



Nigeria

Metering Code

Version 01



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INTRODUCTION

The current report – “Metering Code Report. Ver.2” – corresponds to the Work Stream C – “Technical” deliverable (partial) established in the “Implementation of the Corporate Restructuring of the Power Holding Company of Nigeria PLC (PHCN)” project.

The Consultant has developed a second draft of the Metering Code, taking into account the comments received from the NERC to the first version.

Following chapters present the amended complete version of the code “Metering Code Version 2.1”

Changes from the previous version (Metering Code – Version 2.0) are highlighted using track changes.



METERING CODE

(Version 01)

METERING CODE

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METERING CODE

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PART 1: GENERAL CONDITIONS

1. SECTION: BACKGROUND

1.1. TITLE

1.1.1. This code shall be called the metering code (otherwise known as “MC”) for the Nigeria electricity supply industry.

1.2. NEW ARRANGEMENTS FOR THE NIGERIAN ELECTRICITY SECTOR

1.2.1. The Electric Power Sector Reform Act, 2005 (henceforth referred to as the act) gave legal backing to the unbundling of the Nigeria Power Sector. The act stipulates the functional unbundling of the 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 meters systems with reliable communication facilities shall be deployed across the industry production and supply chain to measure and record energy production and utilization.

1.3. THE METERING CODE

1.3.1. This metering code (MC) is divided in 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 the Transmission or Distribution Network. It caters for the Commercial Metering System. 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 the Distributor, in carrying out its obligation to provide metering services, for the metering of Customers of the Distribution System. The Distribution Metering Code 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. This Metering Code shall be read in conjunction with the Market Rules, the Grid Code, the Distribution Code and the Metering Market Procedures

2. SECTION: INTERPRETATION AND DEFINITIONS

2.1. INTERPRETATION

2.1.1. In this metering code (including the appendixes), unless the context otherwise specifies or requires:

- (a) references to "the Metering Code" or "this Metering Code" or "this Code" are a reference to the whole of the Metering Code, including any Appendixes or other documents attached to any part of this Metering Code;
- (b) the Appendixes shall be deemed to be part of this Metering Code;
- (c) capitalised words used shall have the meanings assigned to them in the Definition Condition of the General Conditions 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" refers to a rule, procedure, requirement or any provision of this Metering Code that requires mandatory compliance;
- (k) all references to a numbered Appendix, Section or Condition is respectively a reference to the Appendix, 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 Appendix
- (l) references to the consent or approval of the NERC shall be references to the approval or consent of the NERC in writing, which may be given subject to such conditions as may be determined by the NERC, 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 the NERC 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 NERC shall be construed to refer to such law, by-law, code, regulation made under any law, directive or other document issued by the NERC 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 capitalized word or expression defined in the Electric Power Sector Reform Act, 2005, 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 appendixes.

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

- **Act** means the Electric Power Sector Reform Act, 2005, as amended from time to time;
- **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**
- **Calibration Tests** means a series of tests and checks performed by an authorised Meter Test Station to determine that the accuracy of an existing Metering Installation is within the specifications of this MC. The NERC will issue directives and procedures regarding the Calibration Tests to be performed.
- **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 utilizing the Check Metering System
- **Check Metering System** means the Commercial Metering System which will be used by the Market Operator, 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.
- **Commercial Meter** means the Meter which measure the energy injected or withdrawn from the grid by a Participant, which will be used by the Market Operator in the Market Settlement process
- **Commercial 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 of the Market Operator.
- **Commission (NERC)** means the Nigerian Electricity Regulatory Commission (NERC) created in the Act;
- **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 connects to the system to inject or extract energy, and which will be considered its Market trading point for Market Settlement and energy commercial metering Transmission System
- **CT** is an acronym for current transformer
- **Data Collection System** means the data collection system operated by the Market Operator, for use in the Market Settlement
- **Data Registers** means the equipment which receives, registers and stores the information received from the **Meters**, and serves as a link to the remote reading. Data registers could be incorporated into the Meters itself or constitute a separated piece of equipment.
- **Distribution Company (Disco)** means a successor Distribution Company created in the restructuring of the PHCN, provided that until such companies are created it will refer to a distribution zone, or a person holding a Distribution Licence
- **Distribution Metering Code (DMC)** means Part 3 of this Code
- **Distribution Network** means any connection of cables, service lines and overhead lines, meters, electrical apparatus / equipment and having design voltage of 33 kV 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 33 KV and below, plus related system used in the safe operation of an Electricity Network.
- **Distributor** has the same meaning as Distribution Company
- **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 use to transport electric power on a Transmission or Distribution Network or both
- **Eligible Customer** has the meaning assigned to the term in the **Act**
- **Generation Station** means a facility with one or more Generation Units.
- **Generation Substation** means a substation in the Transmission Network or the Distribution Network, as corresponds, where Generators are connected.

