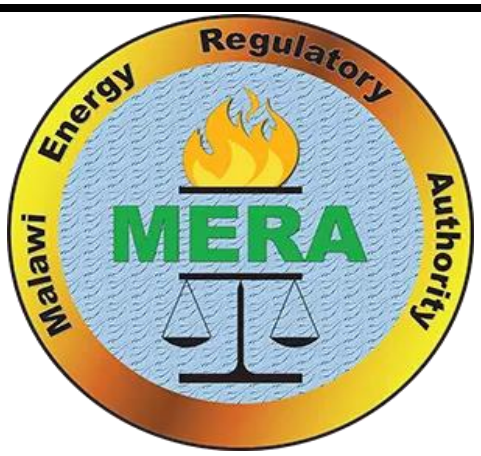

MALAWI DISTRIBUTION GRID CODE

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1 ACKNOWLEDGEMENTS

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ACRONYMS AND ABBREVIATIONS

AC - Alternating Current

CT - Current Transformer

DC - Direct Current

DGCRP - Distribution Grid Code Review Panel

DL – DL (Distribution Network Service Provider)

DSM - Demand Side Management

DS - Distribution System

EGENCO – Electricity Generation Company

ESCOM – Electricity Supply Corporation of Malawi Limited

GENCO – Generation Company

HV - High Voltage

Hz – Hertz

IPP – Independent Power Producer

IPS - Interconnected Power System

LV - Low Voltage

MBS – Malawi Bureau of Standards

MERA – Malawi Energy Regulatory Authority

MV - Medium Voltage

MVA - Mega-Volt-Ampere

MVAr - Mega-Volt-Ampere reactive

MW - Mega-Watt

NEP - National Energy Policy

POC – Point of Connection

PV - Photovoltaic

SCADA - Supervisory Control and Data Acquisition

SMO - System Marketing Operator

TL – Transmission Licensee (Transmission Network Service-Provider)

VT - Voltage Transformer

DEFINITIONS

Authority

Malawi Energy Regulatory Authority (MERA)

Code

The Malawi Distribution Grid Code

Connection Agreement

An agreement between DL(s) and each Customer setting out terms relating to a connection with the Distribution System

Customer

A person or entity whose premises are connected or has applied to have premises connected to the Distribution System.

Customer Asset

Electrical assets that are owned by the customer and are designed and installed in accordance with acceptable wiring standards approved by MERA.

Demand

The electrical power, which is drawn from the system by a customer, expressed in MW, MVA or MVAr.

Demand Side Management (DSM)

Planning and implementing strategies aimed at influencing the pattern and magnitude of electricity consumption by end users. This may include encouraging end users on energy efficiency, load shifting and reducing peak demand to promote overall grid availability and reliability.

Distribution System

The network owned or operated by a Distribution Licensee (DL).

Distribution Network Service Provider (DL)

A licensee that owns and maintains a network on the Distribution.

Distribution System Impact Assessment Studies

Studies to model and assess the impact of connecting a customer load or an embedded generator on the Distribution System.

Earthing

The provision of a connection between conductors and earth by means of an Earthing Device.

Earthing Device

A means of providing a connection between a conductor and earth of adequate strength and capability for its intended purpose.

Economic Cost

Total cost of the electricity related investment to both the DL and the customer(s).

Embedded Generation

Generation units connected within a distribution network and not having direct access to the transmission network.

Embedded Generator

A Licensee, who owns, operates, or controls an embedded generation unit.

End-use customer

Users of electricity connected to the Distribution System.

Fault Level

The prospective current that would flow at a stated point on the system during a short-circuit. It is expressed in kA or in MVA.

Forced outages.

Outages which occur when a component is taken out of service immediately, either automatically or as soon as switching operations can be performed as a direct result of abnormal operating/emergency conditions or human error.

Generator

A Licensee that operates one or more units that supply power to the Transmission System or Distribution system.

Harmonics

Sinusoidal currents with a frequency equal to an integer multiple of the fundamental frequency.

High Voltage (HV)

Nominal voltage levels equal or greater than 66000 Volts (RMS).

International customers

Customers who are situated outside the borders of Malawi and supplied by the DL as defined in this Code.

Interruption (of supply)

A phenomenon that occurs when one or more phases of a supply to a consumer/group of consumers are disconnected for a period exceeding 3s.

Licensee

A legal entity licensed by the MERA in terms of the Energy Regulation Act to provide the electricity distribution and/or trading services.

Losses

Energy for which the DL does not recover revenue. Losses include technical losses and non-technical losses.

Low Voltage (LV)

Nominal voltage levels up to and including 1000 V (RMS).

Metering Installations

All meters, fittings, equipment, wiring and installations, used for measuring the flow of electricity.

Medium Voltage (MV)

Nominal voltage levels greater than 1000 V (RMS) and less than 44000V (RMS).

Network

Electrical infrastructure over which electrical energy is transported from source to point of consumption.

Network stability

The ability of an electrical network to cope with changes in the operational conditions (such as prolonged over voltage, faults, switching large loads/generators on and off, lightning strikes, etc) Network instability may lead to the total loss of power to sections of, or the complete electrical network (“blackouts”).

Non-technical losses

Losses due to theft of electrical energy and errors due to inaccuracy of meters and administrative losses.

Parallel operation

The operation of embedded generation by a customer while the customer is connected to a DL’s system.

POC (Point of Connection)

The electrical node on a distribution system where a customer’s assets are physically connected to the DL’s assets.

Participant

Participants are:

a) DLs

b) Embedded Generators

c). End-use customers

d). Retailers

f). TLs- Transmission Network System- Providers

g) Single buyer

h) System and market operator

Point of supply

Physical point on the electrical network where electricity is supplied to a customer.

Resellers

An "unlicensed buyer of electricity from a licensed DL for the purpose of selling it to the end users within the area of distribution of such DL at the approved tariff of such DL."

Small to Medium Scale Embedded Generation Installation

For this Code, a small-scale embedded generator is up to a capacity of

1 MVA and a medium scale embedded generator is up to a capacity of 10 MVA.

This definition includes initiatives such as:

a). Synchronous generators driven by hydro turbines.

b). Synchronous generators driven by gas engines, gas turbines or diesel engines.

c). Inverter Energy Systems.

This does not include plant which is operated and connected in parallel with the network for the purpose of network or emergency support.

Substation

System and Marketing Operator (SMO)

A Licensee responsible for short-term reliability of the Interconnected Power System

(IPS), which oversees controlling and operating the transmission system (TS)

and dispatching generation (or balancing the supply and demand) in real time.

Transmission System (TS)

This is the electrical system that supplies power in bulk from power stations to DLs and other customers. This includes all transmission lines and substation equipment.

Transmission Network Service-Provider (TL)

A Licensee that owns and maintains transmission equipment.

User

A Customer or Embedded Generator

User Development

A participant's Plant and/or Apparatus and/or System to be connected to the Distribution System, or a modification relating to a User's Plant and/or Apparatus and/or System already connected to the Distribution System, or a proposed new connection or modification to the connection within the participant’s system.

1. INTRODUCTION

1.1 The Electricity Supply Industry in Malawi.

The Electricity Act 2016, amended, provides the framework and mandate for all players in the Electricity Supply Industry in Malawi, alongside the National Energy Policy crafted and enforced by the Ministry of Energy. The aim is to ensure accessible, reliable, sustainable, and efficient energy for all sectors and individuals in the country.

