmable integration period d. Switching times e. Seasons times f. Billing dates g. End of billing dates
19.	Display	The display shall be capable of displaying default, customer and utility modes
20.	Events Monitoring	The meter shall be able to monitor the following events among others: a. Battery failure b. Battery elapse warning c. Reverse run warning d. Over current e. Over voltage

		f. Phase failure g. Power factor h. Demand i. Meter communication event j. Time and date of events etc.
21.	Communication	a. RS485 to be fitted b. Opto port: electronic, bi-directional c. Modems such as mobile telephony, radio frequency, fixed line, satellite or power line communications technology d. Protocol: IEC 62056-21:2002 DLMS/COSEM
22.	Safety Class	Category IEC61010:2019, IEC60335-2-76:2018 – Class II
23.	Real time Clock	a. Type: capable of synchronizing to A.C supply or to a crystal oscillator b. Accuracy: better than 0.5 of a second per day at 50°C

4.5. PREPAYMENT METERING SYSTEM

In addition to general meter requirements in 4.4 above the following shall apply. All Prepayment Metering Installations shall be of the split type and conform to the details below.

4.5.1. KEYPAD SINGLE & THREE PHASE ELECTRICITY DISPENSER

	PARAMETER	TECHNICAL REQUIREMENT
1.	Nominal Voltage	1-Ph-230V,1-Ph,2-wire system, 3-Ph-230V/400V,3-Ph,4-wire system for use in balanced and unbalanced load conditions
2.	Operating Voltage	-40% to +10%
3.	Current Rating	5(60)A, 3x5(100)A
4.	Frequency	50±2%Hz
5.	Accuracy Class	1
6.	Encryption Algorithm	Standard Transfer Specification (STS)
7.	Operating Temperature	Up to 60°C
8.	Storage Temperature	Up to 70°C
9.	Relative Humidity	95% at 45°C non-condensing
10.	Maximum kWh credit stored	99,999.9 kWh(1Ph),999,999.9kWh(3Ph)
11.	Credit transfer number	20 Digits encryption
12.	Protection	High resistance to short circuit
13.	Impulse Withstand Voltage	Preferably greater than 6kV
14.	Insulation Withstand Voltage	2kV per minute

15.	Name plate	a. Indelible serial number shall not be less than eleven (11) digits and legibly printed b. Size of the digit of the meter serial number shall be a minimum of 5mm x 3mm c. Bar code shall be printed below the meter serial number d. Manufacturer's name and trademark e. Place of manufacture f. Year of manufacture g. Reference Voltage, Current and Frequency h. Class Index i. Meter Constant j. Owner/Utility's Identity
16.	Front Panel Indication/Display	Include but not limited to the following: a. Three level credit LED display b. Green-when energy stored is full c. Yellow-when remaining credit will last for 3- days. The red flashes when the remaining energy will last for $1^1/2$ days. d. Blue-Consumption rate indicator e. LCD credit status display f. Credit transfer number accept/reject g. Tamper
17.	Special Mode Display for Engineering/Management	Display up to 3 parameters according to programming to be specified: a) Normal display LCD i. Duplicate copy of token inserted ii. Credit Dispensing Unit identification number and kWh (or voucher serial number) inserted. iii. Electricity Dispenser (ED) full of units. iv. No power ON ED v. No credit on ED vi. Credit rejects or accepts. vii. Remaining Credit. viii. Instantaneous Power ix. Total kWh used in the past 24 hrs. x. Total kWh used in the past 30 days. xi. Historical value minimum of 6months kWh

		xii. Total kWh used since the ED was installed. b) Display only available with valid codes. c) Display only available within chosen programming or engineering mode. For the purpose of these specifications, items b) and c) above are treated as one. These shall be accessible only to utility staff. a. Overcurrent trip level. b. Green-Yellow Light emitting diode (LED) display change over level in kWh (high). c. Yellow-Red LED display change over level in kWh (low). d. Test on LED for tripping function. e. Display of LED number. f. Electronics faulty. g. Power failure counter (Number of times power supply failed or disconnected)-400 cycles and back to Zero. h. Enabling of disabled LED caused by tampering. i. Number of days/hours into the current 30 days when there was power and total Wh used during the period
18.	EMC Compliance	Relevant section of IEC 62052-11:2020
19.	Burden	Preferably less than 2VA per phase
20.	Terminals	Extended cover type. Hole diameter shall be a minimum of 9mm
21.	Casing/cover materials	Fire retardant – Bakelite or polycarbonate
22.	Sealing	Provision must be adequate to prevent tampering
23.	Power Factor Range	-1 to +1
24.	Data Storage	Non –Volatile EPROM
25.	Switching	Latching contactor
26.	EMC Susceptibility	According to IEC 62052-11:2020, IEC 62053 – 22:2020, Not adversely affected by external magnetic fields
27.	Life Span	Minimum 15 years

4.5.1.1. The meter shall be decrement units for consumption in accordance with, and to the level of accuracy specified in the active tariff.

4.5.2. SINGLE AND THREE PHASE SMART CARD PREPAYMENT METER

	PARAMETER	TECHNICAL REQUIREMENT
1.	Nominal Voltage	1-ph-230V,1-ph,2-wire system, 3-ph-230V/400V,3-ph,4-wire system for use in balanced and unbalanced load conditions
2.	Operating Voltage	-40% to +10%
3.	Current Rating	5(60)A, 3x5(100) A
4.	Frequency	50±2%Hz
5.	Accuracy Class	1
6.	Operating Temperature	Up to 60°C
7.	Storage Temperature	Up to 70°C
8.	Relative Humidity	95% at 45°C non-condensing
9.	Maximum WH credit stored	99,999.9 kWh(1-ph), 999,999.9kWh(3-ph)
10.	Credit transfer number	20 Digits encryption
11.	Protection	High resistance to short circuit
12.	Impulse Withstand Voltage	Preferably greater than 6kV
13.	Insulation Withstand Voltage	2kV per minute
14.	Name plate	a. Indelible serial number shall not be less than eleven (11) digits and legibly printed b. Size of the digit of the meter serial number shall be a minimum of 5mm x 3mm c. Bar code shall be printed below the meter serial number d. Manufacturer's name and trademark e. Place of manufacture f. Year of manufacture g. Reference Voltage, Current and Frequency h. Class Index i. Meter Constant j. Owner/Utility's Identity
15.	Front Panel Indication/Display	Include but not limited to the following: a. Three-level credit LED display b. Green-when energy stored is full c. Yellow-when remaining credit will last for 3 - days. The red

		flashes when the remaining energy will last for $1^1/2$ days. d. Blue-Consumption rate indicator e. LCD credit status display f. Credit transfer number accept/reject g. Tamper
16.	Special Mode Display for Engineering/Management	Display up to 3 parameters according to programming to be specified: d) Normal display –LCD i. Electricity Dispenser (ED) full of units. ii. No power ON ED iii. No credit on ED iv. Credit rejects or accepts. v. Remaining Credit. vi. Instantaneous Power vii. Total kWh used in the past 24 hrs. viii. Total kWh used in the past 30 days. ix. Historical value minimum of 6months kWh x. Total kWh used since the ED was installed. e) Display only available within chosen programming or engineering mode. For the purpose of these specifications, items b) and c) above are treated as one. These shall be accessible only to utility staff. a. Over current trip level. b. Green-Yellow Light emitting diode (LED) display change over level in kWh (high). c. Yellow-Red LED display change over level in kWh (low). d. Test on LED for tripping function. e. Display of LED number. f. Electronics faulty. g. Power failure counter (Number of times power supply failed or disconnected)-400 cycles and back to Zero.

		h. Enabling of disabled LED caused by tampering. i. Number of days/hours into the current 30 days when there was power and total kWh used during the period
17.	EMC Compliance	Relevant section of IEC 62052 – 11:2020,
18.	Burden	Preferably less than 2VA per phase
19.	Terminals	Extended cover type. Hole diameter shall be a minimum of 9mm
20.	Casing/cover materials	Fire retardant – Bakelite or polycarbonate
21.	Sealing	Provision must be adequate to prevent tampering
22.	Power Factor Range	-1 to +1
23.	Data Storage	Non –Volatile EPROM
24.	Switching	Latching contactor
25.	EMC Susceptibility	According to IEC 62052 – 11:2020, IEC 62053-23:2020. Not adversely affected by external magnetic fields
26.	Life Span	Minimum 15 years

4.5.3 POINT OF SALE (POS) – Smart Card Prepayment Meters

4.5.3.1. The Point of Sale shall have a card reader attached to the Credit Dispensing Unit. (CDU). The card reader shall be able to read or issue customer identification card.

4.5.3.2. The identification card shall contain meter identification and customer personal information. The issuing of credit to customer shall be made easy or quicker using the ID card. If a customer ID card is lost, it shall still be possible for the customer to purchase credit by using his name, meter serial number or account number.

4.5.3.3. The technical specifications and functions are the same with that of credit dispensing unit in keypad prepayment Metering System except that the application software is different. In this case, every transaction made is immediately transferred to the Control Centre.

4.5.3.4. Similarly, credit purchased at the POS is immediately transferred to the Control Centre to the appropriate Meter. This operation shall not take more than 5 minutes. Also the software used shall interact on a real time

4.5.3.5. The system shall have full diagnostic capabilities to ensure minimum downtime. It shall be able to detect the failure of any of the peripheral equipment.

4.5.4. RECEIPTING

Receipts issued for prepayments shall contain the following data:

(i) Name of the utility company
(ii) Date and time of issue
(iii) Customer's name
(iv) ID number of electricity dispenser (Meter)
(v) Utility's ID number
(vi) Account number
(vii) Amount of money paid
(viii) Amount of electricity units paid for
(ix) Fixed charge
(x) Tariff class
(xi) Auxiliary charges where applicable (e.g. legacy debt recovery)
(xii) Penalty
(xiii) VAT
(xiv) Type of payment-cash/cheque
(xv) Customer transaction number (optional).
(xvi) Credit Dispensing Unit (CDU) number
(xvii) Operator's name
(xviii) Message-if any
(xix) Contacts for complaints

Any other information as deemed necessary

4.5.5. SPLIT TYPE PREPAYMENT SINGLE & THREE PHASE DISPENSER

The technical specifications for single and three phase Electricity Dispenser shall apply except that it comprises the display unit or the Customer interface (which will be in the apartment) while the Energy Measuring and Control Unit (EMCU) shall be installed remotely from the apartment (or Customer).

Mounting shall be pole or surface (EMCU only).

4.6. TECHNICAL SPECIFICATION FOR SINGLE PHASE AND THREE PHASE DIN RAIL METERS

S/N	FUNCTIONS AND FEATURES	TECHNICAL REQUIREMENTS
1	Nominal Voltage	1-ph-230V, 1-ph, 2-wire system,
		3-ph- 230/400V, 3-ph, 4-wire system (balanced and unbalanced load conditions)
2	Operating Voltage	-40% to +10% Nominal Voltage
		-40% to +10% Nominal Voltage
3	Current Rating	5(60)A – Single Phase
		3 X5(100) A - Three Phase

4	Frequency	50 ±2%Hz
5	Accuracy Class	Class 1.0 – Active Class 2.0 - Reactive
6	Encryption Algorithm for PPM	Standard Transfer Specification (STS)
7	Operating Temp.	Up to 60°C
8	Storage Temp.	Up to 70°C
9	Relative Humidity	95% at 45° C non- condensing
10	Maximum kWh credit stored	99,999.9 kWh(1-ph), 999,999.9kWh(3-ph)
11	Credit transfer number	20 Digits encryption
12	Protection	High resistance to short circuit
13	Impulse withstand voltage	Preferably greater than 6 kV
14	Insulation withstand voltage	2 kV per minute
15	Name plate	a) Indelible Meter serial number shall not be less than eleven (11) digits and legibly printed
		b) Size of the digit of the Meter serial number shall be a minimum of 5mm x3mm.
		c) Bar code shall be printed below the Meter serial number
		d) Manufacturer's name and Trademark.
		e) Place of manufacture.
		f) Year of manufacture.
		g) Reference Voltage, Current and frequency.
		h) Class index.
		i) Meter Constant.
		j) Owner/Utility's Identity.
16	Front panel Indication/Display	Include but not limited to the following:
		Three level credit LED display
17	Special Mode Display for Engineering / Management using User Interface Unit (UIU)	Green-when energy stored is full Yellow-when remaining credit will last for 3 days.
		The red flashes when the remaining energy will last for 11/2 days.

		Blue/Amber-Consumption rate indicator. LCD credit status display.
		Credit transfer number accept/reject Tamper.
		Display up to 3 parameters according to programming to be specified:
		a. Normal display – LCD
		i. Duplicate copy of token inserted
		ii. Credit Dispensing Unit identification number and kWh (or voucher serial number) inserted.
		iii. Electricity Dispenser (LED) full of units.
		iv. No power ON LED
		v. No credit on LED
		vi. Credit rejects or accepts.
		vii. Remaining Credit.
		viii. Instantaneous Power
		ix. Total kWh used in the past 24 hrs.
		x. Total KWh used in the past 30 days.
		xi. Total kWh used since the LED was installed.
		b. Display only available with valid codes.
		c. Display only available within chosen programming or engineering mode.
		For the purpose of these specifications, items b) and c) above are treated as one. These shall be accessible only to utility staff.
		a. Over current trip level.
		b. Green-Yellow Light emitting diode (LED) display change over level in KWh (high).
		c. Yellow-Red LED display change over level in kWh (low).

		d. Test on LED for tripping function.
		e. Display of LED number.
		f. Error message.
		g. Power failure counter (Number of times power supply failed or disconnected)-400 cycles and back to zero.
		h. Enabling of disabled LED caused by tampering.
		i. Number of days/hours into the current 30 days when there was power and total kWh used during the period.
		j. Historical Value minimum 6 months kWh
18	EMC Compliance	Relevant section of IEC 62052-11:2020 & 62053-21:2020
19	Burden	Preferably less than 2 VA per phase.
20	Terminals	Extended cover type. Hole diameter shall be between 8.5mm - 9mm.- Single Phase
		Extended cover type. Hole diameter shall be between 8.5mm - 9mm – Three Phase
21	Casing/ Cover Material	Fire retardant- Bakelite or polycarbonate material Transparent Polycarbonate material
22	Sealing	Provision must be adequate to prevent tampering. 2 Seals on either side of the meter/Ultrasonic sealing/Chemical bounding
		Terminal Cover: One or more sealing provision shall be provided at meter terminal cover
23	Power Factor Range	-1 to +1
24	Data Storage	Non-Volatile EPROM
25	Switching	Latching contactor.
26	EMC Susceptibility	According to IEC 62052-11:2020 & 62053-23:2020. Not adversely affected by external magnetic fields.

27	Life Span	Minimum 15 years
28	Measurement	1-Ph, 2-Wire System. CT on Neutral line measurement 3 -Ph, 4 Wire System
29	Disconnection relay	Maximum switching voltage: 400V AC Maximum switching current: Single Phase – 90A Three Phase - 120A Maximum switching power: Single Phase – 13kVA Three Phase - 45kVA
30	Battery	• Internal lithium battery life span 15-year minimum • External backup: Easily replaceable without breaking seal
31	Ingress Protection	• IP54 casing
32a	Terminal connection Configuration	Ph-N, N-Ph (Symmetrical Single Phase Terminal Configuration)
32b	Terminal connection Configuration	PhR1 – PhR2, PhY1- PhY2, PhB1-PhB2, N-N (Asymmetrical Three Phase Terminal Configuration)

4.7. COMMUNICATION SPECIFICATIONS & SMART FEATURES

	FUNCTIONS	**REQUIREMENTS**
1	Communication interface	Optical as per IEC62056-21:2002, supporting DLMS/COSEM protocol capable of transferring data or Any standard data protocol such as MQTT or MQTTS may be used. Meter may be interrogated wirelessly from a local wireless device linked to the wireless network.
2	Remote Communication interface	Meter Shall be able to communicate with Head end system through Gateway/Modem. Two-way communication between meter and HES or via DCU through RF, PLC, LoRa and GPRS. DCU shall support TCP/IP, G3 PLC, Radio Frequency, Fiber, 3G or 4G.