- **Generator** means a Successor Generation Company, or an Independent Power Producer (IPP), or a Participant who is licensed to generate electricity under section 60 of the Act, including Successor Generation Companies and Independent Power Producers, and self-generation authorised by the Commission
- **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 hydro power plant will be considered a Generating Group unless 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
- **Grid Code** means the “grid code” as defined in the Act to be prepared by the System Operator, as amended from time to time in accordance with these Rules with the approval of the Commission
- **Grid Metering Code (GMC)** means Part 2 of this Code
- **High Voltage (HV)** means a voltage, used for the supply of electricity, whose lower limit of nominal root-mean-square value is greater than 33 kV
- **IEC** means International Electrotechnical Commission;
- **Large Connection** means a connection where the Connection Capacity is greater than [4 MVA] or connections with generation facilities greater than [300 kW].
- **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
- **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 utilizing the Main Metering System
- **Main Metering System** means the Commercial Metering System which will be used by the Market Operator as a prime reference for the measurement of the active or reactive energy interchanged at a Connection Point in Market Settlement process

- **Market Operator** means the company or entity licensed or authorized to provide market administration services and responsible for registration of Participants and commercial metering, collection and validation of meter data, the Market Settlement process the and market payment system
- **Market Rules** means the Market (Settlement) Rules for the Electricity Sector of Nigeria
- **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 [50 KVA] and up to and including [4MVA] where no generation facility greater than [50 kW] exists for an LV connection and no generation facility greater than [300 kW] 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 33 kV;
- **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 this Code
- **Metering Committee** has the meaning indicated in Section 3 of this Part.
- **Metering Installation**, in the DMC, means a Meter or Meters and their associated Metering Equipment, if exists, which is located at a definite Customer's location.
- **Meter Test Station** means a certified test laboratory which has the technical and infrastructure capability to perform accuracy tests for Meters and Metering Equipment.
- **Meter Type** means a specific and unique model of Meter of a specific manufacturer, identified by a definite trademark and type. Manufacturer's variants of a specific Meter model or trademark, or different options of a model as voltage or current ratings, storage capacity, etc., shall be considered, for purposes of this MC as different Meter Types.
- **Metering Equipment** means current transformers, voltage transformers, metering protection equipment including alarms and LV electrical circuitry, associated with a Meter, but shall be deemed to exclude the Meter itself.
- **Metering Market Procedures** has the meaning assigned to the term in the **Market Rules**
- **Metering System** means a **Meter** and the associated current transformers, voltage transformers, metering protection equipment including alarms, LV electrical circuitry, associated data collectors, data transmitters related to the measurement and recording and transmitting to **the Data Collection System** the active energy and/or reactive energy, as the case may be.

- **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
- **Power Transformer** means the transformers which interconnect the Transmission Network with the Distribution Networks, or the Transmission Network with the equipments or apparatus of an Eligible Customer.
- **Prepaid Meter** means a Meter that requires the Customer pay its consumption in advance in order to allow a connection to the network.
- **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 this MC. Routine Tests shall be performed to each individual Meter or Metering Equipment or by sampling of a group of Meters or Metering Equipments, as prescribed by NERC directives which will include sampling techniques and Routine Tests to be performed.

Routine Tests shall be performed to each individual Meter or Metering Equipment or by sampling of a group of Meters or Metering Equipments, as prescribed by NERC directives which will include sampling techniques and Routine Tests to be performed.

- **Station Auxiliary Transformer** means the transformer at a Generation Substation which feeds exclusively the auxiliary equipments of a Generation Unit or a Generation Group.
- **Step Up Transformer** means the transformer that connects the stator windings of a Generation Unit with the Transmission or Distribution Network, as corresponds.
- **System Operator** means the holder of a System Operation License, issued according Article 66 of the Act.
- **System Operator Controlled Grid** has the meaning assigned to the term in the Market Rules
- **Trader** means a holder of a Trading License, issued according to Article 68 of the Act.
- **Transmission Network** means any connection of High Voltage apparatus, equipment, lines, and stations, having design voltage of 132 KV and above used in transporting electric power on a Transmission System
- **Transmission Service Provider (TSP)** means a holder of a Transmission License, issued according to Article 65 of the Act.
- **Transmission System** means the System consisting of High Voltage apparatus, equipment, lines, and stations, having design voltage of 132 KV and above used in the safe operation of transmitting electrical power from

the generating station bus bars up to the interconnection point with the Distribution System. This shall not include any part of the Distribution System

- **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. The NERC will issue directives and procedures regarding the Type Tests to be performed to each Meter Type.
- **User**, in Part 1 General Conditions, means any person to which this MC applies, or has any type of interest in the outcomes resulting from this MC implementation.
- **Urgent Metering Services** means urgent unplanned work by a Distributor on a Metering System as a result of actual or potential equipment failure, actual or suspected tampering or suspected theft
- **VT** Is an acronym for voltage transformer

3. SECTION: REVIEW PROCESS AND DISPUTES

3.1. DISPUTES

3.1.1. 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 disputes procedure.

3.1.2. Any dispute in relation to the following matters:

- (a) Siting of the Commercial 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 technical specifications of this Metering Code;
- (e) Compensation values;
- (f) Such other matters as the relevant Parties may agree;

shall be referred to the Metering Committee 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).