The Malawi Energy Regulatory Authority (MERA) handles regulatory and oversight duties. EGENCO, a state-owned company, and other independent power producers are responsible for electricity generation. ESCOM, another state-owned entity, manages transmission, distribution, and supply nationwide, including system and market operations and acting as a single buyer.

The Electricity Supply Industry model involves ESCOM procuring power in bulk from EGENCO, other independent procedures, and neighboring countries, then transmitting and distributing it to customers at tariffs approved by MERA. Figure 1 below, illustrates the model for Electricity Supply Industry in Malawi.

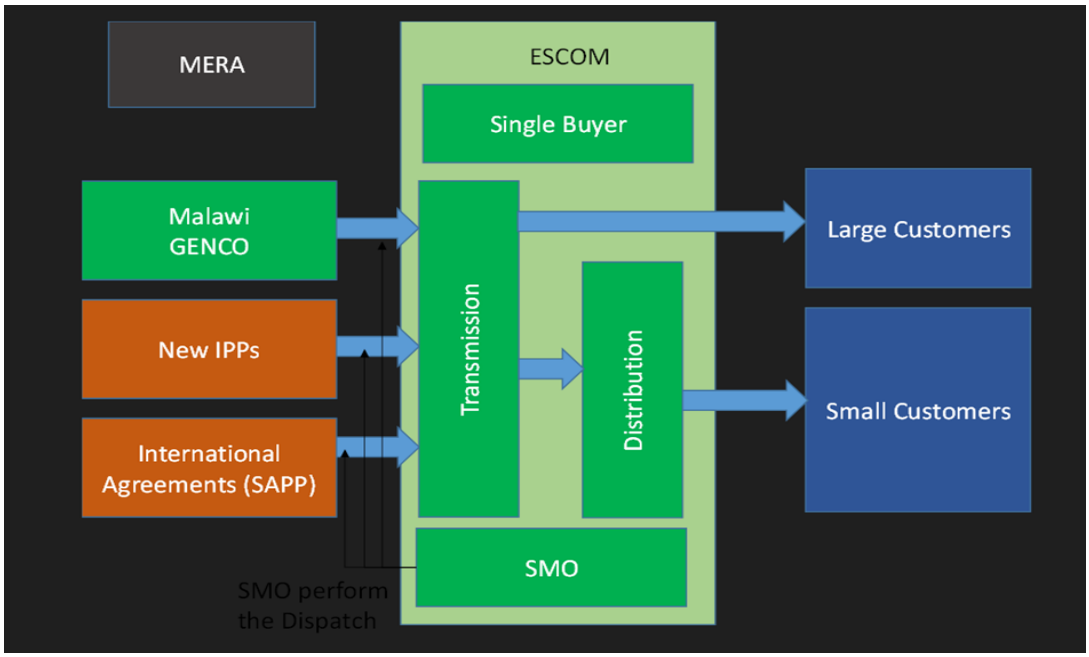

Figure 1: Electricity Supply Industry in Malawi

1.2 The Distribution System

The Distribution System in Malawi comprises power infrastructure whose operating voltage is 33kV and below. The distribution Licensee (DL) under ESCOM, is responsible for planning, building, operating, and maintaining the distribution system power lines and associated switchgear up to the ESCOM metering point across the country and some parts of neighboring countries. Users are responsible for planning, installation, and maintenance of the electrical infrastructure beyond ESCOM metering point.

1.3 Purpose of the Malawi Distribution Grid Code

The Distribution Grid Code is a document approved by MERA formulated to ensure efficient and coordinated planning, construction, alteration, operation, and maintenance of the electricity distribution system in Malawi. It shall be a document agreed upon and to be complied with by all users of the Distribution System.

The Distribution Grid Code is a dynamic document that shall be revised periodically as per the procedures laid down, considering the reasonable interests and views as expressed by the stakeholders.

1.4 Objectives of the Malawi Distribution Grid Code

This Code establishes the basic rules, procedures, requirements, and standards that govern the operation, maintenance, and development of the electricity distribution systems in Malawi to ensure the safe, reliable, and efficient operation of distribution system.

The objectives will be achieved through the following: -

a) Specification of minimum planning and connection standards
b) Specification of minimum metering standards.
c) Specification of minimum operational and maintenance standards
d) Specification of minimum technical requirements
e) Specification of minimum safety and customer handling standards
f) Specification of information requirements and procedures
g) Specification of minimum requirements for embedded generators
h) Streamlining responsibilities and obligations for all the participants

1.4.1 Assurances by the Distribution Grid Code

The Distribution Grid Code provides the following assurances:

a) To the Authority, the assurance that the licensees shall operate according to the respective licensee conditions.
b) To customers, the assurance that licensees shall operate transparently and provide non-discriminatory access to their defined services.
c) To licensees, the assurance that customers will honor their mutual Distribution Code obligations and that there is industry agreement on these.

2. DISTRIBUTION GRID CODE GOVERNANCE

2.1 Introduction

This section has governance provisions that can be applied broadly across all the sections under this code.

2.2 Objective

To ensure that various sections of the Distribution Grid Code apply consistently to all users of the distribution system.

2.3 Scope

The Distribution Governance Code shall apply to all Users of the distribution system.

2.4 Implementation of the Distribution Code

2.4.1 The DL shall implement and enforce the provisions of the Distribution Grid Code. To implement this enforcement, the DL may need access across boundaries, services, and facilities from Users or to issue instructions to Users, for example to isolate or disconnect their plant or apparatus.

2.4.2 All Users shall abide by the Distribution Grid Code and provide the DL with such rights of access to services and facilities and shall comply with such instructions as it may reasonably require for effective implementation and enforcement of the Distribution Grid Code.

2.5 Unforeseen Circumstances

2.5.1 If circumstances arise which the provisions of the Distribution Grid Code have not foreseen, the DL shall to the extent reasonably practicable in the circumstances, consult promptly and in good faith with the affected Users to reach agreement within agreed time as to what should be done.

2.5.2 If an agreement cannot be reached under the circumstances, the DL shall determine what is to be done.

2.5.3 Whenever the DL decides, it shall have regard, wherever possible to the views expressed by Users, and in any event, to what is reasonable in all the circumstances.

2.5.4 Each User shall comply with all instructions given to it by the DL following such a determination provided that the instructions are consistent with the current technical parameters of the User's System registered under the Distribution Grid Code. The DL shall promptly refer all such unforeseen circumstances and any such determination to the Distribution Code Review Panel in accordance with 2.6.1.2.

2.6 Hierarchy

In the event of any conflict between the provisions of the Distribution Grid Code and any contract, agreement or arrangement between the DL and a User, the provisions of the Distribution Grid Code shall prevail unless the Distribution Grid Code expressly provides otherwise.