3	Midnight Energy Snapshot	Capable of recording and storing midnight snapshot of kWh, for minimum of 30 days and transferring same on demand and at predetermined interval.
4	Interval data recording	30 minutes with 3 voltages, current and power factors readings
5	Billing History	Current month plus minimum last 6 months billing data
6	Event recording NOTE C6	Meter shall have facility to download using both optical port or via remote communication capability with date and time stamp. Following events to be recorded:
		As per tamper sheet a) Terminal Cover open
		b) Magnet Disturbance
		c) Phase Miss (R, Y, B)
		d) Current reverse (R, Y, B)
		e) Current Unbalance
		As per Event a) Power On/Off
		Status in Anomaly a) Over voltage (300V)
		b) Identification of neutral current more than line current
		c) Pre-programmed alarms for meter self-check
		d) Alarms trigger LEDs, enunciators, communications event
		e) Alarms are stored in event logs
7	Remote connection-disconnect	Relay for remote load connection or disconnection with date and time stamp. Visual indication (Relay on/off) to be provided on display unit.
8	Remote load control features	Feature to set threshold values to control load (overload Limit) of customers if Programmed demand is exceeded
9	Other remote functions	• Remote reading (Read by Modem) • Remote crediting (Set by STS Token with online transfer mechanism) • Acquire Meter profile/configuration data. • Remote configuration of meters and DCUs. • Read meters according to pre-defined schedule or on-demand. • Automatic re-reading of meters to acquire missed data.

		• Remote disconnection/reconnection of energy supply • Upgrade meter firmware remotely. • Any and all meter credits may be stored remotely in the cloud server software.
10	Tariff Management	• TOD billing and remote update to tariffs. • Any and all tariff structures may be stored in the cloud server software.
11	Measured values	• Import/Export/Absolute: Wh, Varh and VAh • Per quadrant Wh, Varh and VAh • Power: W, Var, VA, Vrms, Irms • 3 Power factors, 3 currents, 3 voltages frequency, phase sequence

4.8. CURRENT LIMITERS

The following are basic requirements:
Accumulation of unused energy in a storage register for later usage

(i) Disconnection of supply if storage register (Stored energy) is depleted and consumption is at a rate higher than the hourly replenishment rate, while reconnection is automatic at the next pre-set time period (hour)
(ii) Energy allocated equally among 24 hours in a day.
(iii) Capable of being mounted on the pole or at customer premises (surface).
(iv) Has an anti-tampering device for cover

4.9. PROGRAMMABLE FLAT RATE CURRENT LIMITER

FUNCTIONS	TECHNICAL REQUIREMENT
Nominal Voltage	230V, 1-phase, 2 wire
Operating voltage range	-40% to 10% nominal voltage
Current Rating	5A, 10A, 15A, 30A
Operating Current Range	+20% rated value(maximum)
Accuracy Class	1
Protection class	2
Operating Temperature	Up to 60°C
Storage Temperature	Up to 70°C
Over voltage withstand	415V for 48hrs
Impulse withstand voltage	At least 6kV
Frequency	50Hz±2%
Burden	At most 0.2VA
Diagnostics	Constant self-diagnostics displaying specific parameters. Error codes include i. No error ii. Test error iii. Memory corrupted iv. Over current
Display	i. Processor LED ii. Energy consumption indication
Terminal hole diameter	Hole diameter shall be between 8.5mm - 9mm
Breaker	30mA, single pole earth leakage
EMC Susceptibility	According to IEC 62056-11:2020 and shall not be adversely affected by external magnetic fields
Protection	Over/under voltage
Condition of environmental influence	Weather Proof: Protection against water ingress, solar radiation, dust, corrosion rust etc.
Relative humidity	95% at 45^0c non-condensing
Interruption Capacity	5kA for 10mins
Casing material	Non-ignitable and fire-retardant polycarbonate
Terminal cover	Extended Type

4.10. NON-PROGRAMMABLE FLAT RATE CURRENT LIMITER

Specific requirements for this are as follows:

FUNCTION/FEATURE	**TECHNICAL REQUIREMENTS**
Nominal Voltage	230V, 1-phase, 2 wire
Operating voltage range	-40% to 10% nominal voltage
Current Rating	5A, 10A, 15A, 30A
Operating Current Range	+20% rated value(maximum)
Operating Temperature	Up to 60^{O}C
Storage Temperature	Up to 70^{O}C
Over voltage withstand	415V for 48hrs
Impulse withstand voltage	At least 6kV
Frequency	50Hz±2%
Burden	At most 0.2VA
Terminal hole diameter	Hole diameter shall be between 8.5mm - 9mm
Breaker	30mA, single pole earth leakage
EMC Susceptibility	According to IEC 62052-11:2020and shall not be adversely affected by external magnetic fields

4.11. SMART CURRENT LIMITER:

Specific requirements for this are as follows:

FUNCTIONS	TECHNICAL REQUIREMENT
Nominal Voltage	230V, 1-phase, 2wire
Operating voltage range	-40% to 10% nominal voltage
Current Rating	5A, 10A, 15A, 30A, 60A
Operating Current Range	+20% rated value(maximum)
Accuracy Class	1
Protection class	2
Operating Temperature	Up to 60°C
Storage Temperature	Up to 70°C
Over voltage withstand	415V for 48hrs
Impulse withstand voltage	At least 6kV
Frequency	50Hz±2%
Burden	At most 0.2VA
Diagnostics	Constant self-diagnostics displaying specific parameters. Error codes include i. No error ii. Test error iii. Memory corrupted iv. Over current
Display	Processor LED Energy consumption indication
Terminal hole diameter	Hole diameter shall be between 8.5mm - 9mm
Breaker	30mA, single pole earth leakage
EMC Susceptibility	According to IEC 62052-11:2020, IEC 62053-21:2020 and shall not be adversely affected by external magnetic fields
Protection	Over/under voltage
Condition of Environmental Influence	Weather Proof: Protection against water ingress, solar radiation, dust, corrosion rust etc.
Relative humidity	96% at 45°C non-condensing
Interruption capacity	5kA for 10ms
Casing material	Non-ignitable and fire-retardant polycarbonate
Terminal cover	Extended type

4.12. SPECIFICATION FOR USER INTERFACE UNIT (UIU)

The UIU **shall have the following basic features** in the table below and have the capacity to pair with the same Meter Type for ease of communication.

	FUNCTIONS AND FEATURES	**TECHNICAL REQUIREMENTS**
1	Operating Voltage	230V AC, 6V DC
2	Operating Current	10mA
3	Frequency	50Hz ±2%
4	Communication Mode	PLC, RF, MBus, etc.
5	Communication Distance	100 meters minimum
6	Operating Temp.	Up to 60°C
7	Storage Temp.	Up to 70°C
8	Relative Humidity	95% at 45° C non- condensing
9	Display	1. LCD with good contrast and wide viewing angle with backlight features. 2. Minimum of eight (8) digits representing the energy and at least one (1) digit after the first decimal point 3. LCD display size: 9mm x 4.5mm minimum 4. Viewing angle: 160 degrees minimum 5. Parameters: i. Total units used to date (in kWh) ii. Available credit (in kWh) iii. Present consumption rate iv. Last billing date v. Last billed amount (kWh) vi. Credit level vii. Warning on credit level viii. Other messages
10	LEDs Display	1. Green - Credit 2. Yellow – Warning on no Credit 3. Red – No Credit
11	Protection	IP54

4.13. DATA CONCENTRATOR UNIT (DCU)

4.13.1. DCU is the backbone of Advanced Metering Infrastructure (AMI) that helps in data acquisition and transfer of energy data to the central database using Automated Meter Reading (AMR) in electronic energy meters.

4.13.2. It shall have sufficient non-volatile memory to store relevant information for a period of not less than one year. It shall have multiple communication channels and maintain data integrity. DCU shall be able to communicate with or accommodate not less than 1000 Meters. However, mini DCU of lesser capacity shall be deployed where clustered customers exist.

4.13.3. The DCU shall have the following basic features as contained in the table below**:**

4.14. SPECIFICATION FOR DATA CONCENTRATOR UNIT

FUNCTION/FEATURE	**TECHNICAL REQUIREMENT**
Reference Voltage	3X230/400V
Frequency	50Hz±2%
Power Consumption	Voltage Circuit ≤ 10VA
In current Circuit	Current Circuit ≤ 15VA
Operating Temp.	Up to 60°C
Storage Temp.	Up to 70°C
Relative Humidity	95% at 45° C non- condensing
Impermeability to IEC60529:2020	IP54
Data Storage	Minimum of 128MB of non-volatile memory
	Data life >15 years
LED Output	LED Indicator for Power ON
	LED Indicator for network availability
	LED Indicator for Data Transmission
Backup time	15 years
Impulse Voltage	IEC 62052-11:2020
Voltage Value	6kV
Electro-magnetic Compatibility (MC-NESI)	IEC 61000-4-4:2012
Local Communication Interface	Optical Port RS485
Remote Communication Interface	RF, GPRS (3G and above), LoRa, PLC
Data Collection	Demand data reading
	Day data reading
	Billing data reading
	Key users profile data reading
	Power quality profile reading

	Event reading
Data Storage Period	Curve of daily data: 60 days
	Monthly billing data: 12 months
	96 hourly curve data of 20 key users in 10 days
	Record of last 1000 events
	Data Storage Capacity: 128MB Minimum
Data Recopy	In case of automatic meter reading failures, the concentrator shall initiate a retransmission mechanism of three (3) times retrial.
	If the concentrator fails to read the meter within the interval, it shall send a warning to the main station
Electrostatic Discharges	To IEC 61000-4-2:2008
Contact discharge	10kV
Electromagnetic RF Fields	IEC 61000-4-3:2020
Fast transient burst	IEC 61000-4-4:2012
Conducted Voltage induced by radio-frequency	IEC 61000-4-5:2014

5 SCHEDULE E - SMART METERING

5.1. FUNCTIONAL REQUIREMENTS

5.1.1. This section sets out the minimum functions that a Smart Metering System shall be capable of performing.

5.1.2. The Smart Meter shall have the ability to function as multi-source meter (utility, generator) and shall have the ability to function as a bi-directional Meter.

5.1.3. The Meter shall consume no more than 2 Watts on average during normal operational conditions.

5.1.4. Meter shall be integrated with an in-built communication modem for all its communication interfaces.

5.2. CLOCK

The Clock forming part of a Smart Metering System shall be capable of operating so as to be accurate within 10 seconds of UTC+1 at all times.

5.3. COMMUNICATIONS

5.3.1. A Smart Metering System shall be capable of establishing Communications Links via each of its interfaces (including its HAN Interface and its WAN Interface).

5.3.2. A Smart Metering System, and any Device forming part of it, shall be capable of ensuring that the security characteristics of all Communication links are established as stipulated in 5.15.1

5.3.3. For all Commands received via any Communications link the SMS shall be capable of:

(i) Authenticating the source of the Command and on failure to do so generate an entry in the Security Log (5.21.59) to that effect and discarding the Command without execution and without sending a Response;
(ii) verifying that it is the intended recipient of the Command and if it is not the intended recipient, generating an entry in the Security Log (5.21.59) to that effect and discarding the Command without execution and without sending a Response;
(iii) verifying the validity of the contents and format of the Command and if invalid, sending a Response to that effect via its WAN Interface; and
(iv) On detection of unauthorised access of the nature described in (5.13), discarding the Command without execution and without sending a Response.

5.4. COMMUNICATIONS WITH CUSTOMER DEVICES OVER THE HAN INTERFACE

5.4.1. An SMS may be capable of establishing a Communications Link via its HAN Interface with at least one Customer Device that is capable of providing the Customer with access to the information set-out in (5.17.1)

In establishing the Communications Link, the SMS shall be capable of receiving Security Credentials to enable it to Authenticate the Customer Device.

5.4.2. Where it has established a Communications Link with a Customer Device the SMS shall be capable of:

(i) Sending data and information (set-out in 5.17.1) to the Customer Device; and
(ii) Sending Alerts to the Customer Device.

5.5. COMMUNICATIONS WITH MICROGENERATION METERS OVER THE HAN INTERFACE

5.5.1. An SMS shall be capable of establishing a Communications Link via its HAN Interface with at least one Microgeneration Meter.

5.5.2. In establishing the Communications Link, the SMS shall be capable of identifying and Authenticating the Microgeneration Meter with which it has established a Communication Link.

5.5.3. Where it has established a Communications Link with a Microgeneration Meter, the SMS shall be capable of:

(a) sending requests for data and information (at the minimum, those set-out in 5.18) to the Microgeneration Meter; and

(b) receiving data and information (at the minimum, those set-out in 5.18) from the Microgeneration Meter.

5.6. COMMUNICATIONS WITH A HES OVER THE WAN INTERFACE

5.6.1. The SMS shall be capable of establishing a Communications Link via its WAN Interface with a HES.

5.6.2. In establishing the Communications Link, the SMS shall be capable of exchanging Security Credentials to enable mutual Authentication with the HES.

5.6.3. Where it has established a Communications Link with a HES the SMS shall be capable of:

(i) receiving the Commands (at the minimum, those set-out in 5.19) from the HES;
(ii) sending the Responses (at the minimum, those set-out in 5.19) to the HES; and

(iii) sending Alerts to the HES.

5.7. DATA STORAGE

The SMS shall be capable of retaining all information held in its Data Store when in operation and during loss of power.

5.8. DISPLAY OF INFORMATION

5.8.1. The SMS shall be capable of displaying the following up to date information on its User Interface, including standard or defined symbols:

(i) The Payment Mode (5.21.22) currently in operation, being Prepayment Mode or Credit Mode;
(ii) The Tariff Register Matrix (5.21.61) and the Tariff Block Counter Matrix (5.21.60);
(iii) The Credit Balance (5.21.56);
(iv) whether Emergency Credit is available for activation;
(v) whether the SMS has suspended the disablement of Supply during a period defined in the Non-Disablement Calendar (5.21.20) (as set-out in 5.10.2);
(vi) The Emergency Credit Balance (5.21.52) when Emergency Credit is activated;
(vii) Any low credit condition;
(viii) The Supply status, being Enabled or Disabled;
(ix) Any Time-based Debts and Time-based Debt Recovery rates;
(x) Any Payment-based Debt;
(xi) Any accumulated debt recorded in the Accumulated Debt Register (5.21.44); and
(xii) Any Fixed Charge (5.21.31).

5.8.2. The SMS shall be capable of displaying Currency Units in Nigerian Naira.

5.9. MONITORING

The SMS shall be capable of determining when the Active Power Import (5.21.45) exceeds, for a continuous period of thirty seconds or more, the Load Limit Power Threshold (5.21.15) and on such an occurrence the SMS shall be capable of:

(i) generating an entry to that effect in the Event Log (5.21.53);
(ii) counting the number of such occurrences in the Load Limit Counter (5.21.54);
(iii) sending an Alert to that effect via its WAN Interface and its User Interface;
(iv) disabling the Supply in circumstances where the Load Limit Supply State (5.21.16) is configured to require Disablement and then immediately Arming the Load Switch and displaying any such change in state of the Load Switch on its User Interface; and
(v) notifying the change in state via its HAN Interface and WAN Interface.

5.10. PAYMENT MODE

The SMS shall be capable of operating in Credit Mode and Prepayment Mode and of being remotely switched from one mode to the other with the consent of the Customer.

5.10.1. Credit Mode

The SMS when operating in Credit Mode shall be capable of maintaining a calculation of the Credit Balance (5.21.56) based on:

(a) the Consumption in the Tariff Register Matrix (5.21.61) multiplied by the Prices in the Tariff TOU Price Matrix (5.21.41) and,
(b) if operating Time-of-Use with Block Pricing, the Consumption in the Tariff Block Counter Matrix (5.21.60) multiplied by the Prices in the Tariff Block Price Matrix (5.21.35); and
(c) the Fixed Charge (5.21.21), and
(d) displaying the Credit Balance (5.21.56) on its User Interface.