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

3.1.4. The Metering Mommittee can demand 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.

3.1.5. The metering committee may make recommendations to nerc on the payment of cost or/and expenses to any party in respect of any dispute referred to it.

3.2. METERING COMMITEE

3.2.1. A Metering Committee shall be appointed for the purposes of this Metering Code. It will comprise:

- (a) One member representing PHCN successor Generation Companies
- (b) One member representing IPPs
- (c) Two members representing successor PHCN Distribution Companies
- (d) One member representing Meter manufacturers
- (e) One member from the Meter Instrument Laboratories
- (f) One member from the Market Operator
- (g) One member from TCN
- (h) One member from the Nigerian Electricity Regulatory Commission

- 3.2.2. Nominated representatives to the metering committee shall be competent staff of managerial status in the organization which they are representing.
- 3.2.3. The “Metering Committee” 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 NERC, Metering Committee member or User may wish to submit to the Metering Committee Chairman for consideration by the Metering Committee from time to time.
 - (c) Publish recommendations as to the amendments to the MC that the Metering Committee feels are 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
- 3.2.4. The Secretary of the Metering Committee 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 Metering Committee for discussion prior to such amendment.
- 3.2.5. Members of the Metering Committee shall be appointed, from time to time, by the relevant Party or Parties concerned for a period of two years, with the possibility of renewal. In default of appointment by the relevant Parties NERC shall have the right to appoint representatives from the Parties who have failed to appoint their own representatives. Members of the Metering Committee shall be required to enter into confidentiality undertakings in favour of all Parties in a form specified by the Grid Code Review Panel.
- 3.2.6. Decisions of the Metering Committee shall be made by voting of committee members attending any meeting. Each committee member shall have one vote. The chairman, where necessary, (and unless otherwise provided) shall have a casting vote. Five (5) committee members shall be a quorum for any meeting of the Metering Committee. No less than 5 Business Days notice of a meeting of the Metering Committee is required to be given to all committee members entitled to attend such meeting except in the case of an emergency meeting.
- 3.2.7. The chairman shall be elected by the Metering Committee from among its members.
- 3.2.8. The Metering Committee shall operate in accordance with such other rules and procedures as are laid down by it.
- 3.2.9. The Market Operator shall act as secretary of the Metering Committee for the purpose, inter alia, of giving and receiving of notices.

- 3.2.10. The Metering Committee decisions, except when it settles disputes, are not binding on the NERC, but shall have only the nature of an opinion. Any decision for amendment to the MC must be approved by the NERC and be published by the Market Operator in a manner agreed with the NERC.

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 Market Operator 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 Market Operator shall in good faith determine what is to be done and notify all Users affected.
- 3.3.2. The Market Operator shall promptly refer all such unforeseen circumstances and any determination to the Metering Committee 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 Market Operator shall prepare a proposal to correct the default referred to 3.4.1 and 3.4.2 for consideration by the Metering Committee.

PART 2: GRID METERING CODE

1. OBJECTIVES AND SCOPE

1.1. OBJECTIVE

1.1.1. The objectives of the Grid Metering Code are to establish:

- (a) The technical, design and operational procedure for of the Commercial Metering System
- (b) The required accuracy and calibration of the Commercial Metering System
- (c) The procedures for approval, certification and testing of the Meters and Metering Equipment
- (d) The standards to be met by Market and System Operators, the TSP and Users who have or plan to have access to the Transmission Network or MV Distribution Network, provided in the later case they are, or expect to be, Participants trading in the Wholesale Market.
- (e) The responsibilities of the Market Operator and Users in relation to ownership and management of Metering System and provision and use of metering data.

1.2. SCOPE

1.2.1. 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) The System Operator
 - (ii) The 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 non compliance 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 NERC 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. NERC 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 NERC shall inform the Market Operator of its decision within 20 calendar days of receipt of the Market Operator’s notification, provided that if the NERC does not answer within this timeframe, the Market Operator must consider that the opinion of the Market Operator has been accepted.
- 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 NERC or an Associated User.

2. SECTION: METERING REQUIREMENTS

2.1. TYPE OF CONNECTION POINTS

- 2.1.1. Commercial Metering Systems 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 exists between two or more Participants. This will comprise both Import and Export metering when reasonably required by the Market Operator.
- 2.1.2. Commercial Metering Systems comprises both the Main Metering System and the Check Metering System, when the later is required.
- 2.1.3. For the purposes of this GMC the Connection Points shall be classified as follows:
- (a) Type 1: Between a Generator Unit or Generator Group with a Connection Capacity equal to or higher than 10 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 Consumer, with a Connection Capacity equal to or higher than [10 MW]
 - (d) Type 4: International Interconnections
 - (e) Type 5: Between two Distribution Networks of different licensees
 - (f) Type 6: All other Connection Points
- 2.1.4. Main and Check Metering Systems shall be installed in all Connection Points of Type 1, 2, 3, 4 or 5. In Type 6 Connection Points only Main Metering Systems shall be installed, although an installation of a Check Metering System is advisable.
- 2.1.5. 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 Equipments 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 CHECKING 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 System 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) As far as possible, the 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
 - (ii) 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 both ends of the line between substations of different licensees.
- (b) Each licensee shall consider the Metering System at its own substation as Main Metering. Verification Metering can be obtained through the measurements in the other extreme.