2.6.1 Distribution Grid Code Review Panel (DGCRP)

2.6.1.1 Every three years, MERA shall constitute and maintain a Distribution Grid Code Review Panel (DGCRP).

2.6.1.2 The DGCRP shall consist of the following members:

a). Three members from DL

b). One member from Conventional Generator (EGENCO)

c). Two members from the Authority (Secretariat)

d). One member from Transmission

e). One member from System Market Operator

f). One member from Single Buyer

g). One member from Embedded Generators

h). Two members from bulk supply customers

2.6.2 The DL shall chair the DGCRP meetings, and the Authority will serve as secretariat.

2.6.3 The DGCRP shall carry out the following functions:

a). Formulate the rules and regulations that shall be approved by the Authority to be followed by the panel.

b). Meet once every four months to Review the Distribution Grid Code.

c). Review all suggestions for amendments to the Distribution Grid Code which participants may submit to the DL for consideration through the Authority from time to time.

d). Recommend to the DL amendments to the Distribution Grid Code that the Panel feels are necessary or desirable and the reasons for the recommendations.

e). Issue guidance in relation to the Distribution Grid Code and its implementation, performance and interpretation when asked to do so by any User.

f). Consider what changes are necessary to the Distribution Grid Code arising out of any unforeseen circumstances referred to it by the DL under 2.5.

2.6.4 No revision or modification of the Distribution Grid Code shall be made without knowledge of the Distribution Grid Code Review Panel. These revisions or modifications shall be approved by the Authority.

2.6.5 The Authority must be promptly notified in writing about any provisional revisions and is required to approve these revisions within fourteen (14) days from the date of notification by the Distribution Grid Code Review Panel.

2.6.6 DGCRP shall send clearly marked amended version of the MDGC to Authority through GCTC for approval. This version shall be enclosed together with a report detailing the requests and reasons for the change.

2.7 Communications between the DL and Users

Unless otherwise specified in the Distribution Grid Code, the methods of operational communication and data transfer shall be agreed between the DL and Users from time to time.

2.8 Code Responsibilities

The Distribution Grid Code sets out the procedures and principles governing the relationship between the DL and all Users of the Distribution System.

2.9 Exemptions

If a User finds that it is or will be unable to comply with any provision of the Distribution Grid Code, then it shall without delay report such non-compliance to the DL and shall, subject to the provisions of 2.10.1 make such reasonable efforts as are required to remedy such non- compliance as soon as reasonably practicable.

2.9.1 Where the non-compliance is:

a). with reference to Plant and/or Apparatus connected to the Distribution System and is caused solely or mainly because of a revision to the Distribution Grid Code, or

b). with reference to Plant and/or Apparatus which is connected, approved to connect, or for which approval to connect to the Distribution System is being sought and the User believes either that it would be unreasonable (including cost and technical considerations) to require it to remedy such non-compliance or that it should be granted an extended period to remedy such non-compliance it shall promptly submit to the Authority a request for an exemption from such provision in accordance with the requirements of 2.10.2 and shall provide the DL with a copy of such application.

2.9.2 A request for exemption from any provision of the Distribution Grid Code shall contain:

a). the issue number and the date of the Distribution Grid Code provision against which the non-compliance or predicted non-compliance was identified,

b). identification of the Plant and/or Apparatus in respect of which an exemption is sought and, if relevant, the nature and extent to which the non-compliance exists,

c). identification of the provision with which the User is, or will be, unable to comply,

d). the reason for the non-compliance, and

e). The date by which compliance will be achieved (if remedy of the noncompliance is possible) subject to 2.10.1 (b).

A standard Distribution Grid Code Exemption Application form is included in Appendix A (to be adopted).

2.9.3 If the DL finds that it is, or will be, unable to comply with any provision of the Distribution Grid Code, then it shall make such reasonable efforts as are required to remedy such non-compliance as soon as reasonably practicable.

2.9.4 In the case where the DL requests Exemption, the DL shall submit the information set out in 2.10.2 to MERA.

2.9.5 On receipt of any request for exemption, MERA through the DGCRP shall promptly consider such request and provided that the DGCRP considers that the grounds for the exemption are reasonable, MERA shall grant such Exemption unless the Exemption would, or it is likely that it would have a material adverse impact on the security and stability of the Distribution System or imposes unreasonable costs on the operation of the Distribution System or Transmission System or on other Users.

2.9.6 In its consideration of an Exemption request by a User, the Authority may contact the relevant User and or the DL to obtain clarification of the request to discuss changes to the request. Where the Exemption may have an impact on the Transmission System, the DL shall liaise with the SMO prior to providing an assessment to the Authority.

2.9.7 The DL shall:

a). Keep a register of all exemptions which have been granted, identifying the name of the participant in respect of whom the Exemption has been granted, the relevant provision of the Distribution Grid Code and the period of the Exemption, and
b). On request from any User, provide a copy of such register of exemptions to such User.

2.9.8 Where a material change in circumstance has occurred, a review of any existing exemptions, and any exemption requests under consideration, may be initiated by the Authority at the request of the DL, or Users.

2.10 Dispute Resolution

2.10.1 Mutual Discussion

2.10.1.1 If a Dispute arises between the participants in connection with, or arising out of, the interpretation, implementation, or breach of any provision in this MDGC, any Party may issue to the other Party a written notice (the "Dispute Notice") outlining the matter.

2.10.1.2 Following issue of a Dispute Notice both participants shall discuss in good faith and attempt to settle the Dispute between them. Dispute resolution may include a request to the Authority to refer the matter to the DGCRP for resolutions.

2.10.2 Determination by the Authority

2.10.2.1 If the Dispute cannot be settled within thirty (30) working days after issue of the Dispute Notice, either participant shall have the right to refer the Dispute to the Authority for resolution. In this case, the procedure will be as follows:

(a) The request for referral shall be made in writing to the Authority and a dated copy of the original Dispute Notice between the participants shall be attached.

(b) Upon receipt of a request for referral, the Authority shall within five (5) working days write to the Parties acknowledging that the Dispute has been referred to the Authority for determination.

(c) Following receipt of Authority acknowledgment, each Party shall have five (5) business days to submit their reason(s) as to the cause of the Dispute in writing to the Authority, and

(d) No later than ten (10) business days after the Authority has received each Party's reason(s) as to the causes of the Dispute in writing, the Authority shall write to each

Party setting out the way it intends to resolve the Dispute and indicate a date by which a determination may be expected which in any case shall not exceed three (3) months.

(e) The Authority may also seek the views and advice of an Independent Expert on settlement of the Dispute.

(f) The determination by the Authority shall be legally binding on all Participants.

(g) Determinations by the Authority are subject to appeal before the High court as provided under the Electricity Act.

3. DISTRIBUTION CONNECTION CODE

3.1 Objectives

This section has the following objectives:

a) To set the basic rules of connecting to the Distribution System.
b) To ensure that all participants are treated in a non-discriminatory manner.
c) To specify the technical requirements to ensure the safety and reliability of the Distribution System.

3.2 Scope of Application

The Distribution Connection Code shall apply to all Participants of the Distribution System.

3.3 Distribution System Connection Process and Procedure

3.3.1. Connection Agreement

3.3.1.1 Any Customer or Embedded Generator seeking a new connection to the Distribution System shall secure the required Connection Agreement with the DL prior to the actual connection to the Distribution System.

3.3.1.2 The DL shall develop and provide application procedures for connection to the distribution system to be used by customers for application to be connected to the Distribution System. The application for connection procedures shall be approved by Authority.