5.10.2. Prepayment Mode

a. The SMS shall be capable of operating in Prepayment Mode, including during Emergency Credit Balance periods, periods of loss of its Communications Link via its WAN Interface. It shall maintain a balance of credit, Credit Balance, and reflect any reduction in credit based on Consumption, Fixed Charge and Time-based Debt Recovery.
b. The SMS shall be capable of adding credit to the Credit Balance (5.21.56) (as set out in 5.18.6 and 5.19.7) and reducing the amount of credit in the Credit Balance (5.21.56).
c. The SMS shall be capable of making Emergency Credit available to the Customer (by means of the Emergency Credit Limit (5.21.52) if the Credit Balance (5.21.56) is below the Emergency Credit Threshold (5.21.14).
d. The SMS shall be capable of displaying the availability of Emergency Credit on its User Interface. The amount of Emergency Credit made available to the Customer shall be equal to the Emergency Credit Limit (5.21.13).
e. The SMS shall be capable of reducing the amount of credit in the Emergency Credit Balance (5.21.52) in the case where Emergency Credit is activated by the Customer (as set out in 5.18.3 and 5.19.6) and the Credit Balance (5.21.56) is exhausted. Any Emergency Credit used shall be repaid when credit is added to the SMS (as set out in 5.18.3 and 5.19.6).
f. The SMS shall be capable of reducing the Credit Balance (5.21.56) until exhausted followed by reducing the Emergency Credit Balance (5.21.52), if activated, until exhausted on the basis of:

    (i) the Consumption in the Tariff TOU Register Matrix (5.21.61) multiplied by the Prices in the Tariff TOU Price Matrix (5.21.41) and,

(ii) if operating Time-of-Use with Block Pricing, the Consumption in the Tariff Block Counter Matrix (5.21.60) multiplied by the Prices in the Tariff Block Price Matrix (5.21.35);
(iii) the Fixed Charge (5.21.31); and
(iv) the recovery of debt through each of the Time Debt Registers [1 … 2] (5.21.62) at rates determined by the Debt Recovery Rates [1 … 2] (5.21.10) with the SMS recording the amount of debt recovered in the Billing Data Log (5.21.50).

g. The SMS shall be capable of monitoring the Credit Balance (5.21.56) and the activated Emergency Credit Balance (5.21.52) and:

(i) when the combined credit of the Credit Balance (5.21.56) and Emergency Credit Balance (5.21.52) falls below the Low Credit Threshold (5.21.17), the SMS shall display an Alert to that effect on its User Interface, and send an Alert to that effect via both its HAN and WAN Interfaces;

(ii) when the combined credit of the Credit Balance (5.21.56) and Emergency Credit Balance (5.21.52) falls below the Disablement Threshold (5.21.12), the SMS shall disable the Supply, displaying an Alert to that effect on its User Interface and sending an Alert to that effect via its HAN and WAN Interfaces; and

(iii) suspend the Disablement of Supply during periods defined in the Non-Disablement Calendar (5.21.20), and display an Alert that the Disablement of Supply has been suspended on its User Interface.

h. The SMS shall be capable of controlling recovery of debt in cases where:

(i) Emergency Credit is in use by operating in a Suspend Debt Recovery - Emergency (5.21.34) state;
(ii) Supply is disabled by operating in a Suspend Debt Recovery – Disabled (5.21.33) state.

i. In circumstances where the Supply is Disabled, the SMS shall be capable of:

(i) The continuous recovery of Time-based Debt (if so configured as set out in 3.6.2.2f(ii) above) and Fixed Charge (5.21.31); and
(ii) Keeping records of the debt recovered in the Accumulated Debt Register (5.21.44).

5.11. PRICING

The SMS shall be capable of applying all allowable tariff classes like Time-of-Use Pricing and Time-of-Use with Block Pricing, as configured by Tariff Type (5.21.42).

5.11.1. Time-of-use Pricing:

The SMS shall be capable of recording Consumption according to Time-of-use Bands in one of forty-eight Tariff Registers in the Tariff Register Matrix (5.21.61).
The SMS shall be capable of switching between different Tariff Registers once every half hour. The switching between Time-of-use Bands and thus Tariff Registers shall be based on time of Consumption and switching rules defined in the Tariff Switching Table (5.21.36).

5.11.2. Time-of-use with Block Pricing

The SMS shall be capable of recording Consumption according to Time-of-use Bands in one of eight Tariff Registers in the Tariff Register Matrix (5.21.61).
The SMS shall also be capable of accumulating Consumption in one of four Block Counters in the Tariff Block Counter Matrix (5.21.60) for each of the eight Time-of-use Bands. The SMS shall be capable of switching between Block Counters according to the Consumption thresholds in the Tariff Threshold Matrix (5.21.40).

The SMS shall be capable of switching between different Tariff Registers once every half hour. The switching between Time-of-use Bands and thus Tariff Registers shall be based on time of Consumption and switching rules set out in the Tariff Switching Table (5.21.36).

5.12. RECORDING

5.12.1. Billing data

The SMS shall be capable of taking a date and time stamped copy of and storing the Tariff Register Matrix (5.21.61) and the Tariff Block Counter
Matrix (5.21.60) in the Billing Data Log (5.21.50) in accordance with the timetable set out in the Billing Calendar (5.21.8) and then immediately resetting the Block Counters in the Tariff Block Counter Matrix (5.21.60) and if operating in Credit Mode immediately resetting the Credit Balance (5.21.56).

5.12.2. Daily read data

The SMS shall be capable of taking a copy of and storing the Tariff TOU Register Matrix (5.21.61), the Tariff Block Counter Matrix (5.21.60) and the Total Active Import Register (5.21.64) together with a date and time stamp in the Daily Read Log (5.21.51) every day at midnight UTC+1.

5.12.3. Half hour profile data

In each thirty-minute period (commencing at the start of minutes 00 and 30 in each hour), a SMS shall be capable of recording the following (including details of the thirty-minute period to which the data relates) in the Profile Data Log (5.21.15);

(i) Active Energy Imported (Consumption);
(ii) Active Energy Exported;
(iii) Reactive Energy Imported; and
(iv) Reactive Energy Exported.

5.12.4. Power threshold status

The SMS shall be capable of comparing the Active Power Import (5.21.45) against thresholds and recording an indication of the level of consumption as follows:

(i) if the Active Power Import (5.21.45) is equal to or lower than the Low Medium Power Threshold (5.21.18), set Ambient Power (5.21.46) to low;
(ii) if the Active Power Import (5.21.45) is higher than the Low Medium Power Threshold (5.21.18) and equal to or lower than the Medium High-Power Threshold (5.21.19), set Ambient Power (5.21.45) to medium; or
(iii) Otherwise, set the Ambient Power (5.21.46) to high.

5.12.5. Total Active Energy Imported

The SMS shall be capable of recording cumulative Active Energy Imported in the Total Active Import Register (5.21.64).

5.12.6. Total Active Energy Exported

The SMS shall be capable of recording cumulative Active Energy Exported in the Total Active Export Register (5.21.63).

5.12.7. Total Reactive Energy Imported

The SMS shall be capable of recording cumulative Reactive Energy Imported in the Total Reactive Import Register (5.21.66).

5.12.8. Total Reactive Energy Exported

The SMS shall be capable of recording cumulative Reactive Energy Exported in the Total Reactive Export Register (5.21.65).

5.13. SECURITY

5.13.1. General

The SMS shall be designed taking all reasonable steps so as to ensure that any failure or compromise of its Integrity shall not compromise the Security Credentials or Personal Data stored on it or compromise the Integrity of any other Device to which it is connected by means of a Communications Link.

5.13.2. The SMS shall be capable of verifying the Integrity of its Firmware at power-on and prior to execution.

5.13.3. The SMS shall be capable of logging in the Security Log (5.21.59) information on all Sensitive Events.

5.14. PHYSICAL

5.14.1. The SMS shall be designed taking all reasonable steps so as to prevent unauthorized Physical Access through its Secure Perimeter that could compromise the Confidentiality and/or Data Integrity of:

(i) Personal Data;
(ii) Security Credentials;
(iii) Random Number Generator;
(iv) the Electricity Meter; and
(v) Firmware and data essential for ensuring its Integrity, held or executing on the SMS.

5.14.2. The SMS shall be capable of detecting any attempt at unauthorized Physical Access through its Secure Perimeter that could compromise such Confidentiality and/or Data Integrity and on such detection shall be capable of providing evidence of such an attempt through the use of tamper evident coatings or seals and;

5.14.3. Where reasonably practicable:

(i) Generating an entry to that effect in the Security Log (5.21.59);
(ii) Sending an Alert to that effect via its WAN Interface; and
(iii) Disabling the Supply, in circumstances where the Supply Tamper State (5.21.32) is configured to require Disablement.

5.15. COMMUNICATIONS

5.15.1. The SMS shall be capable of preventing and detecting, on all of its interfaces, Unauthorised access that could compromise the Confidentiality and/or Data Integrity of:

(i) Personal Data whilst being transferred via an interface;
(ii) Security Credentials whilst being transferred via an interface;
(iii) Firmware and data essential for ensuring its Integrity whilst being transferred via an interface and;

5.15.2. Any Command that could compromise the Confidentiality and/or Data Integrity of:

(i) Personal Data;
(ii) Security Credentials; and
(iii) Firmware and data essential for ensuring its Integrity, Held or executing on the SMS, and on such detection shall be capable of:
i. Generating an entry to that effect in the Security Log (5.21.59); and
ii. Sending an Alert to that effect via its WAN Interface.

5.15.3. A SMS shall be capable of employing techniques to protect against Replay Attacks of information used to Authenticate the identity of a system or individual.

5.15.4. A SMS shall not be capable of modifying entries from, or executing a Command to modify or delete entries from the Security Log (5.21.59).

5.16. VOLTAGE QUALITY MEASUREMENTS

5.16.1. Average RMS voltage

A SMS shall be capable of calculating the average value of RMS voltage over a configurable period as defined in the Average RMS Voltage Measurement Period (5.21.7), and:

i. Recording the value so calculated (including details of the period to which the value relates) in the Average RMS Voltage Profile Data Log (5.21.47).

ii. Detecting when the value so calculated is above the Average RMS Over Voltage Threshold (5.21.5), and on detection:

(a) Generating an entry to that effect in the Event Log (5.21.53);
(b) Counting the number of such occurrences in the Average RMS Over Voltage Counter (5.21.47); and
(c) Sending an Alert to that effect via its WAN Interface.

iii. Detecting when the value so calculated is below the Average RMS Under Voltage Threshold (5.21.6), and on detection:

(a) Generating an entry to that effect in the Event Log (5.21.53);
(b) Counting the number of such occurrences in the Average RMS Under Voltage Counter (5.21.48); and
(c) Sending an Alert to that effect via its WAN Interface.

5.16.2. RMS extreme over voltage detection

A SMS shall be capable of detecting when the RMS voltage is above the RMS Extreme Over Voltage Threshold (5.21.25) for longer than the continuous period defined in the RMS Extreme Over Voltage Measurement Period (5.21.23), and on detection:

(i) Generating an entry to that effect in the Event Log (5.21.53); and
(ii) Sending an Alert to that effect via its WAN Interface.
(iii) Disable supply until RMS voltage normalizes

5.16.3. RMS extreme under voltage detection

The SMS shall be capable of detecting when the RMS voltage is below the RMS Extreme Under Voltage Threshold (5.21.26) for longer than the continuous period defined in the RMS Extreme Under Voltage Measurement Period (5.21.24), and on detection:

(i) Generating an entry to that effect in the Event Log (5.21.53); and
(ii) Sending an Alert to that effect via its WAN Interface.
(iii) disable supply until RMS voltage normalizes

5.16.4. RMS voltage sag detection

The SMS shall be capable of detecting when the RMS voltage is below the RMS Voltage Sag Threshold (5.21.29) for longer than the continuous period defined in the RMS Voltage Sag Measurement Period (5.21.27), and on detection:

(i) Generating an entry to that effect in the Event Log (5.21.53); and
(ii) Sending an Alert to that effect via its WAN Interface.

5.16.5. RMS voltage swell detection

The SMS shall be capable of detecting when the RMS voltage is above the RMS Voltage Swell Threshold (5.21.30) for longer than the continuous period defined in the RMS Voltage Swell Measurement Period (5.21.28), and on detection:

(i) Generating an entry to that effect in the Event Log (5.21.53); and
(ii) Sending an Alert to that effect via its WAN Interface.

5.16.6. Supply outage detection

The SMS shall be capable of generating entries in the Event Log (5.21.53) recording each occasion when the Supply is interrupted and/or restored.

5.17. INTERFACE REQUIREMENTS

This section sets out the minimum required interactions which a SMS shall be capable of undertaking with Customer Devices and a Head End System (HES) via its interfaces.

5.17.1. HAN Interface Customer Device Information Provision

The SMS shall be capable of providing the following information immediately upon establishment of a Communications Link with a Customer Device (as set out in 5.4), with updates of any changes to the instantaneous Active Power measurement every 10 seconds thereafter, and timely updates of any changes to the other information to that Customer Device:

(i) the Credit Balance (5.21.56);
(ii) the date and time of the last update of the Credit Balance (5.21.56);
(iii) the Clock time in UTC+1;
(iv) the Total Active Import Register (5.21.64);
(v) the Tariff TOU Register Matrix (5.21.61) and Tariff Block Counter Matrix (5.21.60);
(vi) the Tariff Switching Table (5.21.36);
(vii) the Daily Read Log (5.21.51);
(viii) the Emergency Credit Balance (5.21.52) if Emergency Credit is activated;
(ix) the Tariff TOU Price Matrix (5.21.41) and Tariff Block Price Matrix (5.21.35) with an indication of the active Tariff Price;
(x) the Time-based Debts from the Time Debt Registers [1 … 2] (5.21.62);
(xi) the Time-based Debt Recovery rates from the Debt Recovery Rates [1 … 2] (5.21.10);
(xii) the Payment-based Debt from the Payment Debt Register (5.21.57);
(xiii) the accumulated debt from the Accumulated Debt Register (5.21.44);
(xiv) the Low Medium Power Threshold (5.21.18) and Medium High-Power Threshold (5.21.19);
(xv) the instantaneous Active Power measurement;
(xvi) the Low Credit Threshold (5.21.17);
(xvii) the Profile Data Log (5.21.58); and
(xviii) the Payment Mode (5.21.22).

5.18. HAN INTERFACE MICROGENERATION METER INFORMATION FORWARDING

The SMS shall be capable, upon establishment of a Communications Link with a Micro Generation Meter (as set out in 5.5), of:

(i) receiving requests for information from the HES via its WAN Interface and forwarding such requests for information to the Microgeneration Meter via its HAN Interface; and

(ii) sending information received from a Microgeneration Meter via its HAN Interface and forwarding such information to the HES via its WAN Interface.

5.18.1. User Interface Commands

i. A SMS shall be capable of executing immediately the Commands set out in this section following their receipt via its User Interface.

ii. The SMS shall be capable of logging all such Commands received and Outcomes in the Event Log (5.21.53).

5.18.2. Activate Emergency Credit

i. A Command to activate Emergency Credit (when the SMS is operating in Prepayment Mode) if Emergency Credit is available (as set out in 5.10.1).

ii. In executing the Command, if the Supply is disabled, the SMS shall be capable of Arming the Load Switch and Enabling the Supply.

5.18.3. Add Credit: A Command to add credit to the SMS (when the SMS is operating in Prepayment Mode) on input of a UTRN. In executing the Command, the SMS shall be capable of:

(i) Verifying the Authenticity of the UTRN;
(ii) Verifying that the SMS is the intended recipient of the UTRN;
(iii) Rejecting duplicate presentation of the same UTRN; and
(iv) Controlling the number of invalid UTRN entries processed.

5.18.4. The SMS shall be capable, on failure of any of (i) to (iv) above, of generating an entry in the Security Log (5.21.59) to that effect.

5.18.5. In executing the Command, the SMS shall be capable of applying the credit added in the following order:

(i) recovery of Payment-based Debt of an amount defined by Debt Recovery per Payment (5.21.9) from the Payment Debt Register (5.3.14) subject to the Debt Recovery Rate Cap (5.21.11);
(ii) recovery of debt accumulated in the Accumulated Debt Register (5.21.44);
(iii) repayment of Emergency Credit activated and used by Customer; and
(iv) Adding remaining credit (the credit after deduction of 4.3.4.3 (i, ii and iii) to the Credit Balance (5.21.56).

5.18.6. In executing the Command, the SMS shall be capable of Arming the Load Switch if the Credit Balance (5.21.56) rises above the Disablement Threshold (5.21.12) and displaying any such change in state of the Load Switch on its User Interface and notifying the change in state via its HAN Interface and WAN Interface.

5.18.7. In executing the Command, the SMS shall be capable of recording the credit added to the Credit Balance (5.21.56) in the Billing Data Log (5.21.50).

5.18.8. Enable Supply: A Command to enable the Supply if the Load Switch is Armed.

5.19. WAN INTERFACE COMMANDS

5.19.1. A SMS shall be capable of executing the Commands set out in this section (5.19).

5.19.2. The SMS shall be capable of executing Commands immediately on receipt ("immediate Commands") and at a future date ("future dated Commands"). A future dated Command shall include a date and time at which the Command shall be executed by the SMS.

5.19.3. The SMS shall be capable of sending a Response containing the Outcome on execution of an immediate Command.

5.19.4. The SMS shall be capable of sending a Response acknowledging receipt of a future dated Command immediately upon its receipt. A SMS shall be capable of sending a Response containing the Outcome at the future date and time of execution of a future dated Command.

5.19.5. The SMS shall be capable of over-writing an outstanding future dated Command on receipt of a new future dated Command of the same type. A future dated Command shall be capable of being cancelled by an Authorised party. A SMS shall be capable of cancelling a future dated Command upon receipt of an immediate Command of the same type. A SMS shall be capable of sending an Outcome including the reason for failure of a future dated Command in the event that it has been over-written or cancelled.

5.19.6. The SMS shall be capable of logging all such Commands received and Outcomes in the Event Log (5.21.53).

5.19.7. Activate Emergency Credit: A Command to activate Emergency Credit (when the SMS is operating in Prepayment Mode) if Emergency Credit is available (as set-out in 5.10.1).