2.2.7. Type 6 Connection Points

- (a) The Main Metering System shall be located as close as possible to the actual Connection Point.

2.3. APPLICABLE STANDARDS

2.3.1. The accuracy of the various items of measuring equipment comprising Meters and Metering Systems shall conform to the relevant IEC standards or any equivalent Nigerian standards. The following IEC standards approved for use with this GMC are:

- (a) IEC Standard 62053-22 – Alternating current static meters for active energy (classes 0.2 S and 0.5 S).
- (b) IEC Standard 62053-21 - Alternating current static meters for active energy (classes 1 and 2).
- (c) IEC Standard 62053-11 – Alternating current electromechanical meters for active energy (classes 0.5, 1 and 2).
- (d) IEC Standard 62053-23 – Alternating current static meters for reactive energy (classes 2 and 3).
- (e) IEC Standard 60044 Part 1 – Current transformers.
- (f) IEC Standard 60044 Part 2 – Voltage transformers.
- (g) IEC Standard 60044 Part 3 – Combined transformers.
- (h) IEC Standard 62056-21 – Data exchange for meter reading – Direct local data exchange.

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 NERC through the Metering Committee the extent to which any changes should be implemented.

- 2.3.4. Where a User proposes to utilize equipment that does not meet these standards, then a derogation submission must be made to the Market Operator in accordance with Chapter 1.4

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 section enough to guarantee that the voltage drop will be always lower than 1 per 1000. The maximum burden imposed by the cables that connect the current transformers with the metering equipment shall be lower than 4 VA. In any case the section of these cables shall not be lower than 6 mm².
- (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 equipments 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 three (3) 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 or the Data Register, as the case may be, shall have an adequate communication channel, either through a serial port RS-232, opto-couplers according to IEC Standard 62.056-21, or any other system the Market Operator may authorize. This communication channel will permit automatic downloading, including remote interrogation and batch downloading, 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 Market Operator shall define the communication protocol to be used, which shall be unique and of standard type in order to reduce the costs that shall be borne by the Users. The selected communication protocol shall be approved by the NERC and communicated to the involved Users at least six (6) month before remote interrogation will start.
- 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) Calibration 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 synchronization of Meters and Data Registers, as the case may be, shall be done preferably through GPS systems. Other synchronization 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 measuring equipment comprising Meters and Metering Equipments shall conform to the relevant IEC standards as listed in 2.3. Accuracy requirements for the purpose of this GMC are defined by Type of Connection Point (as indicated in 2.2) and circuit capacity, rated in MVA. Circuit capacity shall be determined by the lowest rated primary plant of the circuit i.e., generator, transformer, lines etc. and must be based on the primary plant maximum continuous ratings. The rating and accuracy requirements of Metering System should anticipate any future increase in rating of the primary plant.

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 and 3		Type 4	Type 5		Type 6	
Connection Capacity	>50 MVA	< 50 MVA	all	> 10 MVA	< 10 MVA	> 1 MVA	<1 MVA
Current Transformers (Note 1 & 2)	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	1	1	1
Active Energy Meters (Note 2 & 3)	0.2S	0.2S/0.5	0.2S	0.2S/0.5	1	1	1 / 2
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: For new connections made after the date of approval of the first issue of the GMC the higher accuracy class shall be used

Note 3: 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 is 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).

- 2.5.3. 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.
- 2.5.4. 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 and 3		Type 4	Type 5		Type 6	
Current Expressed as a Percentage of Rated Measuring Current	Power Factor	>50 MVA	< 50 MVA	All	> 10 MVA	< 10 MVA	> 1 MVA	<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%	1	±1.5%	±2.5%	±1.5%	±2.5%	±3.5%	±3.5%	±4.0%
120% to 10% inclusive	0.8 lag	±1.0%	±2.0%	±1.0%	±2.0%	±3.0%	±3.0%	±3.5%
120% 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 6)
 - (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) Distributors 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 6)
 - (i) Main Metering System shall be owned by the Eligible Customer:
 - (ii) Check Metering shall be owned by the TSP
- (d) International Interconnections (Type 4)
 - (i) Main Metering System shall be owned by TCN, 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.

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.

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 Commercial 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 Commercial 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 Commercial Meters and Metering Systems.
- (c) The owner of each Commercial 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) Organization which issue 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 Commercial 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 Chapter 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 Equipments 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 Chapter 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 Metering 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 the NERC, 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 later case, the Meter Test Station which will perform the test will issue the required certification. All these tests shall be performed not later than one (1) 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 NERC in case of certifications issued by the manufacturers, as the case may be, shall be issued for a pre-definite period of time, which in no case will exceed [fifteen (15)] years, and shall clearly indicate the minimum required calibration tests and their frequency 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 Metering 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 Metering 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 Appendix 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

- 4.2.1. All initial calibration 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 2.5. A unique identifiable calibration record shall be provided before the connection is made live.
- 4.2.2. New voltage transformers and current transformers shall be calibrated by the 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

- 4.3.1. 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 one (1) 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 Chapter 2.5 and that such testing is witnessed by the nominated representative of the Market Operator. Such testing shall be in accordance with Appendix B of this GMC.