3.3.1.3 A customer requiring new connection/alteration to existing supply shall provide all technical details requested by the DL to enable the DL to make a fair assessment of the customer's requirements.

3.3.1.4 Before the customer is physically connected, the DL shall satisfy itself that the installation is safe to be connected. These safety requirements shall be approved and monitored by Authority.

3.3.1.5 The DL shall issue a certificate of electrical safety to the customer for every installation established.

3.3.1.6 A connection agreement, detailing among others the contracted supply and applicable tariff, shall be drafted by the DL, and signed by both DL and customer in respect of each connection/supply point.

3.3.1.7 A new connection to the distribution network shall be by means of a single or three phase overhead line with bare or insulated conductors, an underground cable, or a combination of both in accordance with the Electricity (Supply) Regulations.

3.3.1.8 All equipment on the customer's installation shall be suitable for use at the operating frequency of 50 Hz and at the voltage and stipulated short-circuit rating and shall normally be controlled within the approved limits.

3.3.1.9 The DL shall require certification and evidence to conclusively prove that the equipment installed or to be installed has been designed, tested, and installed in a satisfactory manner and in conformance with the relevant standards and this Code.

3.3.2. Application for Connection or Modification

Any Customer or Embedded Generator applying for connection or a modification of an existing connection to the Distribution System shall submit to the DL the completed application form for connection or modification of an existing connection to the Distribution System. The application form shall include the following information:

a) A description of the proposed connection or modification to an existing connection, which shall comprise the Customer Development at the POC.
b) The relevant Standard Planning Data as requested by the DL, and
c) The Completion Date of the proposed Customer Development.

3.3.3. Processing of Application

3.3.3.1 The DL shall establish the procedure for the processing of applications for connection or modification of an existing connection to the Distribution System.

3.3.3.2 The DL shall evaluate the impact of the proposed participants' development on the Distribution System.

3.3.3.3 After evaluating the application submitted by the participant, The DL shall inform the Customer whether the proposed development is acceptable or not.

3.3.3.4 If the application of the customer is acceptable, the DL and the customer shall sign a Connection Agreement or an Amended Connection Agreement, as the case may be.

3.3.3.5 If the application of the Customer is not acceptable, The DL shall notify the Customer why its application is not acceptable.

3.3.3.6 The Customer shall accept the proposal of The DL within 30 days, or a longer period specified in The DL's proposal, after which the proposal automatically lapses.

3.3.3.7 The acceptance by the Customer of the DL's proposal shall lead to the signing of a Connection Agreement or an Amended Connection Agreement.

3.3.3.8 If the DL and the Customer cannot reach agreement on the proposed connection or modification to an existing connection, the DL or the customer may bring the matter before the Authority for resolution.

3.3.3.9 The DL shall connect the customer in line with the DL's customer service charter.

3.3.3.10 The DL shall be responsible for the planning, design and engineering specifications of the work required for the distribution system connection or expansion.

3.3.4. Information to be Submitted Prior to Commissioning

The following shall be submitted to the DL by the Customer or Embedded Generator prior to the commissioning date, pursuant to the terms and conditions and schedules specified in the Connection Agreement:

a) Specifications of major Customer Assets not included in the Standard Planning Data and Detailed Planning Data.
b) Details of the protection arrangements and settings for Embedded Generating Units and for other Customer.
c) Information to enable the DL to prepare the Fixed Asset Boundary.
d) Electrical Diagrams of the Customer Assets at the POC.
e) Information that will enable the DL to prepare the POC Drawings

f) A list of the names and telephone numbers of authorized representatives, including the confirmation that they are fully authorized to make binding decisions on behalf of the Customer.

g) Proof of ownership of premises or lease agreement.

3.3.5. Commissioning of Equipment and Physical Connection to the Distribution System

3.3.5.1 The Customer or Embedded Generator shall submit to the DL a written notice (as per Appendix E) of readiness to connect.

3.3.5.2 Upon completion of the User Development, including work at the POC, the Customer Assets at the POC and the User Development shall be subjected to the Test and Commissioning procedure as set by the DL.

3.3.5.3 Upon acceptance of the customer's written notice of readiness to connect, the DL shall, within 15 days, issue a certificate of approval to connect.

3.3.5.4 The physical connection to the Distribution System shall be made only after the DL has issued the certificate of approval to connect to the User.

3.3.6. Connection Agreement for modification of existing connections

3.3.6.1 Any customer seeking to modify an existing connection to the Distribution System shall secure the required Connection Agreement with the DL prior to the actual modification.

3.3.6.2 Any alteration (be it temporary or permanent) to an existing installation shall not be made without approval from the DL.

3.3.6.3 The Connection Agreement shall include provisions for the submission of additional information required by the DL.

3.3.7. Conditions for Disconnection of Supply

Embedded Generation and Customer Assets may be disconnected from the Distribution system for the following reasons:

a) On customer's written request to the DL.
b) In cases of emergency
c) In the event of violation of electricity safety regulations (as per Malawi Electricity Act) such as:
    i. The supply of electricity to a customer's electrical installation is used other than at the customer's premises.
    ii. A customer takes at the customer's supply address electricity supplied to another supply address.
    iii. A customer tampers with, or permits tampering with, the meter or associated equipment, or
    iv. A customer allows electricity supplied to the customer's supply address to bypass the meter.
    v. Failure by customer to comply to any provision of this Distribution Grid Code

3.3.8. Conditions for Reconnection of Supply after disconnection

After the disconnection under 3.3.7 an embedded generation or customer asset may be reconnected for the following reasons:

a) On customer's written request
b) Compliance with relevant electricity supply regulations where a disconnection was made.
c) Compliance with relevant commercial terms and agreements.

3.3.9 Distribution Load Flow Studies

3.3.9.1 The DL shall take all necessary measures to ensure that any proposed connection or modification of an existing connection to the Distribution System shall not result in the degradation of the quality of supply and service.

3.3.9.2 The DL shall conduct Distribution Load Flow Studies to evaluate the impact of the proposed connection or modification to an existing connection on the Distribution System. The evaluation shall include the following:

a) Impact of short circuit in-feed to the Distribution Equipment.
b) Coordination of protection system and
c) Impact of User Development on power quality
d) Impact of User Development on the environment

3.3.9.3 The DL may disapprove an application for connection or a modification of an existing connection to the Distribution System if it is determined through the Distribution Impact Studies that the proposed connection or modification will result in the degradation of the quality of supply and service.

3.4 Responsibilities of the DL

3.4.1 The DL shall make capacity available on its networks and provide open and non-discriminatory access for the use of this capacity to all customers including Embedded Generators. In exchange for this service, the DL is entitled to a fair compensation through electricity tariffs as approved by Authority.

3.4.2 DL shall make available to the customers the Customer Connection Information Guide.

3.4.3 Network upgrade may be required at the cost of the customer when the connection of the embedded generator causes any of the following to occur:

a) Insufficient thermal capacity
b) Prospective fault levels exceed the DL network's safe operating levels.
c) Network voltage limits are breached.
d) Network protection systems unable to detect all credible fault types.
e) Quality of supply limits are breached, and
f) Remote monitoring and control is required to be installed by the DL.

3.4.4 The DL may request the customer to submit design information, drawings, or other relevant information to the DL if the DL believes any proposed installation or modification has the potential to affect the performance of the Distribution System adversely or materially.