5.19.8. In executing the Command, if the Supply is Disabled, the SMS shall be capable of Arming the Load Switch.

5.19.9. Add Credit

A Command to accept credit to be applied to the SMS (when the SMS is operating in Prepayment Mode). In executing the Command, the SMS shall be capable of applying the credit added in the following order:

(i) recovery of Payment-based Debt of an amount defined by Debt Recovery per Payment (5.21.9) from the Payment Debt Register (5.21.57) subject to the Debt Recovery Rate Cap (5.21.11);
(ii) recovery of debt accumulated in the Accumulated Debt Register (5.21.46);
(iii) repayment of Emergency Credit activated and used by Customer; and
(iv) adding remaining credit (the credit after deduction of 4.4.7.1(i, ii and iii)) to the Credit Balance (5.21.56).

5.19.10. In executing the Command, the SMS shall be capable of Arming the Load Switch if the Credit Balance (5.21.56) rises above the Disablement Threshold (5.21.12) and displaying any such change in state of the Load Switch on its User Interface and notifying the change in state via its HAN Interface and WAN Interface.

5.19.11. In executing the Command, the SMS shall be capable of recording the credit added to the Credit Balance (5.21.56) in the Billing Data Log (5.21.50).

5.19.12. Adjust Debt
A Command to apply positive and negative adjustments to the Time Debt Registers [1 … 2] (5.21.62) and the Payment Debt Register (5.21.57) (when operating in Prepayment Mode).

5.19.13. Adjust Credit Balance
A Command to apply positive and negative adjustments to the Credit Balance (5.21.56).

5.19.14. If the SMS is operating in Prepayment Mode and, following such adjustment, if the Credit Balance (5.21.56) rises above the Disablement Threshold (5.21.12), the SMS shall be capable of Arming the Load Switch and displaying any such change in state of the Load Switch on its User Interface and notifying the change in state via its HAN Interface and WAN Interface.

5.19.15. Arm Load Switch
A Command to Arm the Load Switch.

5.19.16. Clear Event Log
A Command to clear all entries from the Event Log (5.21.53).

5.19.17. Disable Supply
A Command to Disable the Supply without need for local physical interaction.

5.19.18. Enable Supply
A Command to Enable the Supply without the need for local physical interaction.

5.19.19. Read Configuration Data
A Command to read the value of one or more of the configuration data items set out in 5.21.4.

5.19.20. In executing the Command, the SMS shall be capable of sending such value(s) in a Response via its WAN Interface.

5.19.21. Read Constant Data
A Command to read the value of one or more of the constant data items set out in 5.21.1.

5.19.22. In executing the Command, the SMS shall be capable of sending such value(s) in a Response via its WAN Interface.

5.19.23. Read Operational Data
A Command to read the value of one or more of the operational data items set out in 5.21.43.

In executing the Command, the SMS shall be capable of sending such value(s) in a Response via its WAN Interface.

5.19.24. Reset Load Limit Counter
A Command to reset the Load Limit Counter (5.21.54) to zero.

5.19.25. Reset Average RMS Over Voltage Counter
A Command to reset the Average RMS Over Voltage Counter (5.21.47) to zero.

5.19.26. Reset Average RMS Under Voltage Counter
A Command to reset the Average RMS Under Voltage Counter (5.21.48) to zero.

5.19.27. Restrict Data
A Command to mark configuration and/or operational data as restricted so as to prevent from disclosure on its HAN Interface and its User Interface.

5.19.28. Set Payment Mode
A Command to set the payment mode as either Prepayment Mode or Credit Mode and to record the mode of operation in Payment Mode (5.21.21).

In executing the Command, the SMS shall be capable of recording:
(i) the Tariff TOU Register Matrix (5.21.61);
(ii) the Tariff Block Counter Matrix (5.21.60);
(iii) the Credit Balance (5.21.56);
(iv) the Emergency Credit Balance (5.21.52);
(v) the Payment Debt Register (5.21.57);
(vi) the Time Debt Registers [1 … 2] (5.21.62); and
(vii) the Accumulated Debt Register (5.21.44),
(viii) in the Billing Data Log (5.21.50).

5.20. SET TARIFF

5.20.1. A Command to accept new values for Tariff Type (5.21.42), Tariff TOU Price Matrix (5.21.41), Tariff Block Price Matrix (5.21.35), Tariff Switching Table (5.21.36), and Tariff Threshold Matrix (5.21.40).

5.20.2. In executing the Command, the SMS shall be capable of recording:
(i) the Tariff TOU Register Matrix (5.21.61);
(ii) the Tariff Block Counter Matrix (5.21.60);
(iii) the Credit Balance (5.21.56);
(iv) the Emergency Credit Balance (5.21.52);
(v) the Payment Debt Register (5.21.57);
(vi) the Time Debt Registers [1 … 2] (5.21.62); and
(vii) the Accumulated Debt Register (5.21.44),
(viii) in the Billing Data Log (5.21.50).

5.20.3. Synchronize Clock
A Command to synchronize the Clock with UTC+1 over its WAN Interface.

5.20.4. Update Firmware
A Command to receive new Firmware; In executing the Command, the SMS shall be capable of:
(i) only accepting new Firmware from an Authorised and Authenticated source;
(ii) verifying the Authenticity and Integrity of new Firmware before installation; and
(iii) installing new Firmware using a mechanism that is robust against failure and loss of data.

5.20.5. The new Firmware shall include version information which shall be capable of being made available to be read from Firmware Version (5.21.3).

5.20.6. Update Security Credentials
A Command to update or revoke Security Credentials held within the SMS.

5.20.7. Write Configuration Data
A Command to record one or more new values of the configuration data items set out in 5.21.4
In executing the Command, the SMS shall be capable of logging all changes of values in the Event Log (5.21.53).

5.21. DATA REQUIREMENTS

This section describes the minimum information which a SMS is to be capable of holding in its Data Store.

5.21.1. Constant data
This describes data that remains constant and unchangeable at all times other than through Firmware upgrades.

5.21.2. Device Identifier
An identifier used to uniquely identify each Device installed to comply with this regulation.

5.21.3. Firmware Version
The operational version of Firmware of the SMS.

5.21.4. Configuration data
Describes data that configures the operation of various functions of a SMS.

5.21.5. Average RMS Over Voltage Threshold
The average RMS voltage above which an over voltage condition is reported. The threshold shall be configurable within the specified operating range of the Electricity Meter as specified in IEC 62053-21:2020.

5.21.6. Average RMS Under Voltage Threshold
The average RMS voltage below which an under voltage condition is reported. The threshold shall be configurable within the specified operating range of the Electricity Meter as specified in IEC 62053-21:2020.

5.21.7. Average RMS Voltage Measurement Period
The length of time in minutes that the RMS voltage is averaged over.

5.21.8. Billing Calendar
A calendar defining billing dates for the storage of billing-related information in the Billing Data Log (5.21.50).

5.21.9. Debt Recovery per Payment
The percentage of a payment to be recovered against debt when the SMS is operating Payment-based Debt Recovery in Prepayment Mode.

5.21.10. Debt Recovery Rates [1 … 2]
Two debt recovery rates in Currency Units per unit time for when the SMS is using Time-based Debt Recovery in Prepayment Mode.

5.21.11. Debt Recovery Rate Cap
The maximum amount in Currency Units per unit time that can be recovered through Payment-based Debt Recovery when the SMS is operating in Prepayment Mode.

5.21.12. Disablement Threshold
The threshold in Currency Units for controlling when to Disable the Supply.

5.21.13. Emergency Credit Limit
The amount of Emergency Credit in Currency Units to be made available to a customer when Emergency Credit is activated by the Customer.

5.21.14. Emergency Credit Threshold

The threshold in Currency Units below which Emergency Credit Balance (5.21.52) may be activated by the Customer if so configured when the SMS is operating in Prepayment Mode.

5.21.15. Load Limit Power Threshold
The Active Power threshold in kW above which a load limiting event is recorded.

5.21.16. Load Limit Supply State
A setting to control the state of the Supply in the case of a Load Limit Event being detected, being Disabled or unchanged.

5.21.17. Low Credit Threshold
The threshold in Currency Units below which a low credit Alert is generated.

5.21.18. Low Medium Power Threshold
A value in kW defining the threshold between an indicative low and medium Active Power Import (5.21.45) level.

5.21.19. Medium High-Power Threshold
A value in kW defining the threshold between an indicative medium and high-power Active Power Import (5.21.45) level.

5.21.20. Non-Disablement Calendar
A calendar defining times, days and dates that specify periods during which the Supply will not be disabled when the meter is operating in Prepayment Mode.

5.21.21. All time and dates shall be specified as UTC+1.

5.21.22. Payment Mode
The current mode of operation, being Prepayment Mode or Credit Mode.

5.21.23. RMS Extreme Over Voltage Measurement Period
The duration in seconds used to measure an extreme over voltage condition.

5.21.24. RMS Extreme Under Voltage Measurement Period
The duration in seconds used to measure an extreme under voltage condition.

5.21.25. RMS Extreme Over Voltage Threshold
The RMS voltage above which an extreme over voltage condition is reported. The threshold shall be configurable within the specified operating range of the Electricity Meter as specified in IEC 62053-21:2020.

5.21.26. RMS Extreme Under Voltage Threshold
The RMS voltage below which an extreme under voltage condition is reported. The threshold shall be configurable within the specified operating range of the Electricity Meter.

5.21.27. RMS Voltage Sag Measurement Period
The duration in seconds used to measure a voltage sag condition.

5.21.28. RMS Voltage Swell Measurement Period
The duration in seconds used to measure a voltage swell condition.

5.21.29. RMS Voltage Sag Threshold
The RMS voltage below which a sag condition is reported. The threshold shall be configurable within the specified operating range of the Electricity Meter as specified in IEC 62053-21:2020.

5.21.30. RMS Voltage Swell Threshold
The RMS voltage above which a swell condition is reported. The threshold shall be configurable within the specified operating range of the Electricity Meter as specified in IEC 62053-21:2020.

5.21.31. Fixed Charge
A charge to be levied in Currency Units per unit time when operating in Credit Mode and Prepayment Mode.

5.21.32. Supply Tamper State
A setting to control the state of the Supply in the case of a Tamper Event being detected, being Disabled or unchanged.

5.21.33. Suspend Debt Disabled
A setting controlling whether debt should be collected when the SMS is operating in Prepayment Mode and Supply is Disabled.

5.21.34. Suspend Debt Emergency
A setting which determines whether debt should be collected when the SMS is operating in Prepayment Mode and the Emergency Credit Balance (5.21.52) is below the Emergency Credit Limit (5.21.13).

5.21.35. Tariff Block Price Matrix
A 4 x 8 matrix containing prices for Block Pricing to be determined by the Commission from time to time.

5.21.36. Tariff Switching Table

5.21.37. A set of switching rules for allocating half-hourly Consumption to a Tariff Register for Time-of-use Pricing and Time-of-use with Block Pricing. The rules stored within the table shall support at least 200 Time-of-use switching rules per annum.

5.21.38. The rules shall support allocation based on:
(i) half-hour, half-hours and half-hour ranges;
(ii) day, days and day ranges; and

(iii) date, dates and date ranges.

5.21.39. All dates shall be specified as UTC+1.

5.21.40. Tariff Threshold Matrix
A 3 x 8 matrix capable of holding thresholds in kWh for controlling Block Tariffs.

5.21.41. Tariff TOU Price Matrix
A 1 x 48 matrix containing prices for Time-of-use Pricing.

5.21.42. Tariff Type
The Tariff type in operation.

5.21.43. Operational data
Describes data used by the functions of a SMS for output of information.

5.21.44. Accumulated Debt Register
The debt resulting from the collection of Fixed Charge (5.2.26) and/or Time-based Debt when no credit or Emergency Credit is available, when operating in Prepayment Mode.

5.21.45. Active Power Import
The import of Active Power measured by the SMS.

5.21.46. Ambient Power
An indication of the Ambient power level, being low, medium or high.

5.21.47. Average RMS Over Voltage Counter
The number of times the average RMS voltage, as calculated in 5.10.1, has been above the Average RMS Over Voltage Threshold (5.21.5) since last reset.

5.21.48. Average RMS Under Voltage Counter
The number of times the average RMS voltage, as calculated in 5.10.1, has been below the Average RMS Under Voltage Threshold (5.21.6) since last reset.

5.21.49. Average RMS Voltage Profile Data Log
A log for storing 4320 entries (including details of the period to which each entry relates) comprising the averaged RMS voltage for each Average RMS Voltage Measurement Period (5.21.7) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.21.50. Billing Data Log
A log for storing the following date and time stamped entries of: twelve entries comprising Tariff TOU Register Matrix (5.21.61) and Tariff Block Counter Matrix (5.21.60);

i. five entries comprising prepayment credits;
ii. ten entries comprising time-based debt payments;

iii. ten entries comprising payment-based debt payments; and
iv. twelve entries comprising
   (a) Credit Balance (5.21.56),
   (b) Emergency Credit Balance (5.21.52),
   (c) Accumulated Debt Register (5.21.44),
   (d) Payment Debt Register (5.21.57) and
   (e) Time Debt Registers [1 … 2] (5.21.62), arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.21.51. Daily Read Log
A log for storing fourteen date and time stamped entries of the
(i) Tariff TOU Register Matrix (5.21.61),
(ii) the Tariff Block Counter Matrix (5.21.60) and
(iii) the Total Active Import Register (5.21.64) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.21.52. Emergency Credit Balance
The amount of Emergency Credit available to the Customer after it has been activated by the Customer.

5.21.53. Event Log
A log for storing at least one hundred UTC+1 date and time stamped entries of non-security related information for diagnosis and auditing, arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.21.54. Load Limit Counter
The number of times the Active Power Import has exceeded the Load Limit Power Threshold (5.21.54) since last cleared.

5.21.55. Load Switch State
The state of the Load Switch, being opened, closed or Armed.

5.21.56. Credit Balance
The amount of money in Currency Units as determined by the SMS. If operating in Prepayment Mode, the Credit Balance represents the SMS's determination of the amount of credit available to the Customer (other than any Emergency Credit Balance (5.21.52)). If operating in Credit Mode, it represents the SMS's determination of the amount of money due from the Customer since the Credit Balance was last reset.

5.21.57. Payment Debt Register
Debt to be recovered as a percentage of payment when using Payment-based Debt Recovery in Prepayment Mode.

5.21.58. Profile Data Log
A log for storing date and time-stamped half hourly data arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten. The log shall be capable of storing a minimum of:

(i) 13 months of Active Energy Imported (Consumption);
(ii) 3 months of Active Energy Exported;
(iii) 3 months of Reactive Energy Imported; and
(iv) 3 months of Reactive Energy Exported.

For Grid Metering
(i) 12 months Active Energy Import
(ii) 12 months Active Energy Export
(iii) 12 months Reactive Import
(iv) 12 months Reactive Export

5.21.59. Security Log
A log for storing at least one hundred UTC+1 date and time stamped entries of security related information for diagnosis and auditing arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.21.60. Tariff Block Counter Matrix
A 4 x 8 matrix for storing Block Counters for Block Pricing.

5.21.61. Tariff Register Matrix
A 1 x 48 matrix for storing Tariff Registers for Time-of-use Pricing.

5.21.62. Time Debt Registers [1 … 2]
Two registers recording independent debts to be recovered over time when operating Time-based Debt Recovery in Prepayment Mode.

5.21.63. Total Active Export Register
The register recording the total cumulative Active Energy Exported.

5.21.64. Total Active Import Register
The register recording the cumulative Active Energy Imported.

5.21.65. Total Reactive Export Register
The register recording the cumulative Reactive Energy Exported.

5.21.66. Total Reactive Import Register
The register recording the cumulative Reactive Energy Imported.

5.22. IN HOME DISPLAY (IHD) TECHNICAL SPECIFICATION

5.22.1. General
This section defines the minimum physical requirements, minimum functional requirements, minimum interface requirements and minimum data requirements of an In-home Display installed to comply with this regulation.

5.22.2. Physical requirements

5.22.3. An IHD shall as a minimum include the following components:
(i) a Data Store;
(ii) a HAN Interface; and

(iii) a User Interface.

5.22.4. An IHD shall be mains powered and shall be capable of operating at a nominal voltage of 230VAC and consuming not more than an average of 0.6 watts of electricity under normal operating conditions.

5.22.5. An IHD shall display the Device Identifier (5.22.25).

5.22.6. The HAN Interface of an IHD shall be capable of supporting communications based on Open Standards.

5.22.7. An IHD shall be designed to enable the information displayed on it to be easily accessed and presented in a form that is clear and easy to understand including by Customers with impaired:
(i) sight;
(ii) memory and learning ability;
(iii) perception and attention; or
(iv) dexterity.