4.4. PERIODIC TESTS

- 4.4.1. Meters shall be periodically checked, 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, and keep appropriate records of meter readings and where appropriate, challenge invoices on a prompt, comprehensive and accurate basis.
- 4.4.2. Regardless of the calibration requirements stated in the certification issued, the owner, upon an instruction by the Market Operator, will undertake the testing of the Meters and associated Metering Equipment, according the following schedules:
- (a) Meters and Metering Equipment, at Connection Points of Type 1, 2, 3 or 4
 - (i) Meters: Every 2 years
 - (ii) CTs and VTs every 5 years. If the Meters are adjusted to compensate for errors in the CTs and VTs, then the CTs and VTs will also be tested every year.
 - (b) Meters and Metering Equipment, at Connection Points of Types 5 and 6
 - (i) Meters: Every 5 years
 - (ii) CTs and VTs every 5 years.

4.4.3. The above mentioned test shall be performed by an authorised Meter Test Station, and will be witnessed by the nominated representative of the Market Operator.

4.4.4. The cost of routine testing shall be met by the owner of the Metering System.

4.5. OTHER PERIODIC TESTS

4.5.1. The owner of a Check Metering System or a Commercial Metering System will undertake calibration testing upon request by the Market Operator, relevant User or Associated User.

4.5.2. Where a User or Associated User reasonably believes the Commercial 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 Appendix A.

4.5.3. The cost of calibration 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 compliance with the GMC.

4.5.4. With regards to all testing in Nigeria, such work will only be undertaken by an authorized Metering Test Station. Where a User undertakes testing of its own Commercial 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 its intention to undertake such test with at least 15 business days in advance.

4.5.5. Results of the tests that shown the Commercial 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 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 Commercial Metering System is found to be faulty, or non-compliant or outside the accuracy stated in Chapter 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 NERC).

5. SECTION: SECURITY AND DATA ACCESS

5.1. SEALING:

- 5.1.1. Following the Effective Date, or following any test or inspection carried out according to Section 4, the Commercial 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 Appendix C.

- 5.1.2. Each User shall, following the Effective Date, 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 Appendix 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 Provision 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 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 sealing pliers, and shall keep an accurate register of all such pliers and the authorised persons to whom they are issued. All such pliers shall bear a distinctive mark.

5.2. ACCESS TO METERING DATA

- 5.2.1. With respect to any Commercial 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 Commercial 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 Commercial 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 distributor, 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) Distributors
 - (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 Distributor shall:
- (a) Own, install, verify, operate, maintain, inspect and replace all Metering Systems at Metering Points on the Distribution System;
 - (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 NERC of all Metering Systems where the Distributor cannot comply with this Distribution Metering Code and shall seek derogation from the NERC, and the NERC may or may not grant such derogation and may impose any conditions as it reasonably sees fit.

1.2. DEROGATIONS

- 1.2.1 If a Distributor finds that an existing installation cannot comply with the standards contained in this DMC or cannot meet the required accuracy levels, it shall without delay report such non compliance to the NERC stating the reasons for non-compliance and the proposed remedy for this situation
- 1.2.2 Where a Distributor has received professional technical advice that the proposed equipment or existing equipment, although not fully meeting the standards as listed in Condition 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 Distributor or the NERC, as appropriate, as due process for a derogation request if the Distributor wishes.
- 1.2.3 Any request for derogations from any provision of the DMC by a Distributor 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 NERC 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 distributor 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 NERC shall:

- (a) keep a register of all derogations which have been granted, identifying the name of the Distributor 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 NERC.



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 Distributor 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 later exists; and
- (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 distributor 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 distributor shall notify the user in advance of any replacement, unless that replacement is provided as part of urgent metering services.

2.1.4. The distributor shall maintain the following information for each metering system:

- (a) Location of the Metering System;
- (b) A record of any calibration 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 Distributor shall, on request, make available for each Metering System the information listed in DMC Paragraphs 2.1.3 and 2.1.4 to:

- (a) The User;

- (b) The NERC.

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.

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 specifies 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 11 kV; or
- (b) 20kA for 3 seconds for MV Metering Points at 11 kV and below.

2.2.4. For each circuit:

- (a) Metering VT of accuracy class 1.0 or better 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 better with 5 amperes secondary current and 5VA burden shall be provided

2.2.5. Accuracy shall be as minimum class 2.0, provided that for new connections made after the date of approval of the first issue of the GMC the minimum accuracy class shall 1.0

2.2.6. The Distributor may agree with the User 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 2.0 and metering current transformers, where applicable, 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 Distributor 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 Distributor, in which to house the Metering System.

2.2.8. The Distributor 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 10 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 equipments, but in any case not longer than 20 years unless a larger value will be authorized by the NERC.

2.3. ALTERNATIVES TO STANDARD METERING SYSTEMS

(a) Upon the request of a User, the Distributor 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:

(b) 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

(c) 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 Distributor 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:

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

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

- (a) IEC Standard 60044 Part 1 – Current transformers.