3.4.5 Should the results of the Distribution System Impact Assessment Studies of proposed new or altered equipment owned, operated, or controlled by the DL or another customer indicate that there will be a physical effect at the POC, the DL shall notify all affected customers prior to commissioning.

3.4.6 The DL shall connect the Embedded Generator in accordance with the requirements of section 4.7 of this code.

3.5 Responsibilities of customers and /or users

3.5.1 The Customer(s) shall provide safe access to the DL employees to carry out the installation, operation, inspection, and maintenance of the DL's electrical equipment on the customer's premises.

3.5.2 Customers shall ensure that there is no unreasonable delay to access to the DL's equipment.

3.5.3 Customers shall be responsible for the removal and the reinstallation of any Customer Asset for the DL to perform the installation work that the customer has requested.

3.5.4 Customers shall, prior to commissioning, attempt to identify if new or altered Customer Assets could have a deleterious effect at the POC. The customer shall advise the DL should such deleterious effect be identified.

3.5.5 Where the customer believes the present, or proposed DL installation has the potential to affect the performance of the customer Assets adversely or materially, the customer may request the DL to submit design information, drawings, or other relevant information.

3.5.6 In addition, Customers shall comply with the reasonable additional requirements specified by the relevant DL in respect of the technical and design requirements of equipment proposed to be connected to the Distribution System.

4 DISTRIBUTION SYSTEM TECHNICAL REQUIREMENTS

4.1 Protection Requirements

4.1.1 The DL's protection system shall be appropriately designed and maintained to ensure optimal discrimination, safety, and minimum interruptions to customers.

4.1.2 The customer shall install and maintain protection, which is compatible with the existing Distribution System protection. The customer's protection settings shall ensure coordination with the DL's protection.

4.1.3 The customer shall provide the DL with test certificates, prior to commissioning, of the protection system/s that are installed at the POC with the DL.

4.1.4 Participants' protection systems shall make provisions to safeguard their own equipment from faults or conditions that may occur at the POC including loss of one or two phases of the three-phase supply and low/high voltages on the phases and any auto-reclosing or sequential switching features that may exist on the Distribution System.

4.1.5 Where equipment or protection schemes are shared, the participants shall provide the necessary equipment and interconnections to the equipment of the other party.

4.1.6 The protection functions are considered adequate when the protection relays perform correctly in terms of:

a). Reliability

b). Security

c). Speed of operation

d). Selectivity

e). Sensitivity

4.1.7 All Distribution System users shall ensure correct and appropriate settings of protection to achieve effective isolation of faulty equipment within the specified clearance time. Protection settings at the POC shall not be altered, or protection

bypassed and/or disconnected without consultation and agreement of the DL and the User. In the case where protection is bypassed and/or disconnected, by agreement, then the cause must be rectified, and the protection restored to normal condition as quickly as possible. If agreement has not been reached the electrical equipment will be removed from service forthwith.

4.1.8 MERA shall monitor compliance to all matters covered by this section of the Code and shall design and effect appropriate penalties for enforcing compliance.

4.2 Testing of Protection Equipment

4.2.1 Each Distribution System User is responsible for tests on own equipment and a record of test results shall be kept for submission upon demand by the other users or MERA or both. Additionally records of protection test results of the users own equipment must be submitted to the DL. Periodic tests must be performed once every two years.

4.3 Earthing Requirements for Substations

4.3.1 Earthing Systems

4.3.1.1 All substations earthing systems should have earth resistance lower than 10 ohms for effective discharge of lightning or over voltages to earth.

4.3.1.2 The current carrying paths of an earthing system should have enough capacity to deal with maximum fault current.

4.3.1.3 Earthing Mat shall be provided below ground level and earth electrodes shall be driven into ground at several points and shall be connected to the Earthing Mat to form an Earthing Mesh.

4.3.1.4 All structures, transformer tanks, breakers, equipment panels shall be connected to this mat by copper conductor or galvanized steel strips.

4.3.1.5 Buried elements of the earthing system should be checked for condition at random points as and when necessary but not exceeding a period of five (5) years.

4.3.2 Earthing Requirements

4.3.2.1 The DL shall advise Users about the neutral earthing methods used in the Distribution System.

4.3.2.2 The method of neutral earthing used on those portions of User's installations that are physically connected to the Distribution System shall comply with the DL's applicable earthing standards.

4.3.2.3 Protective earthing of equipment must be done in accordance with the applicable DL standard.

4.3.2.4 In cases where the calculated Ground Potential Rise exceeds 5kV, the responsible party shall inform the affected participants.

4.3.2.5 Approved designed lightning protection requirements shall be applied to the Distribution Substation earthing requirement shall be in accordance with applicable standards.

4.4 Quality of Supply

4.4.1 The DL and other participants shall comply with MBS approved Power Quality standards regarding the parameters listed below:

a). Voltage harmonics and inter-harmonics

b). Voltage flicker

c). Voltage unbalance

d). Voltage dips

e). Interruptions

f). Voltage regulation

g). Frequency

h). Voltage surges and switching disturbances.

4.4.2 Special quality of supply criteria will be agreed between the DL and the Embedded Generator and must meet the minimum requirements in the applicable MBS PQ standard.

4.5 Load Power Factor

4.5.1 Users, except for embedded generators, (with demand exceeding 100kVA) shall ensure that the power factor shall not be less than 0.92 lagging nor shall it go leading unless otherwise agreed to with the relevant DL.

4.5.2 Should the power factor go below these limits, participants shall take corrective action within a reasonable timeframe to remedy the situation. The Authority approved low power factor surcharge mechanism shall also apply.

4.5.3 The participant intending to install shunt capacitors or any other equipment for the purpose of complying with the power factor requirements shall inform the DL.

4.6 Distribution Network Interruption Performance Indices

4.6.1 The Authority shall be responsible for setting the format in which the Distribution Reliability Indices are reported.

4.6.2 Before the end of each year the DL shall publish its targets for reliability of supply for the following year.

4.6.3 The Authority shall annually evaluate the Distribution System Reliability Indices to compare each DL's actual performance with the DL unique targets set by Authority and shall publish these comparative results.

4.7 Losses in the Distribution System

4.7.1 Distribution System Losses shall be classified into three categories: Technical Loss and Non - technical Loss, and Administrative Loss.

4.7.2 The Technical Loss shall be the aggregate of conductor loss, the core loss in transformers, and any loss due to technical metering error.

4.7.3 The Non-Technical Loss shall be the aggregate of the Energy lost due to pilferage, meter-reading errors, and meter tampering.

4.7.4 The Administrative Loss shall include the Energy that is required for the proper operation of the Distribution System and any unbilled Energy for community related activities.

4.7.5 The DL shall identify and report separately to MERA the Technical and Non - technical Losses in its Distribution System.

4.7.6 The Authority shall, after due notice and hearing, prescribe a cap on the System Loss that the DL can pass on to its End-Users. Separate caps shall be set for the Technical and Non-Technical Losses.

4.8 Equipment Requirements

4.8.1 Equipment at the POC shall comply with the national standards prevailing at the time.

4.8.2 The DL shall provide the User with the necessary information to enable the User to install equipment with the required rating and capacity.