5.22.8. Functional Requirements
This section defines the minimum functions that an IHD shall be capable of performing.

5.22.9. Communications
An IHD shall be capable of establishing Communications Links via its HAN Interface with a SMS.

5.22.10. An IHD shall be capable of ensuring that the security characteristics of all Communications Links it establishes meet the requirements set-out in 5.4.1. Communications with Other SMS

(i) An IHD shall be capable of establishing a Communications Link via its HAN Interface with other SMS like Gas SMS (GSMS) or neighbouring electrical SMS as appropriate.
(ii) In establishing the Communications Link, the IHD shall be capable of providing Security Credentials to enable it to be Authenticated by the GSMS or SMS as appropriate.
(iii) Where it has established a Communications Link, the IHD shall be capable of receiving the information (set-out in 5.17.1) from the other SMS.
(iv) The IHD shall be capable of detecting a failure of a Communications Link and on detection of a failure, shall be capable of clearing or suitably annotating the information displayed on its User Interface (set out in 5.22.11) to indicate that the information may be out of date.

5.22.11. Information Pertaining to the Supply of Electricity to the Premises
(a) An IHD shall be capable, upon establishment of a Communications Link with another SMS (as set out in 5.22.10), of providing the following information on its User Interface and providing updates of any changes to the information every 10 seconds thereafter.
(b) The IHD shall be capable of displaying Currency Units in Naira.

5.22.12. Active Tariff Price [NUM]
The active Tariff Price for Energy Consumption in Currency Units per kWh.

5.22.13. Aggregate Debt [NUM]
The sum of all Time-based and Payment-based Debt registers on the SMS operating in Prepayment Mode.

5.22.14. Aggregate Debt Recovery Rate [NUM]
The sum of the Time-based Debt Recovery rates on the SMS operating in Prepayment Mode.

5.22.15. Connection Link Quality
The signal quality of the Communications Link to the other SMS.

5.22.16. Cumulative Consumption [NUM]
(i) Current Day cumulative Energy Consumption;
(ii) Current Day cost to the Customer of cumulative Energy Consumption in Currency Units;
(iii) Current Week Cumulative Energy Consumption;
(iv) Current Week cost to the Customer of cumulative Energy Consumption in Currency Units;
(v) Current month cumulative Energy Consumption; and
(vi) Current month cost to the Customer of cumulative Energy Consumption in Currency Units.

5.22.17. Emergency Credit Balance [NUM]
The emergency credit balance if Emergency Credit is activated in the SMS (including a clear indication that the Emergency credit has been activated).

5.22.18. Historic Consumption
(i) D-1 to D-8 historic Energy Consumption;
(ii) D-1 to D-8 cost to the Customer of historic Energy Consumption in Currency Units;
(iii) W-1 to W-5 historic Energy Consumption;
(iv) W-1 to W-5 cost to the Customer of historic Energy Consumption in Currency Units;
(v) M-1 to M-13 historic Energy Consumption; and
(vi) M-1 to M-13 cost to the Customer of historic Energy Consumption in Currency Units.
a. where: D-1 = current Day minus 1, D-2 = current Day minus 2, W- 1 = current Week minus 1, M-1 = current month minus 1 etc.

5.22.19. Instantaneous Active Power Import [NUM]
A near real-time indication of the Active Power Import in kW; and the cost to the Customer of that Instantaneous Active Power Import.

5.22.20. Local Time
The Local Time as derived from UTC+1.

5.22.21. Low Credit Alert
An indication that the combined electricity Credit Balance and electricity emergency credit balance (if Emergency Credit is activated) has fallen below the SMS low credit threshold.

5.22.22. Credit Balance [NUM]
The amount of money in Currency Units as determined by the SMS. If operating in Prepayment Mode, the Credit Balance represents the SMS's determination of the amount of credit available to the Customer (excluding any Emergency Credit Balance [NUM] (6.3.3.6)). If operating in Credit Mode, it represents the SMS's determination of the amount of money due from the Customer since the Credit Balance was last reset.

5.22.23. Payment Mode
The current mode of operation of the SMS, being Prepayment Mode or Credit Mode.

5.22.24. Power Threshold Status [AMB]
An indication of the level of Active Power Import as high, medium or low.

5.22.25. Security

General

(a) The IHD shall be designed taking all reasonable steps to ensure that it is capable of protecting Personal Data and Security Credentials at all times from disclosure or modification that is not authorised.

(b) An IHD shall be designed taking all reasonable steps so as to ensure that any failure or compromise of its Integrity shall not compromise the Integrity of any other Device to which it is connected by means of a Communications Link.

Communications

(a) An IHD shall be capable of preventing and detecting, on all of its interfaces, Unauthorised access that could compromise the Confidentiality and/or Data Integrity of:

i. Personal Data whilst being transferred via an interface; and
ii. Security Credentials whilst being transferred via an interface.

(b) An IHD shall be capable of employing techniques to protect against Replay Attacks of information used to authenticate the identity of a system or individual.

Interface Requirements

This section sets out the minimum required interactions which an IHD shall be capable of undertaking with other SMS as appropriate via its HAN Interface.

Receipt of information via the HAN Interface

An IHD shall be capable, immediately upon establishment of a Communications Link with a SMS (as set out in 5.3.1) of receiving information (and updates of any changes of this information every 10 seconds thereafter) required to meet the display requirements set out in 5.3.2.

Data requirements

This section describes the minimum information which an IHD is to be capable of holding in its Data Store.

Constant data

It describes data that remains constant and unchangeable at all times.

Device Identifier

An identifier used to uniquely identify each IHD installed to comply with the smart metering roll-out licence conditions.

Meter Protection and design

The meter shall be installable in current existing meter locations at Customer premises.

The smart metering system components shall support local access and configuration by authorised personnel.

The smart metering system shall be installed and maintained in a manner that protects public safety.

The smart metering system shall display energy supply status (enabled or disabled) and origin of supply (grid or generator).

The smart metering system shall be protected from physical tampering or interference, e.g. security seals, tamper switches, etc.

The smart metering system shall integrate a tampering detector, recognising the following signals:

Removal of terminal cover when the meter is powered as well as when it is not powered
Reverse current flow
Phase inversion (single-phase meters)
Current flow with no voltage

The meter and its measurement technology shall be highly resistant to tamper attempts with DC magnetic fields
Phase rotation (for three phase meters)
Single phasing (for three phase meters)

5.23. TECHNICAL SPECIFICATION FOR SINGLE PHASE AND THREE PHASE SMART METERS

	FUNCTIONS AND FEATURES	TECHNICAL REQUIREMENTS
1	Nominal Voltage	- 1-ph-230V, 1-ph, 2-wire system,
		- 3-ph- 400V, 3-ph, 4-wire system (balanced and unbalanced load conditions)
2	Operating Voltage	-40% to +10% Nominal Voltage
		-40% to +10% Nominal Voltage
3	Current Rating	5(60)A – Single Phase
		3 X5(100) A - Three Phase
4	Frequency	50Hz ±5%
5	Accuracy Class	Class 1.0 – Active Class 2.0 - Reactive
6	Encryption Algorithm for PPM	Standard Transfer Specification (STS)
		E-wallet
7	Operating Temp.	-40°C to 70°C
8	Storage Temp.	Up to 70°C
9	Relative Humidity	95% at 45° C non- condensing
10	Maximum KWH credit stored	99,999.9 kWh(1-ph), 999,999.9kWh(3-ph) In addition to the above, any and all account credits may be stored in a cloud server and not necessarily within the meter itself, and thus presenting no theoretical limit to the energy or credit consumption value.
11	Credit transfer number	20 Digits encryption
12	Protection	High resistance to short circuit
13	Impulse withstand voltage	Preferably greater than 6 kV
14	Insulation withstand voltage	2 kV per minute
15	Name plate	a) Indelible Meter serial number shall not be less than eleven (11) digits and legibly printed
		b) Size of the digit of the Meter serial number shall be a minimum of 5mm x 3mm.
		c) Bar code shall be printed below the Meter

		serial number
		d) Manufacturer's name and Trademark.
		e) Place of manufacture.
		f) Year of manufacture.
		g) Reference Voltage, Current and frequency.
		h) Class index.
		i) Meter Constant.
		j) Owner/Utility's Identity.
16	Front panel Indication/Display	Include but not limited to the following:
		- Three level credit LED display
17	Special Mode Display for Engineering / Management	- Green-when energy stored is full Yellow-when remaining credit will last for 3 days.
		- The red flashes when the remaining energy will last for 11/2 days.
		- Blue/Amber-Consumption rate indicator. LCD credit status display.
		- Credit transfer number accept/reject Tamper.
		Display up to 3 parameters according to programming to be specified:
		a. Normal display – LCD
		I. Duplicate copy of token inserted
		ii. Credit Dispensing Unit identification number and kWh (or voucher serial number) inserted.
		iii. Electricity Dispenser (LED) full of units.
		iv. No power ON LED
		v. No credit on LED
		vi. Credit rejects or accepts.
		vii. Remaining Credit.
		viii. Instantaneous Power
		ix. Total kWh used in the past 24 hrs.
		x. Total kWh used in the past 30 days.
		xi. Total kWh used since the LED was installed.
		b. Display only available with valid codes.
		c. Display only available within chosen programming or engineering mode.

		For the purpose of these specifications, items b) and c) above are treated as one. These shall be accessible only to utility staff.
		a. Over current trip level.
		b. Green-Yellow Light emitting diode (LED) display change over level in kWh (high).
		c. Yellow-Red LED display change over level in kWh (low).
		d. Test on LED for tripping function.
		e. Display of LED number.
		f. Error message.
		g. Power failure counter (Number of times power supply failed or disconnected)-400 cycles and back to zero.
		h. Enabling of disabled LED caused by tampering.
		i. Number of days/hours into the current 30 days when there was power and total kWh used during the period.
		j. Historical Value minimum 6 months kWh
		k. Energy-reporting red LED pulse (1,000 pulses per kWh
		l. Status LED reporting relay status (open/closed) and wireless status (linked/unlinked). All other readout and control interfaces may be performed via wireless link.
18	EMC Compliance	Relevant section of IEC 62052-11:2020 & 62053-21:2020
19	Burden	Preferably less than 2 VA per phase.
20	Terminals	Extended cover type. Hole diameter shall be between 8.5mm - 9mm.- Single Phase
		Extended cover type. Hole diameter shall be between 8.5mm- 9mm – Three Phase
21	Casing/Cover Material	Fire retardant- Bakelite and transparent

		polycarbonate material
22	Sealing	Provision must be adequate to prevent tampering. 2 Seals on either side of the meter/Ultrasonic sealing/Chemical bounding
		Terminal Cover: One or more sealing provision shall be provided at meter terminal cover
23	Power Factor Range	-1 to +1
24	Data Storage	Non-Volatile EPROM
25	Switching	Latching contactor.
26	EMC Susceptibility	According to IEC 62052-11:2020 & 62053-23:2020. Not adversely affected by external magnetic fields.
27	Life Span	Minimum 15 years
28	Measurement	1-Ph, 2-Wire System. CT on Neutral line measurement 3- Ph, 4 Wire System
29	Disconnection relay	Maximum switching voltage: 400V AC Maximum switching current: Single Phase – 90A Three Phase - 120A Maximum switching power: Single Phase – 13kVA Three Phase - 45kVA
30	Battery	• Internal lithium battery life span 15-year minimum • External backup: Easily replaceable without breaking seal
31	Ingress Protection	• IP54 casing
32a	Terminal connection Configuration	Ph-N, N-Ph (Symmetrical Single Phase Terminal Configuration)
32b	Terminal connection Configuration	PhR1 – PhR2, PhY1- PhY2, PhB1-PhB2, N-N (Asymmetrical Three Phase Terminal Configuration)

5.24. COMMUNICATION SPECIFICATIONS & SMART FEATURES

S/N	FUNCTIONS	REQUIREMENTS
1	Communication interface	Optical as per IEC62056-21:2002, supporting DLMS/COSEM protocol capable of transferring data or any standard data protocol such as MQTT or MQTTS may be used. Meter may be interrogated wirelessly from a local wireless device linked to the wireless network.
2	Remote Communication interface	Meter shall be able to communicate with Head End System (HES) through Gateway/Modem. Two-way communication between meter and HES or via DCU through RF, PLC, LoRa and GPRS. DCU shall support TCP/IP, G3 PLC, Radio Frequency, Fiber, 3G or 4G.
3	Midnight Energy Snapshot	Capable of recording and storing midnight snapshot of kWh, for minimum of 30 days and transferring same on demand and at predetermined interval.
4	Interval data recording	30 minutes with 3 voltages, current and power factors readings
5	Billing History	Current month + minimum last 6 months billing data
6	Event recording	Meter shall have facility to download using both optical port or via remote communication capability with date and time stamp. In addition, any and all meter events may be transmitted wirelessly and subsequently recorded and acted upon from a cloud server software. Following events to be recorded:
		As per tamper sheet a) Terminal Cover open
		b) Magnet Disturbance
		c) Phase Miss (R, Y, B)
		d) Current reverse (R, Y, B)
		e) Current Unbalance
		As per Event a) Power On/Off
		Status in Anomaly a) Over voltage (300Volts)
		b) Identification of neutral current more than line current

		c) Pre-programmed alarms for meter self-check
		d)Alarms trigger LEDs, enunciators, communications event
		e) Alarms are stored in event logs
7	Remote connection-disconnect	Relay for remote load connection or disconnection with date and time stamp. Visual indication (Relay on/off) to be provided on display unit.
8	Remote load control features	Feature to set threshold values to control load (overload limit) of customers if programmed demand is exceeded
9	Other remote functions	• Remote reading (Read by Modem) • Remote crediting (Set by STS Token with online transfer mechanism) • Acquire Meter profile/configuration data. • Remote configuration of meters and DCUs. • Read meters according to pre-defined schedule or on-demand. • Automatic re-reading of meters to acquire missed data. • Remote disconnection/reconnection of energy supply • Upgrade meter firmware remotely. • Any and all meter credits may be stored remotely in a cloud server software.
10	Tariff Management	• TOD billing and remote update to tariffs. • Any and all tariff structures may be stored in a cloud server software.
11	Measured values	• Import/Export/Absolute: Wh, Varh and VAh • Per quadrant Wh, Varh and VAh • Power: W, Var, VA, Vrms, I rms • 3 Power factors, 3 currents, 3 voltages frequency, phase sequence

5.25. SPECIFICATIONS FOR IN-HOME DISPLAY (IHD)

S/N	FUNCTIONS AND FEATURES	TECHNICAL REQUIREMENTS
1	Operating Voltage	230V (AC)
2	Operating Power	0.6W (Maximum)
3	Frequency	50Hz ±2%
4	Communication Mode	WAN, LAN, HAN etc.
5	Memory	Non-volatile (Minimum 5MB)

6	Operating Temp.	Up to 60°C
7	Storage Temp.	Up to 70°C
8	Relative Humidity	95% at 45° C non- condensing
9	Display	1. with good contrast and wide viewing angle with backlight features. 2. Minimum of eight (8) digits representing the energy and at least one (1) digit after the first decimal point 3. LCD display size: 9mm x 4.5mm minimum 4. Viewing angle: 160 degrees minimum 5. Parameters: Total units used to date (in kWh) Available credit (in kWh) Present consumption rate Last billing date Last billed amount (kWh) Credit level Warning on credit level Other messages
10	Protection	IP54
11	For additional information, kindly refer to section 5.22 (IHD)	

5.26 SPECIFICATIONS FOR HEAD END SYSTEM (HES)

A Head End System (HES) is a central control system used in Advanced Metering Infrastructure (AMI) for remotely managing and monitoring Smart Meters. It is the central point of communication between the utility company and the Smart Meters installed in customers' homes or businesses.

The HES collects data from the Smart Meters, such as energy consumption, voltage levels, and other relevant information. It then processes this data and sends it to the utility company for analysis and billing purposes. The HES can also send commands to the Smart Meters, such as disconnection and connection, or adjusting the voltage levels.