- (b) IEC Standard 60044 Part 2 – Voltage transformers.
- (c) IEC Standard 60044 Part 3 – Combined transformers.
- (d) IEC Standard 60186 – Inductive voltage dividers (Only for Metering Systems installed before the Effective Date of this MC).
- (e) IEC 60687 - Alternating Current Static Watt-Hour Meters for Active Energy classes 0,2S and 0,5S
- (f) IEC 60136 - Alternating Current Static Watt-Hour Meters for Active Energy classes 1 and 2
- (g) IEC 61268 - Alternating Current Static Var-Hour Meters for Reactive Energy (Class 2 and 3)
- (h) IEC 60252 - Electric Metering Equipments (AC). General requirements, tests and test conditions
- (i) IEC 60253 - Electric Metering Equipments (AC). Particular requirements

3. SECTION: CERTIFICATION AND TESTS

3.1. CERTIFICATION OF NEW METERING INSTALLATIONS

- 3.1.1. Every Meter Type (model) of meter intended to be used in a Metering Installation shall be certified (type-tested) by National Meter Test & Calibration Laboratory (NMTCL) or any other body as may be approved by NERC 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. The NERC shall permanently maintain registers with the list of certified Meter Types
- 3.1.2. The NERC will issue recommendations for Meters and Metering Equipment procurement. These procurement recommendations should 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 up to the Distributor responsibility to select the Meters and Metering Equipment which meet the accuracy and performance requirements contained in this DMC.
- 3.1.3. Prior to the installation of any Meter or Metering shall be:
- (a) Submitted by the Distributor to a Meter Test Station, which has been accredited by the NERC for by the NERC to perform Routine Tests and certification; or
 - (b) Received by the Distributor directly from a manufacturer with a test certificate endorsed by a Meter Test Station accredited by the NERC to endorse manufacturer's certifications.
- 3.1.4. Certifications of Meters or Metering Equipment issued by a manufacturer or an authorised Meter Test Station, shall be issued for a pre-definite period of time, which in no case will exceed [twenty (20)] years, and shall clearly indicate the minimum required calibration tests and their frequency to maintain its validity.
- 3.1.5. Certification shall be confirmed by the attachment 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 Distributor whilst the Metering Equipment is in use, and for Metering Equipment that is no longer in use, for a minimum period of five (5) years after the Metering Equipment has been de-commissioned and rendered un-useable or scrapped. The Distributor shall submit copies of these certificates upon notice from the NERC.
- 3.1.7. The NERC shall permanently maintain a register of authorized Meter Test Stations, accredited to perform either:
- (a) Type Tests certification

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

On request from any Distributor or User the NERC shall provide a copy of such register to such Distributor or User

3.1.8. The NERC will issue directives with the procedures to be applied and tests to be conducted to:

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

These directives could specify that, in cases of sampling testing of more than one meter, a pre-defined percentage of Meters shall comply with more stringent accuracy. 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 either:

- (a) Certified, if at NERC discretion, the installed Meter and Metering Equipment have undergone calibration or verification tests which are deemed compatible with the provisions of this MC. In this case the NERC will determine the additional period of time that this certification will remain valid.
- (b) Non certified, otherwise.

3.2.2. In order to obtain NERC's certifications indicated in paragraph 3.2.1 (a), the Distributor shall submit, within the first twelve (12) months of the Effective Date of this DMC, a requirement to the NERC with all supporting documentation the Distributor considers suitable to support its claim. The NERC will evaluate the submitted documentation, require clarifications and conduct independent analysis which should include testing, by an authorised Meter Test Station, of specific samples of the Meters or Metering Equipment, before issuing or rejecting the required certification.

3.2.3. For uncertified Meters or Metering Equipment, the Distributors shall replace the involved equipments or obtain a valid certification according with the procedures stated in Condition 3.3 Re-certification. The Distributor shall replace the equipment or obtain the above mentioned certification within [eight (8)] years of Effective date

3.3. RE-CERTIFICATION

- 3.3.1. Before the certification of a Metering Installation, or of any of its components, has expired, the Metering Installation should require re-certification, by an authorized Meter Test Station accredited to perform Calibration Tests certifications.
- 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 would be recertified by removal and tests, testing online, 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 should 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 **Distributor** shall ensure that each **Metering System** is inspected according to the minimum frequencies specified in following Table:

Type of Metering System	Frequency
Medium Voltage	Once every year
Low Voltage, including prepayment	Once every 3 years

- 3.4.2. The **Distributor** shall ensure that each **Metering System** is tested and calibrated by an authorised Meter Test Station accredited to perform Calibration Tests according to the minimum frequencies specified in following Table:

Type of Metering System	Frequency
Medium Voltage	
Connection Capacity above 10 MW	4 years
Connection Capacity between 1 and 10 MW	8 years
Connection Capacity below 1 MW	8 years
Low Voltage, including prepayment, either static type or electromechanical)	8 years (see Note)

NOTE: For direct connected meters (without CTs), the calibration intervals shown above will not apply, provided that the Distributor has implemented sampling accuracy tests, approved by NERC, which can demonstrate the statistical confidence that the calibration of the meter population for that category of meters is within limits.