4.8.3 The participants shall ensure that all equipment at the POC is maintained at least in accordance with the DL specifications.

4.8.4 The participants connected at MV and HV levels shall retain the test results and maintenance records relating to the equipment at the POC and make this information available if requested.

4.9 Embedded Generators Connection Conditions

4.9.1 Responsibilities of Embedded Generators to DL

4.9.1.1 The Embedded Generator shall enter into a connection agreement with the DL before connecting to the Distribution system.

4.9.1.2 The Embedded Generator shall ensure that the reliability and quality of supply complies with the terms of the connection agreement.

4.9.1.3 The Embedded Generator shall comply with the DL's protection requirement guide detailed in this section as well as protection of own plant against abnormalities, which could arise on the Distribution System.

4.9.1.4 The Embedded Generator shall be responsible for any dedicated connection costs incurred on the Transmission System or Distribution System because of connection of the Embedded Generation facility to the Distribution System.

4.9.1.5 The Embedded Generator shall be responsible for synchronizing the generating facility to the Distribution System within pre-agreed settings.

4.9.1.6 Embedded generator shall obtain the relevant license from the MERA. It shall be the responsibility of an Embedded Generator to present a generating license to the DL.

4.9.1.7 Embedded Generators owning a micro/mini-embedded generating installation do not require a Generation License. However, these installations must be registered with the DL. This is both a safety issue and a network security issue registration is not intended to restrict connection, but rather provide for safety and information for future planning requirements.

4.9.1.8 Where a license (or exemption) is required, evidence of either shall be provided to the DL prior to connection to the network.

4.9.2 Responsibilities of DL to the Embedded Generators

4.9.2.1 If requested by the Embedded Generator, the DL shall provide information relating to the Distribution System capacity and loading to enable the Embedded Generator to identify and evaluate opportunities for connecting to the Distribution System.

4.9.2.2 The DL shall treat all applications for connection to the Distribution System by potential Embedded Generators in an open and transparent manner that ensures equal treatment for all applicants.

4.9.2.3 The DL shall be responsible for the installation of the bi-directional metering equipment between the DL and the Embedded Generator's generation facility.

4.9.2.4 The DL shall develop the protection requirement guide for connecting Embedded Generators to the Distribution System to ensure safe and reliable operation of the Distribution System.

4.9.2.5 The DL shall develop and publish its own application form for connecting Embedded Generators.

4.9.3 Provision of Planning Information

4.9.3.1 Before entering into a connection agreement, the Embedded Generator shall provide to the DL information relating to the Generator plant data, location and time scale, capacity and standby requirements as detailed in Appendix F.

4.9.3.2 The DL shall provide the Embedded Generator any information necessary for the Embedded Generator to properly design the connection to the Distribution System.

4.9.3.3 Embedded Generators shall specify, with all relevant details, in their application for connection if the generator facility to be connected shall have black-start and / or self-start capabilities.

4.9.4 POC Technical Requirements

4.9.4.1 The Embedded Generator shall be responsible for the design, construction, maintenance and operation of the equipment on the generation side of the POC.

4.9.4.2 The Embedded Generator shall be responsible for the provision of the site required for the installation of the DL equipment required for connecting the generating facility.

4.9.4.3 The technical specifications of the connection shall be agreed upon by the participants based on the Distribution System Impact Assessment Studies.

4.9.4.4 A circuit breaker and visible isolation shall be installed at the POC to provide the means of electrically isolating the Distribution System from the generating facility.

4.9.4.5 The Embedded Generator shall be responsible for the circuit breaker to connect and disconnect the generator.

4.9.4.6 The location of the circuit breaker and visible isolation shall be decided upon by the embedded generator and the DL.

4.9.4.7 The Embedded Generator shall pay for any expenses incurred by the DL on works related to POC on behalf of the Embedded Generator.

4.9.4.8 Connection between the Micro/Mini-embedded generating unit (e.g. PV Array) and the distribution system must be via an approved inverter and the connection must be undertaken in accordance with this Code. DLs will generally connect single phase small-embedded generating units via approved inverters up to 10 kVA and three phase up to 30kVA. Three phase Inverters must be configured to always ensure reasonably balanced output to all phases whilst connected to the distribution system. All three phases of the Inverter must simultaneously disconnect from, or connect to, the distribution system in response to protection or automatic controls (e.g. anti islanding trip and subsequent reconnection).

4.9.4.9 Where multiple single-phase Inverters are connected to more than one phase, the Inverters must be interlocked and configured to behave as an integrated multiphase Inverter always providing a reasonably balanced output to all connected phases whilst connected to the distribution system. Alternatively, where Inverters cannot be interlocked by internal controls, the installation must be protected by a phase balance relay which must immediately isolate the Inverter in the absence of reasonable balance. The Inverters must be physically prevented from operating independently and all installed Inverters must simultaneously disconnect from, or connect to, the distribution system in response to protection or automatic controls (e.g. anti islanding trip and subsequent reconnection).

4.9.5 General Protection Requirements for Embedded Generators

4.9.5.1 The Embedded Generator's protection shall comply with the requirements of this code. Embedded Generators of nominal capacity greater than 10 MVA shall in addition to the requirements of this code, comply with the Malawian Grid code.

4.9.5.2 Additional features including inter-tripping, anti-islanding, and generator plant status to be agreed upon by the participants.

4.9.5.3 The protection schemes used by the Embedded Generator shall incorporate adequate facilities for testing, monitoring and maintenance.

4.9.5.4 The protection scheme shall be submitted by the Embedded Generator for approval by the DL and / or the SMO.

4.9.6 Specific Protection requirements for Embedded Generators

4.9.6.1 Phase and Earth Fault Protection

4.9.6.1.1 The protection system of the Embedded Generator shall fully coordinate with the protective relays of the Distribution System.

4.9.6.1.2 The Embedded Generator shall be responsible for the installation and maintenance of all protection relays at the POC.

4.9.6.2 Under/Over-frequency Protection

4.9.6.2.1 Under and over frequency protection must be installed to ensure the embedded generator is disconnected from the Distribution System when the system frequency varies outside the nominated range. The frequency protection settings must be based on the embedded generator's proposed distribution network connection arrangement and operating requirements.

4.9.6.2.2 The Embedded Generator shall install under/over-voltage protection to disconnect the generating facility under abnormal network conditions as agreed between the DL and the Embedded Generator. Under and over voltage protection must be installed to monitor all three phases at the POC. This protection is set to ensure the generating system is disconnected from the Distribution system when the voltage varies outside predetermined values. If the generating system is located remote from the POC, the DL may accept use of a local voltage reference source for use with under and over voltage protection.

The under and over voltage protection will be a two staged protection scheme, incorporating short term (less than 1 second) and long term (10 minute) voltage measurements. The customer's protection relays must be capable of at least a two-stage protection scheme.

4.9.6.3 Faults on the Distribution System

The Embedded Generator shall be responsible for protecting its generation facility in the event of faults and other disturbances arising on the Distribution System.

4.9.6.4 Islanding

4.9.6.4.1 The DL shall specify when the Embedded Generator may remain connected if the section of the Distribution System to which the Embedded Generator is connected is isolated from the rest of the network.