The HES shall have the following basic features as contained in the table below:

Specifications for Head End System (HES)		
S/No.	**Function/Features**	**Technical Requirement**
1	Architecture	Servers deployed in a multi-tiered environment
		communication server
		Application server
		Database server deployed in a multi-tiered environment
		Meters and Data Concentrators should be connected to the HES via APNs
		HES application server must be web-based, with a W3C-compliant web browser supporting HTTP and HTTPS over TCPIP
		HES system shall expose open interfaces for data exchange with Disco's Meter Data Management System (MDMS)
		Working on both hardware options i.e. 1. Meter to HES directly through GPRS 2. Meter to DCU through PLC, RF, LoRa etc and then DCU to HES system through GPRS
		Non-proprietary standards and protocols
		Interoperability across utility infrastructures
		Shall enable bi-directional communication with other manufacturers' hardware and software platforms
2		
	Communication	shall support point-to-point (P2P) and point-to-multipoint (P2M) communication
	Communication media	Low voltage PLC network
		GPRS(3G/4G)
		IP networks (LAN, WAN)
		LoRa/RF
	Communication protocols	DLMS (IEC 62056-6-1:2017)
		PLAN IEC 61334-5-1:2001
		M-BUS
		TCP/IP
		IDIS. IEC 61334-5-1:2001
3	Alarm management	shall be able to communicate alarms to MDM and DMS
		Shall allow remote configuration of metering points to automatically report any external or internal alarms detected in devices connected with the system.
4	Security – ISO/IEC 27001:2022	
	Security	ensures a secure and reliable data transfer at all system levels

	Security Components - ISO/IEC 27001:2022 - system software development, solution integration testing and support process	Authentication
		Authorisation
		Encryption
		Logging
	System security	Shall provide centralised user access management
		Shall ensure each user has access to only the features assigned to him
		Audit trail of every activities of both the admin and the users
	Communication Security	The communication shall be secured:
		1. Between the data concentrator and the system
		2. Between the data concentrator and PLC/LoRa/RF etc. Meters under it
		3. Between point-to-point devices and the system
5	Integration - IEC61968-9:2013 edition 2.0	Third party system shall be able to access and control Smart Metering Devices to perform the following functions:
		1. Pushing Data, e.g. Meter reading, power outages, tampering etc
		2. On-demand Meter reading, e.g. consumption, instantaneous voltage and current values etc
		3. Controls, e.g. connect and disconnect, load control etc
		4. Device Installation, e.g., device discovery, automated communication acceptance etc
		5. Device parametrization and Meter reading scheduling, e.g., tariff (TOU), load control schedules etc
6	Payment Mode	Shall support possibility to control to send token and integrating STS prepayment solution
	STS Integration - IEC 62055-41:2018, IEC 62055-51:2007	
	Credit Mode	Shall be capable of maintaining a calculation of the Credit Balance and display on the user interface

6 SCHEDULE F - METERING ACCESSORIES: CURRENT TRANSFORMERS FOR LV/MV (MD METERS)

This shall have the following basic features:

FUNCTION/FEATURE	TECHNICAL REQUIREMENTS
Rating	100/5A, 200/5A, 300/5A & 800/5A, 400V
Type	Indoor, ring type with sealable terminal cover
Accuracy class	0.5
Compliance	IEC61869-2:2012
Burden	At least 5VA
Operating Temp.	Up to 65^{O}C
Relative Humidity	96% at 45^{O}C non- condensing
Basic Insulation Level	0.72/3 kV
Internal diameter	Not less than 45mm for 100/5A & 200/5A. Not less than 50mm for 300/5A Not less than 60mm for 500/5A & 800/5A

6.1. METERING ACCESSORIES: VOLTAGE TRANSFORMERS - (Oil filled outdoor voltage transformer)

This shall have the following basic features:

FUNCTION/FEATURE	TECHNICAL REQUIREMENTS
Voltage Rating	3x-/110V, 11000/110V and 33000/110V
Burden	200VA, 400VA for 11000/110V and 33000/110V respectively
Accuracy class	0.5 for 33000/110V and 0.5 for 11000/110V
Insulation class	A
Insulation Level	12/28/75 for 11kV, 36/70/170 for 33kV
Operating Frequency	50Hz±2%
Compliance	With the provisions of IEC61869-3:2011
Rated voltage Factor	1.2 continuous or 1.9 for 8hrs single pole

6.2. METERING ACCESSORIES: TEST TERMINAL BLOCKS (TTBs)

This shall have the following basic features:

FUNCTION/FEATURE	TECHNICAL REQUIREMENTS
Connection	Front
Cover	Black Bakelite or clear Poly carbonate
Voltage Terminals	Together, or separate with solid links
Terminal hole diameter	9mm
Voltage Ratings	550V
Current rating	100A

6.3. Terminal configuration shall be as follows:

(i) Three Voltages, one neutral terminal
(ii) Three Current terminals per phase
(iii) Two shunt links per current terminal per phase

6.4. METERING ACCESSORIES: METERING CUBICLES/PANELS/ METER BOX

(i) The HT panel shall be fitted with separate Energy Metering, Protection current transformers and other metering accessories already specified above as well as bushings, connecting links/bus bars, Test Terminal block, with proper wiring.
(ii) The Metering cubicle shall be suitable for outdoor application.
(iii) The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous operation.
(iv) The equipment shall be complete with all components necessary for their effective and trouble-free operation. Such components shall be deemed to be within the scope of the installation irrespective of whether those are specifically brought out in this specification or not.
(v) The Metering Box shall be transparent to allow for visibility of the Meter

6.5. STANDARDS APPLICABLE:

(i) Unless otherwise specified elsewhere in this specification, the performance and testing of the Meters shall conform to the following International Standards and all related international standards to be read with up to-date and latest amendments/revisions thereof.
(ii) Metering Cubicle matching with requirements of other national or international standards, which ensure equal or better performance than the standards mentioned above, shall also be applicable. When the equipment conforms to standards other than those specified, salient points of difference between standards adopted, the standards specified in this specification shall be clearly brought out, and a copy of such standards in English Language shall be made available on request.

	Standard No.	Title
1.	IEC 60060:2023SER	High Voltage Test Techniques
2.	IEC 60071:2023 SER	Insulation Coordination
3.	IEC 61869-2:2012	Current Transformers
4.	IEC 61869-3:2011	Voltage Transformers
5.	IEC 60270:2000	High Voltage Test Techniques – Partial discharge measurements
6.	IEC 60137:2017	Insulated bushings for alternating voltage above 1000 Voltage
7.	IEC 60529:2019	Degree of Protection by enclosures
8.	IEC 62052-11:2020	Electricity Metering equipment (a.c) – General requirements tests and test conditions Part-11: Metering equipment
9.	IEC 62053-22:2020	Electricity Metering equipment (a.c) – Particular requirements Part 21: Static Meters for active energy (class 0.2s and 0.5s)

6.6. SERVICE CONDITIONS

The equipment shall be suitable for satisfactory continuous operation under the following tropical conditions:

a.	Location	Anywhere in Nigeria
b.	Maximum ambient air temperature	60°C
c.	Minimum ambient temperature	-10°C
d.	Maximum relative humidity	96%
e.	Minimum relative humidity	10%
f.	Maximum height above mean sea level	Up to 100 meters

6.7. GENERAL TECHNICAL REQUIREMENTS FOR CUBICLE:

The Metering cubicle shall be installed electrically in between the incoming supply point and the step-down transformer of Customer's installation. The Metering cubicle shall be provided with the following components suitably mounted:

(i) 3nos. 11kV / 33kV Class 0.5 current transformers (CTs) as per the specification
(ii) 3nos. 11kV / 33kV Class 0.5 voltage transformers (VTs) as per the specification
(iii) 1no. Test Terminal Block with transparent extended cover.
(iv) 1no. Three phase four wire HT energy Meter as per the specification.
(v) 1no. space heater.
(vi) Tinned copper bus bars/connecting links totally covered by resin castings.
(vii) Secondary wires from the terminals of CTs and VTs in the CT/VT compartment shall be covered by resin cast blocks and the secondary wires shall be brought in the Metering compartment through rubber bushing and shall be left open duly crimped with suitable pin type copper lugs.

(viii) Mounting plate for resin cast bushings. Bushings shall have suitable arrangement to receive cable terminations for incoming and outgoing cables.
(ix) Adequate nos. of PVC cable glands to receive incoming and/or outgoing cables
(x) Screws with sealing arrangement

6.8. CONSTRUCTIONAL FEATURES OF THE CABINET:

The Metering cubicle shall consist of four metal enclosed compartments as follows:

(i) Incoming Cable termination compartment
(ii) Outgoing Cable termination compartment
(iii) CT / VT. Compartment
(iv) Meter compartment

6.9. Cable Compartment:

(i) Cable compartments for housing purchaser's cable terminations shall be provided on either side.
(ii) Detachable 6mm aluminium gland plate (Two nos.) shall be provided, at the bottom sides of this compartments for accommodating 11/33 kV XLPE 3-core cables (120 mm^2 to 300 mm^2)
(iii) Detachable covers shall be provided on sides of this compartment with sealing provision.
(iv) The gland plate shall have provision to clamp 230V power supply cable for space heater.
(v) Detachable cover for incoming and outgoing cable termination compartment shall be suitably identified.

6.10. CT/VT Compartment:

(i) Three nos. CTs and Three nos. VTs and six nos. resin cast bushings shall be mounted in this compartment. Board for mounting resin cast bushing shall be provided and the bushings shall be mounted on the two sides leading to two cable compartments.
(ii) The inside terminal of these resin cast bushings, the primary terminals of CTs and primary terminals of VTs shall be connected by 25mm X 6mm size links of electrolytic grade tinned copper. All the terminals and links shall be covered by resin casting in rectangular blocks so that no HT part is accessible.
(iii) The secondary wiring of CTs and VTs shall be carried out by 110 volts grade standard single core copper cable of 4mm^2 (multi-strand) for CTs and 2.5mm^2(single core) for VTs. Other ends of these wires shall be brought to the Meter compartment, crimped with suitable pin type copper lugs. Entire wiring of cubicle except in the Meter compartment shall be covered by resin casting in rectangular block so as to not to have easy access without breaking resin casting.
(iv) The CTs and VTs shall be firmly mounted in this compartment as per the enclosed drawing. Additional support, if necessary, may be provided for mounting CT/VT to provide required strength.
(v) The CT/VT compartment shall be provided with detachable front cover with sealing provision.

(vi) As the CT/VTs incorporated in the cubicles are of resin cast type, ventilation for sufficient air circulation will have to be provided in accordance with the drawing.

(vii) One 20W, 230V space heater shall be mounted in this compartment. A 3pin, 230V 5A socket shall be provided for connecting space heater. A two core 6 mm^2 cable of 300mm length shall be provided passing to the lower compartment and gland plate for connection to the Customers' 230V supply.

(viii) Danger board and manufacturer's name shall be engraved on the front cover

6.11. Meter Compartment:

(i) Meter compartment with front hinged cover shall be provided on front side of the CT/VT compartment. Cover shall have provision to have two seals.

(ii) Meter compartment shall house one no. Test Terminal Block and One No. Energy Meter as per the specification. Test terminal block shall be with sealable extended transparent cover so that any tampering/unauthorized is visible.

(iii) Meter compartment shall have toughened glass window of size 110 mm x 175mm for easy viewing of meter display. Window shall be lined with weatherproof neoprene rubber gasket arrangement which shall prevent any ingress of rain water. Screws, bolts and nuts for fixing glass window shall be provided to shield the glass from sun rays and mechanical damages.

(iv) Meter compartment shall have suitable actuator arrangement for Meter push button such that Meter displays are cycled without opening the detachable cover.

(v) Meter compartment shall have suitable arrangement such that Meter can be read by connecting RS-232 cable or CMRI for electronic reading of the Meter without removing the hinged cover.

(vi) Meter compartment shall have suitable arrangement such that Meter can be powered up for reading in absence of mains supply without opening the hinged compartment cover.

(vii) Sloping roof shall be provided so that rain water does not stay.

(viii) The door shall be provided with non-resettable mechanical impulse counter to monitor the number of times the door has been opened.

(ix) The door shall be supported by strong, heavy duty concealed type hinges such that hinges are not accessible from outside.

(x) The name of the utility company of lettering 10 mm height shall be punched /embossed on the door.

6.12. METERING CUBICLE General Features:

(i) The door and covers shall be designed such that the edges of the hinged/detachable cover seal on the rubber gaskets provided in the main body of the metal cabinet.

(ii) The Metering cubicle shall comprise rigid welded structural frame enclosed completely by Mild Steel sheets of not less that 2mm thickness. Structural frame and supporting angles shall be of M.S. angle of size 50x50x5 mm minimum. All the compartments of the cubicle shall be

welded from inside and detachable covers/components shall be bolted. The fabrication of cubicle shall be such that there is no ingress of water. Air vents shall be provided on the panel sides for the panel ventilation in a manner as to prevent rain water ingress.

(iii) All doors and removable covers shall be gasketed all around with neoprene rubber gasket and the Metering cubicle shall meet the requirements of IP-55 protection as per IEC-60529:2019, if the air vents are closed.

(iv) The Metering cubicle shall be mounted on concrete plinth of 300mm height. Legs shall be of size 75mm x 75mm x 5mm. A bottom frame of M.S. angles as shown in the drawings shall be provided, duly welded for mounting the cubicle on the plinth.

(v) Four lifting hooks of suitable size shall be provided at the top for lifting the cubicle.

(vi) The Metering cubicle shall be painted after proper cleaning as follows and the painting performance should be guaranteed for a period of not less than 5 years:

	Paint Type		**No. of coats**	**Total Dry film thickness (min)**
1.	Thermo-setting paint.		01	20 microns
			01	60 microns
2.	Liquid paint			
	a)	Zinc chromate (primer)	01	30 microns
	b)	Polyurethane (Finish coat)	02	25 microns each.

6.13. METERING CUBICLE EARTHING:

(i) Five independent Galvanized Iron bolts of at least M10 size shall be provided on sides so that the inside and outside earthing can be done. It shall be firmly welded to the sides.

(ii) An earthing bus of copper strip of size 25 x 3 mm shall be provided and extended throughout the length of the Metering cubicle. It shall be bolted/brazed to the framework at two points. VT earthing may be made at two locations by 25 x 3 mm copper strips.

(iii) All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus.

(iv) Hinged door shall be earthed through flexible earthing braid.

6.14. METERING CUBICLE CABLE GLANDS:

(i) The size of 11kV/33kV power cable glands being arranged by the purchaser for incoming and or outgoing supply shall be 120 mm^2 to 300 mm^2.

(ii) The bushings shall be suitable for double bolt connection of H.T. cable lugs.

(iii) Two sets of one plain washer and one cup washer and two nuts and one bolt shall be provided for the incoming/outgoing cable connections.

(iv) There shall also include necessary numbers of heavy duty PVC cable glands for terminating 11kV / 33kV power cables.

6.15. METERING CUBICLES/PANELS ELECTRICAL EQUIPMENT: INSTRUMENT TRANSFORMERS

6.15.1. General Requirements of Electrical Equipment are mentioned here under:

(i) The Current Transformers and Voltage transformers shall conform to the requirements stipulated in relevant applicable standards.

(ii) The CTs and VTs shall be of resin cast type (Insulation Class "E") and shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings specified. These shall be completely encapsulated.

(iii) The resin used for manufacture of CT/VT and bushings shall be of reputed make and resin casting shall be carried out under vacuum and hot setting process only. Cold setting resin may be used for casting over complete inside wiring, connecting strip on HV side.

(iv) Instrument transformer shall have polarity marks indelibly marked on each transformer and at the associated terminal block.

(v) Each CT/VT shall be of the single-phase type.

(vi) Core lamination shall be of high-grade steel or other equivalent alloy.

(vii) Name plates showing particular connection diagram shall be provided. They shall be made of non-corrosive material, shall be indelibly punched or marked and shall be firmly fixed on to body of instrument transformer CTs and VTs shall be suitable for mounting on the cubicle.