Results of such sampling accuracy tests shall be kept by the Distributor for at least five (5) years and shall be made available to the NERC on request.

- 3.4.3. The Distributor may, and on the direction of the NERC shall, 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 Distributor 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 NERC may carry out its own unannounced inspection and or test, utilizing an authorised Metering Test Station if considered suitable, in which case the User shall grant access to the NERC.
- 3.4.4. The Distributor 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 Distributor shall provide Urgent Metering Services to repair or replace the Metering System as soon as is reasonably practicable and in any event within two working days of the Distributor discovering that the fault exists.
- 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 Distributor of any damage to the Metering Equipment, however caused.
- 3.5.4. The Distributor 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 Distributor 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 Distributor to enable the Distributor to fulfil its obligations under this Distribution Metering Code. This right of access is conditional upon:

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

4.1.2. Prior arrangement by the Distributor 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 Distributor is performing Urgent Metering Services.

4.2. SECURITY OF METERING SYSTEMS

4.2.1. The Distributor 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 seals shall be applied to each Metering System. Seals shall be replaced following works requiring the removal of any seals. The Distributor's procedures for the control of seals and sealing pliers shall be subject to approval by the NERC.

4.2.3. The Distributor 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 Distributor 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 Distributor shall schedule at least once in four (4) reading for all manually read meters.
- 5.1.2. For kilowatt-hour meters, the Distributor 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 Distributor 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 Distributor shall specify the type of equipment to be used for communication with remote meters.
- 5.2.2. The Distributor 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 Distributor 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 unaccounted for energy;
- (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 Distributor shall establish and maintain a register that contains the following information for each Metering System:

- (a) A unique identifier assigned by the Distributor 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 unaccounted for energy; 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 Distributor shall:

- (a) Have in place data validation procedures and loss adjustment calculation methodologies approved by the NERC;
- (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) Shall maintain both unadjusted and loss-adjusted values in the metering data registry in respect of each Metering System.



METERING CODE – APPENDIXES

1. APPENDIX A – CERTIFICATION TESTS

1.1. GENERAL

1.1.1. This Section sets out those tests and checks that shall be performed by a manufacturer or a Metering 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 test shall be conducted in compliance ICE 60044-1:

- (a) Verification of marking and polarity wiring
- (b) HV Power Factor (HP) test:- secondary windings to earth at 3KV injection for 1 minute
- (c) HV Power Factor (HP) test at 2KV for 1 minute on secondary winding
- (d) Interturn over-voltage test (injection 1 Amp on secondary)
- (e) Partial discharge in accordance with ICE60270-2000

1.2.2. Potential Transformer (PF)

- (a) Verification of marking and polarity wiring
- (b) HV Power Factor :- secondary winding to earth at 3KV injection for 1minute
- (c) HV power Factor test at 2KV for 1 minute on secondary winding
- (d) Partial discharge in accordance with IEC 60270-2000
- (e) Induced over-voltage test by injecting 234V at 150c/s on secondary winding for 40second

1.3. METERS

1.3.1. Accuracy

Accuracy Testing for Meters of Accuracy: 0.5s		
Vref: 65.5 Volts (Phase- Neutral)		
In: 5 Amps or 1 Amps		
Imax: 10 A or 2 Amps		
PF: Lag / Lead / UPF		
Sr.No.	Test Condition	Expected results
The meter is connected to voltage equal to Vref and the accuracy is checked at following values of current and power factor in all the Phases. (i.e. Earthed load condition.)		The meter accuracy should be within the limits as specified below
Unity Power Factor		
1	1 % In	-/+ 1.0 %
2	5 % In	-/+ 0.5 %
3	In	-/+ 0.5 %
4	Imax	-/+ 0.5 %
0.5 Lagging Power Factor.		
5	2 % In	-/+ 1.0 %
6	10 % In	-/+ 0.6 %
7	In	-/+ 0.6 %
8	Imax	-/+ 0.6 %
0.8 Leading Power Factor.		
9	2 % In	-/+ 1.0 %
10	10 % In	-/+ 0.6 %
11	In	-/+ 0.6 %
12	Imax	-/+ 0.6 %

1.3.2. No load test

No Load Test	
Vref: 73.02 Volt (Phase- Neutral) In/ Ib= 0 Amps (Current circuit Open) Time Duration: 200 Mins.	
Test Condition	Expected results
The current circuit of the meter should be open circuit and a voltage of 115 % of the reference voltage should be applied for min 20 times the actual test period of starting conditions. The maximum test period should be limited to 200mins.	Meter should not produce more than one output pulse. Meter should be fully functional within 5 seconds after rated voltage applied

1.3.3. Insulation Test

Insulation Test		
Parameters This test is to be conducted in power off conditions i.e no supply to be given to the meter.		
Sr.No.	Test Condition	Expected Results
Insulation resistance to be measured with 500 VDC megger		
1	Between all voltages, current and auxiliary circuits (if any) connected together and frame.	>= 5 Mohms (MΩ)
2	Between circuits not intended to be connected together in service	>= 50 Mohms (MΩ)