4.9.6.4.2 The Embedded Generation facility shall be equipped with dead-line detection protection system to prevent the generator from being connected to a de-energized distribution system. The DL shall take reasonable steps to prevent closing circuit breakers onto an islanded network.

4.9.6.4.3 For unintentional network islanding, the Embedded Generator and the DL shall agree on methodology for disconnecting and connecting the Embedded Generator.

4.9.7 Quality of Supply requirements for Embedded Generators

4.9.7.1 Frequency Variations

The Embedded Generation facility shall remain synchronized to the Distribution System while the network frequency remains within the agreed frequency limitations subject to guidelines set by the National Grid Code.

4.9.7.2 Power Factor

The power factor at the POC shall be maintained within the limits agreed upon by the standards.

4.9.7.3 Fault Levels

4.9.7.3.1 The Embedded Generator shall ensure that the contractually agreed fault level contribution from the generation facility shall not be exceeded.

4.9.7.3.2 The DL shall ensure that the contractually agreed fault level in the network at the POC shall not be exceeded.

4.9.8 Telemetry

The Embedded Generator shall have the means to remotely report any status change of any critical function that may negatively impact on the quality of supply on the Distribution System.

5 DISTRIBUTION SYSTEM PLANNING AND DEVELOPMENT CODE

5.1 Distribution Planning Responsibilities

5.1.1 DL shall be responsible for Distribution Planning, including:

a) Analyzing the impact of the connection of new facilities such as Embedded Generating Plants, and, distribution lines, or substations.

b) Planning the expansion of the Distribution System to ensure its adequacy to meet forecasted Demand and the connection of new Embedded Generating Plants, and

c) Assessing Reliability of Distribution System.

5.2 Framework for Distribution System Planning and Development

5.2.1 Source of Planning Data

5.2.1.1 The DL shall source relevant data from various sources including the following but not limited to:

a). Power Systems Development Master Plan (PSDMP).

b). Malawi Rural Electrification Master Plan.

c). Customer information, system performance statistics.

d). Distribution network load forecast, and government (Planning

Authority) and

e). Customer development plans to establish the need for network strengthening.

5.2.1.2 The DL shall annually compile a 5-year load forecast at the DL's incoming points of supply including DL's cross-boundary connections.

5.2.1.3 The DL shall be responsible for compiling network development plans with a minimum window period of five years. These network development plans shall be reviewed at the least every 5 years. The aim of network development plans is to ensure a capable network and should therefore include all relevant activities such as electrification and refurbishment. Such plans should be drawn up considering only available information. Unexpected loads or customer requests can be retrospectively added to the plan.

5.2.1.4 The network development plans, and post release changes shall be submitted to MERA upon request.

5.2.1.5 The network development plans shall be made available to customers on request and the Network development plan shall include:

a). Energy and Demand forecasts.

b). Distribution substation siting and sizing.

c). Distribution feeder routing and sizing.

d). Distribution Reactive Power compensation plan.

e). Other Distribution reinforcement plans and of the technical and economic analysis performed to justify the Distribution Development Plans.

5.2.1.6 If a User believes that the cohesive forecast prepared by the DL does not accurately reflect its assumptions on the planning data, it shall promptly notify the DL of its concern. The DL and the User shall promptly meet to address the concern of the User.

5.2.1.7 The Users of the Distribution System, including Embedded Generators, large customers, and other entities that have a System connected to the Distribution System shall cooperate with DL in maintaining a Distribution Planning data bank.

5.2.2 Submission of Planning Data by Applicants

5.2.2.1 Any User applying for connection or a modification of an existing connection to the Distribution System shall submit to DL the relevant Standard Planning Data specified in Section 3 and 4 in accordance with the requirements by the DL.

5.2.2.2 All MD customers and Embedded generators shall submit annually to the DL the relevant historical planning data for the previous year and the forecast planning data for the five (5) succeeding years. These shall include the updated Standard Planning Data and the Detailed Planning Data.

5.2.2.3 The required Standard Planning Data shall consist of information necessary for the DL to evaluate the impact of any User Development on the Distribution System.

5.2.2.4 The Detailed Planning Data shall include additional information necessary for the conduct of a more accurate Distribution Planning study. This shall cover circuit parameters, switchgear, and protection arrangements of equipment directly connected to or affecting the Distribution System. The data shall be adequate to enable the DL to assess any implication associated with the Connection Points.

5.2.2.5 The Standard Planning Data and Detailed Planning Data shall be submitted by the User to the DL according to the following:

(a) forecast data

(b) estimated equipment data

(c) registered equipment data.

5.2.2.6 The Forecast Data shall contain the User's best estimate of the data, including Energy and Demand, being projected for the five (5) succeeding years.

5.2.2.7 The Estimated Equipment Data shall contain the User's best estimate of the values of parameters and information pertaining to its Equipment.

5.2.2.8 The Registered Equipment Data shall contain validated actual values of parameters and information about the User's Equipment, which are part of the Connected Project Planning Data submitted by the User to the DL at the time of connection.

5.2.3 Consolidation and Maintenance of Planning Data

5.2.3.1 The DL shall consolidate and maintain the Distribution planning data according to the following categories:

(a) forecast data.

(b) estimated equipment data.

and

(c) registered equipment data.

5.2.3.2 If there is any change to its planning data, the customer shall notify DL of the change as soon as possible. The notification shall contain the time and date when the change took effect or is expected to take effect. If the change is temporary, the time and date when the data is expected to revert to its previous registered value shall also be indicated in the notification.

5.2.4 Evaluation of Proposed Development

5.2.4.1 The DL shall conduct Distribution Impact Studies to assess the effect of the proposed User Development on the Distribution System and the System of other Users.

5.2.4.2 The DL shall notify the User of the results of the Distribution Impact Studies.

5.2.4.3 The DL shall also notify the user of any planned development in the Distribution System that may have an impact on the User System.

5.2.5 Preparation of Distribution Development Plan

5.2.5.1 The DL shall collate and process the planning data submitted by the Users into a cohesive forecast and use this in preparing the data for the Distribution Master Plan (DMP).

5.2.5.2 The DL shall develop and submit every four years to MERA a DMP.

5.2.5.3 The DMP shall include:

(a) energy and demand forecasts.

(b) distribution substation siting and sizing.

(c) distribution feeder routing and sizing.

(d) distribution reactive power compensation plan

(e) other distribution reinforcement plans and of the technical and economic analysis performed to justify the DMP.

5.2.5.4 If a User believes that the cohesive forecast prepared by the DL does not accurately reflect its assumptions on the planning data, it shall promptly notify the DL of its concern. The DL and the User shall promptly meet to address the concern of the User.

5.2.6 Distribution System Planning Studies

5.2.6.1 The DL shall conduct Distribution planning studies to ensure the safety and reliability of the Distribution System for the following purposes:

a) preparation of the Distribution Master Plan to be submitted every 4 years to MERA.

b) evaluation of Distribution System reinforcement projects, and

c) evaluation of any proposed User Development, which is submitted in accordance with an application for a Connection Agreement or an Amended Connection Agreement.

5.2.6.2 The Distribution planning studies shall be conducted to assess the impact on the Distribution System or to any User System of any Demand forecast or any proposed equipment change in the Distribution System or the User System and to identify corrective measures to eliminate the deficiencies in the Distribution System or the User System.