6.16. METERING CUBICLE GENERAL SYSTEM AND PHYSICAL PARAMETERS

1.	Rated Voltage	11kV	33kV
2.	HT System Voltage	12kV	36kV
3.	Short Circuit withstand current and duration (kA rms 1 sec)		
	For 100/5A	13.1 kV	26.2 kV
	For 25/5A	6.7 kV	13.1 kV
	For 10/5A	3.0 kV	6.7 kV
	For 5/5A	3.0 kV	3.0 kV

1.	Type	Outdoor	Outdoor
2.	Rated Voltage	11kV	33kV
3.	Plate thickness		
	Side plate (mm)	2mm MS	2mm MS
	Bottom Gland plate (mm)	6 mm Aluminium	6 mm Aluminium
	Top Plate	2mm MS	2mm MS
	Front Plate	2mm MS	2mm MS
4.	Metering Cubicle	As per drawing	As per drawing
5.	Material	Mild Steel	Mild Steel
6.	Degree of Protection	IP 55	IP 55

7.	Minimum clearance in air inside cabinet		
	a) Between phase	250mm	350mm
	b) Between phase and earth	250mm	350mm
	BUSBAR CONNECTING STRIPS		
1.	Material	E.C. Grade Copper	E.C. Grade Copper
2.	Cross section rectangular	25mm x 6mm	Same as 11kV
3.	Minimum clearance		
	a) Between phase	250mm	350mm
	b) Between phase and earth	250mm	350mm
	TEST TERMINAL BLOCK		
1.	Type	3ph 4 Wire	3ph 4 Wire
2.	Cover	ETB	ETB
3.	Connection diagram	Pasted inside cover	Pasted inside cover

6.17. METERING CUBICLE CURRENT TRANSFORMERS

1.	Type	Single phase cast resin	Single phase cast resin
2.	Insulation Class	E	E
3.	Rated Voltage	11kV	33kV
4.	Rated Primary Current	5,10,25,50,100A etc.	15,25,50,100A etc.
5.	Rated Secondary Current	5A	1A
6.	Basic Insulation Level (kV) a. One-minute power frequency withstand voltage b. 1.2/50 microsecond impulse voltage (KVP)	12/28/75 28kV rms 75	36/70/170 70kV rms 170
7.	Rated continuous thermal current (Imax=200%)	2 x rated primary current	2 x rated primary current
8.	Burden (VA)	Not more than 10	Not more than 10
9.	Accuracy Class	0.5	0.5
10.	Instr. Sec. Factor	5 or less	5 or less
11.	Core details	Single Core	Single Core
12.	Short withstand current and duration (kA rms/sec) 100/5A 50/5A 25/5A 10/5A 5/5A	13.1kA 6.7kA 6.7kA 3.0kA 3.0kA	26.2kA 13.1kA 13.1kA 6.7kA 3.0kA
13.	Rated Dynamic Withstand current KVP	2.5 X STC	2.5 X STC
14.	Applicable standard	IEC61869-2:2012	IEC61869-2:2012

6.18. METERING CUBICLE VOLTAGE TRANSFORMERS

1.	Type	Single phase cast resin	Single phase cast resin
2.	Insulation Class	E	E
3.	Rated Voltage	11kV	33kV
4.	Rated Primary Current	5,10,25,50,100A etc.	15,25,50,100A, etc.
5.	Rated Secondary Current	5A	1A
6.	Basic Insulation Level (kV) a. One-minute power frequency withstand voltage b. 1.2/50 microsecond impulse voltage (KVP)	12/28/75 28kV 75	36/70/170 70kV 170

7.	Burden	Not more than 10	Not more than 10
8.	Accuracy Class	0.5	0.5
9.	Instr. Sec. Factor	5 or less	5 or less
10.	Core details	Single core	Single core
11.	Ratio	11kV/√3/110/√3	33kV/√3/110/√3
12.	Applicable Standard	IEC61869-2:2012	IEC61869-2:2012

6.19. METERING CUBICLE BUSHINGS

(i) Bushing shall conform to the requirements stipulated in relevant applicable standards.
(ii) A total of Epoxy moulded bushing shall be provided for cable termination and provide connection through the Current and Voltage Transformers.
(iii) Connecting rod will be part of the bushings.

6.20. METERING CUBICLE TEST TERMINAL BLOCKS

(i) 1no. 3 phase 4 wire type Test Terminal block shall be provided in each Metering cubicle.
(ii) Test terminal block shall be provided with extended transparent terminal cover.
(iii) Connection diagram shall be visible and pasted inside the transparent cover.
(iv) Wiring to the Test Terminal block shall be properly marked through ferrules.

6.21. METERING CUBICLE ENERGY METER

Each metering cubicle shall be provided with Class 0.5S accuracy CT/VT operated static 110V three vector meters for tariff purpose and as required.

6.22. LT MD METERING PANELS

Type	Outdoor
Dimension	Spacious enough to accommodate meter, CTs, test terminal block and cablings
Material	Mild steel (or equivalent) of not less than 2mm Thickness
Rated Voltage	400Volt
Panel front Cover	Hinged lockable door with 2 keys and 2 sealing provisions.
Glass Window	There shall be a window on the panel door with toughened glass of 110mm x 75mm minimum dimension for easy viewing of Meter display. The window is also to be lined with weatherproof neoprene rubber gasket arrangement to prevent rain water ingress.
Rain protection	The panel top is to be sloppy to prevent rain water ingress

Sealable optical port window	A window for RS 232/485 port to be provided on the front cover/door for electronic reading of the Meter with Hand Held Unit without the need for opening the hinged door.
Anti- corrosion protection	The panel shall have adequate protective coating using strong anti-corrosion material.
Power-up window	There shall be provision on the panel door for powering the Meter up for reading during power failure without the need for opening the door.
Panel earthing	Grounding bolts for earthing the panel with minimum of 4mm^2 stranded copper wires be provided on the panel side.
Hinged door earthing	The door is to be earthed through flexible braid.
Cable entry and exit holes	8nos holes of 600mm^2 to be fitted with PVC cable glands to be provided on the panel bottom for power cable entry and exit.
Mounting holes	4nos mounting holes of 8mm minimum diameter to be provided on the panel back for mounting the panel on to the concrete wall. The 2 upper mounting holes shall be so bored as to enable the slot-hanging of the panel with mounting self –expanding screws.
Panel ventilation	Air vents shall be provided on the panel sides for the panel ventilation in a manner as to prevent rain water ingress.
Cable clearance	There shall be a minimum clearance between power cables within the panel enough to prevent any electrical short circuit between phases of supply
Degree of protection	As applicable to switchgears operating on 400V

6.23. TECHNICAL SPECIFICATION FOR NON-MD METER BOXES

This specification covers design and manufacturing of Polycarbonate/Bakelite Meter Box. The Meter Box shall be suitable for housing Single Phase /Three Phase Energy Meters on wall mounting in indoor as well as outdoor applications.

6.23.1 DESIGN & CONSTRUCTION:

The meter box shall be so constructed as to have roof tapering down on both sides for easy flow of rainwater for outdoor while flat roof for indoor. It should be prepared by using 100% Polycarbonate or Bakelite material. The box shall be totally polycarbonate/Bakelite material natural white in colour and weatherproof, unbreakable, scratch resistant having good workmanship.

6.23.2 The meter box shall be made of anti-corrosive, dust proof, rust proof, vermin and waterproof, ultraviolet stabilized and flame-retardant, high-grade polycarbonate/Bakelite material having good dielectric and mechanical strength property.

6.23.3 The minimum inside dimensions of the meter box shall be suitable for installation of all types of meters purchased from various meter manufacturers.

6.23.4 The three-phase meter box shall be such that there shall be minimum 100 mm clearance at the bottom, 75 mm clearance on all three sides, 25 mm clearance at the front and 10 mm clearance at the back between meter and meter box inner wall.

6.23.5 The single-phase Meter box shall be such that there shall be minimum 60 mm clearance at the bottom, 40 mm clearance on all three sides, 25 mm clearance at the front and 10mm clearance at the back between meter and meter box inner wall.

6.23.6 The wall thickness of the meter box base shall be minimum 3 mm and cover shall be minimum 2 mm. It should have its base raised by about 10 mm in the box for easy wiring and fixing of the Meter. The Meter screws shall not protrude outside.

6.23.7 Minimum Internal Dimensions of the Meter box shall be as follows, when box is kept vertical.

6.23.8 Single Phase Meter Box: 260 mm (H) x 190 mm (W) x 120 mm (B)

6.23.9 Three Phase Meter Box: 485 mm (H) x 340 mm (W) x 185 mm (B).

6.23.10 The tolerance permissible on the various dimensions of the meter box shall be + 1%.

6.23.11 The base and cover of Meter box shall be individually in one piece except for fixing of accessories like push fit clamps, handles, meter mounting, etc and all metal parts excluding hardware shall be of stainless steel only.

6.23.12 The base and cover must be ultraviolet stabilized to ensure that it does not get 'Yellow' over a period. The base and cover shall be capable of withstanding temperature of boiling water for five minutes continuously without distortion or softening.

6.23.13 The cover shall be made overlapping type having collars on all four sides. The cover of Meter box shall have 4 nos. of non-detachable self-locking push fit type arrangement. It shall have suitable non-detachable fitting to base such that if pushed once inside, the cover shall rest on the base of box in such a way that any access from outside to the Meter is not possible.

6.23.14 The cover in closed position shall be overlapped on base such that direct entry of screwdriver, tool or film is not possible. The cover shall be provided with semi-circular/circular gasket of sufficient size to completely fit to the base. The gasket shall be made from good quality neoprene rubber.

6.23.15 The cover of Transparent Polycarbonate Material shall have light transmission of 80% or more. This will facilitate photometer reading as well as transparency.

6.23.16 Meter Box Base and cover shall have minimum 2 Nos. matching wire Sealing holes for sealing purposes.

6.23.17 Meter box shall conform to IP-54.

6.23.18 The mounting arrangement of the Meter in the meter box shall be by way of adjustable slotted stainless-steel strips of thickness 3 mm which shall be fixed on the base by providing raised groove with internal threads and 4 Nos. of 4mm diameter, 8 mm long full thread screws to suit mounting of various make of Meters.

6.23.19 4nos. of keyholes of diameter 6 mm shall be provided at the backside of the Meter box to facilitate mounting of the Meter box on the wall or pole. 4 nos. of 75 mm long, 6 mm diameter mounting screws with washers shall be provided along with the Meter box.

6.23.20 Pole mounted box shall be provided with 4 (four) nos. grooves at the top and bottom of the box with diameter of 6 mm minimum. The grooves shall be inseparable from the box.

6.23.21 2nos. of holes with polymeric material collapsible glands of maximum diameter of 12 mm for single phase and 25 mm for three phase Meters shall be provided at the bottom of Meter box base for incoming and outgoing cables.

6.23.22 The surface appearance or part of Meter box must be smooth, nonporous and homogeneous, free from ripples, defects and marks. No fillers or fibres should be visible at any place.

	Specifications/Requirements	
1.	Applicable Standards	The Meter Box shall comply with the requirements of the following Standards: IEC 60670-1:2015 (Boxes and Enclosures for electrical accessories for household and similar fixed electrical Installation: General Requirements). IEC 60670-24:2011 (Boxes and Enclosures for electrical accessories for household and similar fixed electrical Installation: Particular Requirements). IEC 60529:2019(Degree of Protection by the Enclosure). IEC 60695-2-13:2021 (Fire Hazard Testing-Glow-wire Ignition Temperature Test Methods for Materials).
2.	Material	The Meter box shall be made of Polycarbonate or heat retardant material with transparent window or cover.

3.	IP Rating	The Meter box shall be of minimum rating of IP54.
4.	Marking	The name plate of the Meter Box shall be marked with: Name, trademark or identification mark of the manufacturer.
5.	Protection against access to hazardous parts	The Meter box shall adequately have protection against access to hazardous parts according to the requirements of IEC 60529:2019.
6.	Degree of Protection against Jet of Water and Dust.	The Meter box is adequately protected against dust and jets of water according to the requirements of IEC 60529:2019.
7.	Mechanical Strength	The Meter box shall have adequate mechanical strength according to IEC 60670-24:2011.
8.	Cable Gland	The Meter box shall have adequate provision for cable gland.

6.24. TECHNICAL SPECIFICATION FOR MINIATURE CIRCUIT BREAKER (MCB) SINGLE & THREE PHASE

6.25. BASIC REQUIREMENT

The Miniature Circuit Breaker shall be used in place of service cut-outs to provide over-current and short circuit protection in all single and three phase residential premises. It shall be a compact electromechanical device for making, breaking and disconnecting a circuit in normal conditions as well as in abnormal conditions such as those of over current and short circuit.

6.26. The Miniature circuit breaker shall be of wire-in, wire-out type basically comprising the following features;

(i) Independent Manually operated latched switching mechanism with trip free release
(ii) Arc-quenching chamber
(iii) Instantaneous short circuit protection
(iv) Safe disconnection of load from source

6.27. The Single-Phase Miniature Circuit Breaker shall be of two (2) pole type suitable for operating on 230V supply and Three Phase Miniature circuit breaker shall be of four (4) pole type suitable for operating on 400V supply. The MCB shall be suitable for panel / surface mounting with screws as necessary.

6.28. GENERAL PROPERTIES

The MCBs shall have the following properties:

	PARAMETER	TECHNICAL REQUIREMENT
1.	Rated Current	I_n = 30A, 45A, 60A
2.	Rated Voltage	V_n = 230V for single phase (single pole), 400V for three phase (three pole)
3.	System highest voltage	3ph and neutral 400/230V+10%V_n
4.	System Frequency	50Hz
5.	System fault current rating	25kA (max.)
6.	Maximum ambient temperature	40°c
7.	Relative humidity	96% Non-Condensing
8.	Environmental Condition	Humid tropical climate
9.	Standard	IEC 60898-1:2015
10.	Rated Impulse Withstand Voltage1.2/50µs	6.0 kV peak
11.	Clearance between open contacts	13mm(min)
12.	Overload tripping Current	120%I_n
13.	Instantaneous tripping	Between 10 and 12I_n
14.	No of poles	Two pole / Four pole
15.	Terminal Holes	Adequate to accommodate 16mm^2 service cable
16.	Operational Performance Capability	10,000 Nos. of operating cycles

6.29. DATA MONITOR

This device is a super analyser that can be installed on transformers to monitor, identify and communicate to the utility and do the following:

(i) Send Automatic notification by text or email to relevant utility personnel of power outage, outage on phase, voltage drop on one or multiple phases with date and time stamp;
(ii) Determine current (load) and power factor on each phase;
(iii) Determine frequency and voltage on each phase, active and reactive energy on each phase, active load on each phase, active apparent power, maximum demand, maximum demand reactive and phase angle; and
(iv) Determine total power consumption on an hourly basis 24/7.

This shall have the following basic features:

FUNCTION/FEATURE	TECHNICAL REQUIREMENT
Reference Voltage	3X230/400V
Frequency	50Hz±2%
In voltage Circuit	≤ 10VA
In current Circuit	≤ 2.5VA
Specified operation	-25°C to +60°C

Limited operation	-40°C to +70°C
Humidity	≤ 95%
Impermeability to IEC60529	IP54
Accuracy	<0.5s/d
Backup time	15 years
Impulse Voltage	IEC 62052-11
Voltage Value	6kV
LCD	Dot matrix
Surges	IEC 61000-4-4
Optical Interface	IEC 62056-21
RS485 Interface	ISO-8482
PLC Interface	Narrow band
GPRS Interface	TCP/UDP
LAN	Communication with centre station
USB Interface	Used for Software download
Flash size	256MB
Weight	Approx. 3.2kg
Dimensions (LXWXD)	290mmX180mmX95mm
Electrostatic Discharges	To IEC 61000-4-2
Contact discharge	10kV
Electromagnetic RF Fields	IEC 61000-4-3
Fast transient burst	IEC 61000-4-4
Conducted Voltage induced by radio-frequency	IEC 61000-4-5

6.30. PROGRAMABLE LOSS CONTROL DEVICE:

This device can be pole mounted on each customer's service line to do the following:

(i) Automatic notification by text or email to relevant utility personnel on loss of voltage, loss of current, power overload, power reversed, under voltage, current

(ii) unbalance, loss of phase, reversed power overload, overcurrent, overvoltage, low power factor etc. on the electricity distribution network;

(iii) The sensor detects and locates network faults and technical losses. Working on a one-to-one basis with each meter, this device installed on the pole monitors and controls energy theft by constantly auditing and comparing electricity passing through the device with consumption of the customer's meter for discrepancies signalling theft or meter tampering. This event causes the sensor to remotely and automatically disconnect electricity supply to the customer to ensure 100% anti-theft protection for the utility.