1.3.4. Test of Power Consumption

Test of Power Consumption-Voltage Circuit		
Parameters Vref: 63.5 Volt (Phase- Neutral) HT Meters In/ Ib= 0 Amps (Current circuit Open) Power Factor: UPF (Unity)		
Sr.No.	Test condition	Expected Result
1	Power consumption in voltage circuit: Voltage circuit is connected to rated voltage and the current circuit is kept open.	Less than 1W and 2VA.
Test of Power Consumption-Current Circuit		
Parameters Vref: 0 Volt (Phase- Neutral) In= 1 A for 33 kV HV Meters		
2	Power consumption in Current circuit: Current equal to In to be passed through current circuit.	Less than 1VA

1.3.5. Starting Condition

Starting Condition Test	
Parameters Vref: 63.5 Volt (Phase- Neutral) for HT Meters I= 0.1 % of In= 0.001 A, for 1 A for Cl. of accuracy 0.5s PF: UPF (Unity Power Factor)	
Test Condition	Expected Results
The meter should be connected to voltage equal to Vref and current equal to 0.1 % of In for meters having accuracy class as 0.5s at unity power factor.	Meter should start and continue to register.

1.3.6. Repeatability of Error Test

Repeatability of Error Test for Accuracy class 0.5s		
Vref: 63.5 Volt (Phase- Neutral) In: 5 or 1 Amps I _{max} : 10 A for In 5 A I _{max} : 2 A for In 1 A PF: UPF (Unity Power Factor) Time Intervals: 5 Min		
Sr.No.	Test Condition	Expected Results
	The meters should be connected to voltage equal to Vref and the accuracy should be measured at time interval of 5 minutes at the following currents at unity power factor. Twenty error samples should be taken for the test. The same procedure is to be adopted for each circuit	The Variation in the percentage error should not exceed 0.25 for class 0.5 meters.
1	5 % In	The Variation in the percentage error should not exceed 0.25 for class 0.5 meters
2	10 % In	The Variation in the percentage error should not exceed 0.25 for class 0.5 meters
3	In	The Variation in the percentage error should not exceed 0.25 for class 0.5 meters

1.3.7. Voltage and frequency Variation

Voltage Variation Test for Accuracy class 0.5s		
Vref: 63.5 Volt (Phase- Neutral) for HT Meters In: 5 A or 1 A Imax: 10 A for In A Imax: 2 A for In 1 A PF: UPF (Unity Power Factor) & 0.5 Lag Reference Frequency: 50 Hz		
Sr.No.	Test procedure	Expected Result
The impact of voltage variation on the meter should be checked at current equal to In and the voltages, power factors as listed below. The same procedure should be adopted for each phase circuit		The variation in errors should not exceed by the following values as compared to the error at rated voltage.
1	Unity power factor and Voltage = -10 % Vrated	± 0.2 %
2	Unity power factor and Voltage = +10 % Vrated	± 0.2 %
3	0.5 Lag power factor and Voltage = -10 % Vrated	± 0.4 %
4	0.5 Lag power factor and Voltage = +10 % Vrated	± 0.4 %
Frequency Variation Test for Accuracy class 0.5s		
The impact of frequency variation on the meter should be checked at current equal to Ib and voltage equal to Vn. Power factors and Frequency as listed below. The same procedure is to be adopted for every phase circuit		The variation in errors should not exceed by the following values as compared to the errors at Rated Frequency, Voltage and Current.
1	Unity power factor and Frequency= 49 Hz (-2% of rated Frequency)	± 0.2 %
2	Unity power factor and Frequency= 51 Hz (+2% of rated Frequency)	± 0.2 %
3	0.5 Lag power factor and Frequency= 49 Hz (-2% of rated Frequency)	± 0.2 %
4	0.5 Lag power factor and Frequency= 51 Hz (+2% of rated Frequency)	± 0.2 %

2. APPENDIX B – COMMISSIONING TESTS

2.1. GENERAL

2.1.1. 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. MEASUREMENT TRANSFORMERS

2.2.1. For all installations with new/replaced measurement transformers the Market Operator and/or User 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 measurement 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 relevant other party.

2.3. MEASUREMENT TRANSFORMERS LEADS AND BURDENS

2.3.1. For all installations the Market Operator and/or User 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-Commercial Metering burdens) necessary to provide evidence of the overall metering accuracy.

2.4. METERING

GENERAL TESTS AND CHECKS

- 2.4.1. 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.

SITE TESTS

- 2.4.2. 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. APPENDIX 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. For MD meter, the meter terminal cover shall also be sealed.
- 3.1.2. 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 1-phase and 3-phase meters
- 3.2.2. In the case of MD meters, the terminal cover 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 2.1 and 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, 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 procedure 3.4.5 shall be followed

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 70oc

Colour -To be of any colour

Wire Dimension - Not more than 2.5mm² 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) Test terminal cover
- (iv) Voltage fuses & Links
- (v) CTs and VTs terminals
- (vi) Associated circuits, and
- (vii) Metering box or cubicles