This shall have the following basic features as stated below:

FUNCTION/FEATURE	**TECHNICAL REQUIREMENT**
Reference Voltage	3X230/400V
Frequency	50Hz±2%
Basic current	5A
Starting Current	0.4%I_b 40mA
Burden	Less than 2VA in voltage circuit and 1VA for current circuit
Specified operation	-20°C to +60°C
Limited operation	-25°C to +70°C
Storage range	-25°C to +70°C
Accuracy	0.5
Temperature Range	IEC 62052-11:2020
Humidity	≤95%
Protection Class	IP54
Back up Time	Greater than 15 years
Battery Type	Lithium
Battery Capacity	Greater than or equal to 1.2Ah
Electrostatic Contact Discharge	10kV, according to IEC 61000-4-2:2008
Electromagnetic RF Fields	80MHz...2GHz, 10 and 30V/m, according to IEC 61000-4-3
Fast Transient Burst	Voltage and Current Circuits: 4kV; Auxiliary Circuits: > 40V 2kV, according to IEC 61000-4-4:2012
Surges	Voltage and Current Circuits: 6kV; Auxiliary Circuits: > 40V 2kV, according to IEC 61000-4-5:2014
Conducted Voltage Induced by Radio-Frequency Field	150kHz to 80MHz 10V, according to IEC 61000-4-6:2013
Radio Interference Suppression	IEC60939-2-2:2004,
Magnetic field immunity	>300mT
Inputs & Outputs	

Optical Verification Output	Red LED, representing kWh, Pulse Length: 80ms±20ms
Electric Output	Infrared Opto-coupler
Meter Constant	800 imp/ kWh
Alarm Output	Red LED (Relay Control Error, Battery Low, Memory Error, Real-Time-Clock (RTC) Error, Power Load Exceeds Limit, Over Voltage, Power Factor Is Less Than Limit, Direction of Active Energy Has Changed, Remaining Credit Value Less than Configurable Limit – Level 1 and Level 2)
Communication Indication	Green LED
Load Switch - Disconnection Device	
Type	Inbuilt Latching Relay
Maximum Current	120 A
Disconnect/Reconnect	Local and Remote Control
Status Indication	LED
Measurement Function	
Energy Measurement	Import (Positive) Active Energy (+A), Export (Negative) Active Energy (-A). Option to Measure Combined Active Energy with |+A| +|-A| or |+A|-|-A|. In situation with both Import and Export of Active Energy, When Renewal Energy Is Used (PV, Wind Energy, etc.), the Meter Will Be Set To Measure +A, and –A Individually.
Power Quality	RMS Voltage, RMS Current of Line, Frequency, Power, Power Factor (PF)
Event Logging	
Parameterization	Record of total number and 10 most recent occurrences of parameterization, with date/ time stamp and event data ID. This shall be programmable.
Time Synchronization	Record of total number and 10 most recent occurrences of Real Time Clock (RTC) synchronization events, with date/time stamp before and after synchronization.
Power Fail	The phase current is less than 5%In, or phase voltage is less than a voltage threshold, and this status was sustained for a configurable period, a Power Fail event is record. Voltage Threshold: 65% to 80%Un (Default value: 75%Un). Period: 1 to 99 seconds (Default value: 60 seconds). Record of

	total number and 10 most recent occurrences of Power Fail events, with date/ time stamp of start and end of event. This shall be programmable.
Over Voltage	The phase voltage is more than a voltage threshold and sustained was sustained for a configurable period, an Over Voltage events is recorded. Voltage threshold: 105% to 115%Un (Default value: 110%Un). Period: 1 to 3600 seconds (Default value: 60 seconds). Record of total number and 10 most recent occurrences of Over Voltage events, with date/time stamp of start and end of event and the maximum voltage value during the period. This shall be programmable.
Under Voltage	The phase voltage is less than a voltage threshold and sustained for a configurable period, an Under Voltage event is recorded. Voltage threshold: 85% to 95%Un (Default value: 90%Un). Period: 1 to 3600 seconds (Default value: 60 seconds). Record of total number and 10 most recent occurrences of Under Voltage events, with date/time stamp of start and end of event and the minimum voltage value during the period. This shall be programmable.
Load Switch Disconnection/ Reconnection	Record of total number and 10 most recent occurrences of load switch disconnection/ reconnection, with date/ time stamp and energy data records (total import and export energy data, data block) at start and end of event. This shall be programmable.
Prepayment Token Credit Input	Record of total number and 10 most recent occurrences of Prepayment Token Input, it includes date/time stamp, token numbers, electricity value of each token input, remaining electricity value before and after each token input, and the accumulated electricity value that has been recharged after each input. This shall be programmable.
Event Record Reset	Record of total number and 10 most recent occurrences of Event Record Reset, it includes date/time stamp and event data ID. This shall be programmable.
Energy Value Reset	Record of total number and 10 most recent occurrences of Energy Value Reset, it includes date/time stamp, the energy data records (total import and export energy data) at the time of event. This shall be programmable.
TARIFFS	
TIME OF USE (TOU)	4 Tariffs (T1 - Peak, T2 - Standard, T3 – Off Peak, T4 – Sharp-Peak), with two sets of tables for day, week, and year. Each table includes at least 2

	time zones per year, 8 possible tier switches per day, with holiday, weekend, Saturday and Sunday schedules. There is maximum of 128 holidays in the Holiday Table, and the dates can be entered and stored for up to several years. After receiving Switch Over commands (indicating the activation time in the future for updated tables), the meter will detect and switch to the updated set of Day/Week/Year Tables on this activation date and time automatically. The Tables can be uploaded to the meter via the two wire/PLC interface locally or via remote communications from the AMI system. This shall be programmable.
Step Tariff	4 Tariffs (T1 - Peak, T2 - Standard, T3 – Off-peak, T4 – Sharp-Peak), with two sets of tables for day, week, and year. Each table includes at least 2 time zones per year, 8 possible tier switches per day, with holiday, weekend, Saturday and Sunday schedules. There is maximum of 128 holidays in the Holiday Table, and the dates can be entered and stored for up to several years. After receiving Switch Over commands (indicating the activation time in the future for updated tables), the meter will detect and switch to the updated set of Day/Week/Year Tables on this activation date and time automatically. The Tables can be uploaded to the meter via the two wire/PLC interface locally or via remote communications from the AMI system. This shall be programmable.
Renewal Energy special Tariff	Separate tariff setting (import and export) for energy metering when renewal energy is used (PV, wind Energy etc.). This shall be programmable.
Billing Related Data Storage	Supports up to 3 different billing dates in a month simultaneously to adapt to different billing requirements. For example, the 1st of the month and 15th of the month. At the end of each billing period, the meter will store the total combined, imported and exported active energy for all available tariff rates. The meter is also able to store import (positive) active energy data of a configurable integration period (typical intervals are 15, 30 and 60 minutes). It can cater for storing import (positive) active energy date for a period of at least 90 days over a 30 minutes' integration period. The data is stored into non-volatile memory. During a power outage situation, all data is retained for at least 15 years. This shall be programmable.

Demand Response (Load Limitation	
Normal limit	The meter can detect Power Load Limit thresholds and disconnect and reconnect the load automatically if the power exceeds the Load Limit Value threshold value over a designated time period. When the average kW demand across the configurable period (between 1 min to 60 min) is greater than the demand limit (between 1 kW to 25 kW in increments of 0.01 kW), the load is disconnected for a period of a configurable period (settable from 1 min to 60 min). The AMI system can remotely configure the Normal Limit by either groups of meters, or by commands sent to individual meters. The meter can be configured with five sets of Normal Limit time periods per week day and five sets of time periods per weekend day. It can function automatically during certain time periods of the day (for example during peak tariff periods).
On Demand Limit (Critical Status)	The On-demand Limit functions as explained in Normal Limit (above), with the only difference the lower setting in kW demand. When activated, the On-demand Limit takes precedence over Normal Limit settings. The On-demand Limit can be de-activated by commands from the Master Station, or the meter automatically reverts back to its normal limit mode after a configurable time (between 1 h to 24 h) from receiving the On demand Limit command. With the ability to group Customers (i.e. by customer type or area location), a single load limitation command is sent to a certain group and within seconds all group load will be limited (each customer a different predefined value). For example, only those customers specified as industrial with capacity over a certain amount, or only those households consuming an excessive amount. During critical status when transformer is supplying near maximum capacity (I critical), select customers may be limited at varying power levels. I.e. automatic disconnection above 60 amps. Certain category groups of customers may be defined as exempt from load limitations (frail/elderly and emergency services).
Under Frequency Control	Using the closed loop "under-frequency" circuitry installed, the meters continuously monitor frequencies and react within 100 ms to 5000 ms (locally and remotely configurable) to frequency variations exceeding a configurable value, by automatically disconnecting load. Reconnection is subject to a configurable time delay, after the

	meter has detected that the supply frequency has reached the configurable "restore load" frequency limit. The random switch on delay shall be retriggered in the event of a second low frequency event within the delay window. Each Customer or group of Customers can be predefined by a different frequency value, with all automatic disconnection and reconnection levels remotely configurable. The under-frequency thresholds can be configured randomly ensuring black-outs will not affect the same Customers.
COMMUNICATION	
Optical Interface	Infrared (IR) Default Baud Rate: 1200bps Serial, Bidirectional, Half Duplex Protocol: IEC62056-21 or DL/T 645-2007 Communications Distance: ≥3m
DCPLC (Serial, Bi-directional, Twisted-Pair Cable) – option	Power supply to Customer Interface Unit (CIU): DC 12V, 30mA Default Baud Rate: 2400bps Maximum Baud Rate: 4800bps Protocol: DLMS or DL/T 645-2007 Communications Distance (2400bps): ≤250m
Power Line Communications (PLC)	Type: Narrowband Default Baud Rate: 2,400bps Communications Distance(point to point): up to 2km 1km 3 Levels Intelligent Relay: More than 1,500m Module Design (option): Hot Plug-in Function Protocol: DLMS or DL/T 645-2007
Firmware Upgrade	Remote firmware upgrade through AMI communication.
Credit or Prepayment Mode	Supports prepayment and credit mode upon remote configuration. By default, the meter will operate in credit mode before input of prepayment token. After input of prepayment token, the meter will operate in prepayment mode automatically.
Options to Set Parameters According to Each Customer (or Group) Profile	-Set friendly "over-draft" credit. A small amount of emergency credit, so that customers can avoid loss of service in the middle of the night. The average amount can be immediately subtracted from the next payment. Another option in the case that the customer did not pay on-time is to allow the customer to consume small amounts of energy (only for lights and refrigerator) before full disconnection. -Option to not automatically disconnect on weekends or holidays. -Flagging of accounts for "critical need" or "lifeline" customers (who use, for instance, vital breathing equipment), so that disconnection does not endanger health and safety.
Download of Credit to the Meter	Supports the ability to download money and not just kWh into the meter. Remote crediting of

	prepayment tokens through two-way communication
Prepayment Security	Unique additional key structure within the STS protocol encryption methodology overcomes the challenge relating to illegal vending of STS tokens observed in other meters. Automatic remote verification with the Master Station ensures that each loading of credit to the meter is backed up by a legal transaction.
OTHER DATA	
Weight	Approx. 0.28kg
Dimensions (LxWxD)	131mm x 46mm x 97 mm
Meter Life Time	Minimum of 15 years
Alarm Systems	All Alarm systems for the loss control devices (Aerial Sensor) shall be programmable

7 SCHEDULE G - GMC METERING CHARACTERISTICS: CLASSIFICATION OF CONNECTION POINTS AND LOCATION OF METERING SYSTEMS

7.1 GENERAL

7.1.1 This Section depicts, in the form of diagrams, the classification of types of connection points and the associated installation of Main and Check Metering Systems as specified in Sections 2.1 and 2.2 of the GMC. Fig. 1a shows Types 1, 2, 3, 4, 5 and 7 while Fig 1b shows Type 6 with their locations of Main, Redundant Check, and Verification Check Metering Systems.

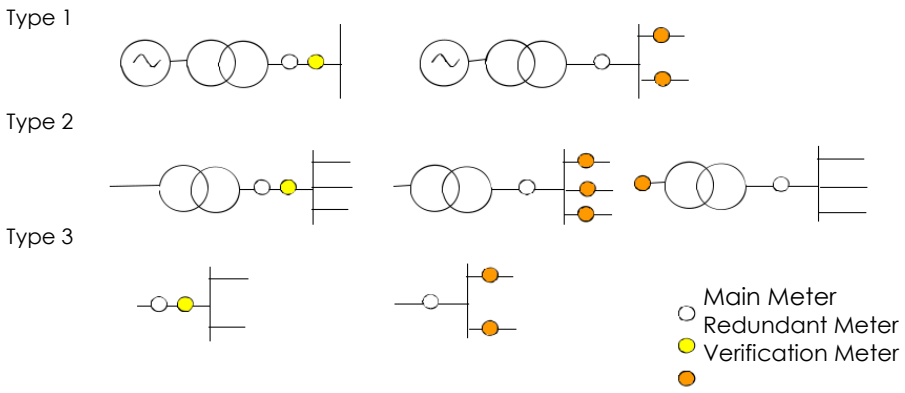


Fig 1a: Types of Connections and Meter Locations

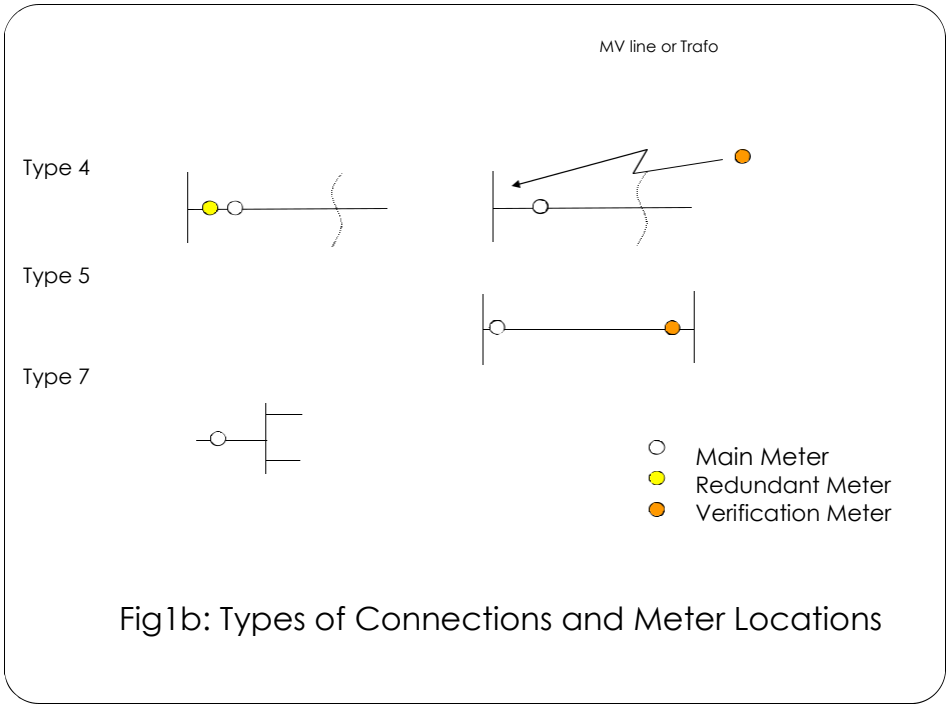
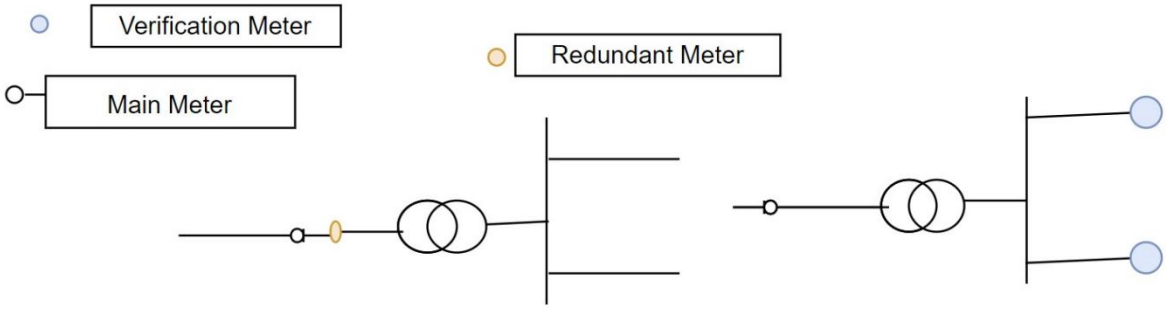


Fig1b: Types of Connections and Meter Locations



TYPE 6 CONNECTION AND METER LOCATION

8 SCHEDULE H - METER INSTALLATIONS

8.1. INSTALLATION STANDARDS

The following installation standards shall apply:

(i) Every Meter along with its auxiliary equipment shall be enclosed in a standard cubicle/box as in Schedule D.
(ii) Metering point shall be located on the incoming side of the customer's switch gear/miniature circuit breaker.
(iii) Where the Metering System is not mounted on a pole, it shall be mounted at a height of 1.8m on a board on a wall (at about an eye level) for ease of reading and maintenance while a split Customer unit if applicable will be mounted at the Customer's convenience at his cost.
(iv) The incoming service cable to the meter shall be visually traceable.
(v) The size of CT secondary cables shall be 4mm^2 (standard) for LV installation and 6mm^2 for H.T installation. V.T cable size shall be 4 mm^2.
(vi) All VT/CT secondary cables shall be numbered and ferruled for easy identification.
(vii) The size of the neutral cable shall be the same as the size of phase cables.
(viii) Correct connection must be ensured with the right polarity, phase association and phase sequence.
(ix) Joints in CT and VT cables shall be avoided.
(x) All CT and VT cable shall be dipped/tied properly.
(xi) In the case of outdoor CT and VT, the Meter shall be located as close as possible to the instrument transformers.
(xii) The class of the CT shall not be inferior to the associated Meter.
(xiii) All components of the metering system shall be sealed as specified in Schedule C.