5.2.6.3 The relevant technical studies described in this section and the required planning data shall be used in the conduct of the Distribution Planning studies.

5.2.6.4 The DL shall conduct distribution planning analysis which shall include:

(a) the determination of optimum patterns for the selection of sites and sizes of distribution substations.

(b) the determination of optimum patterns for feeder development.

(c) the development of optimum Reactive Power compensation programs and

(d) the development of an optimum feeder configuration and switching controls for distribution feeders.

5.2.7 Voltage Drop Studies

5.2.7.1 Voltage drop studies shall be performed to determine the voltages at the Connection Points for the forecasted Demand of the existing Distribution System and any planned expansion, reinforcement, or development.

5.2.7.2 Voltage drop studies shall be performed to evaluate the impact on the Distribution System of the connection of new Embedded Generating Plants, equipment, or distribution lines.

5.2.8 Short Circuit Studies

5.2.8.1 Short circuit studies shall be performed to evaluate the effect on the Distribution System Equipment of the connection of new Generating Plants and other facilities that will result in increased fault duties for the Distribution System Equipment.

5.2.8.2 These studies shall identify the Equipment that could be damaged when current exceeds the design limit of the Equipment. The studies shall also identify the Circuit Breakers and fuses, which may fail when interrupting possible short circuit currents.

5.2.8.3 Three-phase short-circuit studies shall be performed for all nodes of the Distribution System for the maximum and minimum generation scenarios of the Distribution System and for different system circuit configurations.

5.2.8.4 Single line-to-ground fault studies shall also be performed for critical Distribution System nodes. These studies shall identify the most severe conditions that the Distribution System Equipment may be exposed to.

5.2.8.5 The DL and the User shall exchange information on fault in feed levels at the Connection Point. This shall include:

(a) the maximum and minimum three-phase and line-to-ground fault in feeds.

(b) the X/R ratio under short circuit conditions.

(c) in the case of interconnected Systems, adequate equivalent network representation for short circuit calculations.

5.2.8.6 Alternative Distribution System circuit configurations may be studied to reduce the short circuit current within the limits of existing Equipment.

5.2.8.7 The results shall be considered satisfactory when the short-circuit currents are within the design limits of Equipment and the proposed Distribution System configurations are suitable for flexible and safe operation.

5.2.9 Distribution System Loss Studies

5.2.9.1 System Loss studies shall be performed to identify, classify, and quantify the losses in the Distribution System. The various categories and components of System Loss specified in Section 3 shall be identified and quantified in conducting the System Loss studies.

5.2.9.2 System Loss studies shall be performed to determine the effects of any User Development and any development in the Distribution System on the efficiency of the Distribution System.

5.2.10 Distribution Reliability Studies

5.2.10.1 Distribution Reliability studies shall be performed to determine the frequency and duration of Customer Interruptions in the Distribution System.

5.2.10.2 The historical Reliability performance of the Distribution System shall be determined from the Interruptions data of the Distribution System.

5.3 Standard Planning Data

5.3.1 Energy and Demand Forecast

5.3.1.1 The Customer (Distributing 100kW or more) shall provide the DL with its Energy and Demand forecasts at each Connection Point for the five (5) succeeding years if need be.

5.3.1.2 The Forecast Data for the first year shall include monthly Energy and Demand forecasts, while the remaining four years shall include only the annual Energy and Demand forecasts.

5.3.1.3 The Customers shall provide the net values of Energy and Demand forecast after any deductions to reflect the output of a Customer Self-Generating Plant. Such deductions shall be stated separately in the Forecast Data.

5.3.1.4 The following factors shall be considered by the DL and the Customer when forecasting Demand:

(a) historical demand data

(b) demand trends

(c) significant public events

(d) customer self-generating plant schedules

(e) demand transfers

(f) interconnection with adjacent DLs, and other relevant factors.

5.3.1.5 The Embedded Generator shall submit to the DL the projected Energy and Demand to be generated by each Embedded Generating Unit and Embedded Generating Plant.

5.3.2 Embedded Generating Unit Data

5.3.2.1 The Embedded Generator shall provide the DL with data relating to the Embedded Generating Units of each Embedded Generating Plant.

5.3.2.2 The following information shall be provided for the Embedded Generating Units of each Generating Plant:

(a) rated capacity (MVA and MW)

(b) rated voltage (kV)

(c) type of generating unit and expected running mode(s)

(d) direct axis sub transient reactance (%) and

(e) rated capacity, voltage, and impedance of the Generating Unit's step-up transformer.

5.3.2.3 If the Generating Unit is connected to the Distribution System at a Connection Point with a bus arrangement which is, or may be operated in separate sections, the bus section to which each Generating Unit is connected shall be identified.

5.3.3 User System Data

5.3.3.1 If the User is to be connected at Low Voltage, the following data shall be provided to the DL:

(a) connected loads, and (b) maximum demand.

5.3.3.2 If the User is to be connected at Medium Voltage, the following data shall be provided to the DL:

(a) all types of loads:

(I) connected load, including type and control arrangements

(2) maximum demand

(b) Fluctuating and Cyclical Loads:

(1) the rate of change of the demand

(2) the switching interval; and

(3) the magnitude of the largest step change.

5.3.3.3 The Customer shall provide the Electrical Diagrams and Connection Point Drawings of the User System and the Connection Point. The diagrams and drawings shall indicate the quantities, ratings, and operating parameters of the following:

(a) equipment (e.g., Generating Unit, power transformer, and Circuit Breaker)

(b) electrical circuits (e.g., overhead lines and underground cables)

(c) substation bus arrangements

(d) grounding arrangements

(e) phasing arrangements

(f) switching facilities.

5.3.3.4 The User shall provide the values of the following circuit parameters of the overhead lines and/or underground cables from the User's substation to the Connection Point in the Distribution System:

(a) rated and operating voltage (kV)

(b) positive sequence resistance and reactance (ohm)

(c) positive sequence shunt susceptance (Siemens or ohm I)

(d) Zero sequence resistance and reactance (ohm)

(e) Zero sequence susceptance (Siemens or ohm I).

5.3.3.5 If the User System is connected to the Distribution System through a step-up transformer, the following data for the power transformers shall be provided:

(a) rated MVA

(b) rated voltages (kV)

(c) winding arrangement

(d) positive sequence resistance and reactance (at max, min, and nominal tap)

(e) zero sequence reactance for three-legged core type transformer

(f) tap changer range, step size and type (on-load or off-load)

(g) basic Lightning Impulse Insulation Level (kV).

5.3.3.6 The User shall provide the following information for the switchgear, including circuit breakers, load break switches, and disconnect switches at the Connection Point and at the substation of the User (a) rated voltage (kV):

(b) rated current (A),

(c) rated symmetrical RMS short circuit current (kA), and (d) basic Lightning Impulse Insulation Level (kV).

5.3.3.7 The User shall provide the details of its System Grounding. This shall include the rated capacity and impedances of the Grounding Equipment.

5.3.3.8 The User shall provide the data on independently switched Reactive Power compensation Equipment at the Connection Point and at the substation of the Customer. This shall include the following information:

(a) rated capacity (MVAR)

(b) rated voltage (kV)

(c) type (e.g., shunt inductor, shunt capacitor, static var compensator)

(d) operation and control details (e.g. fixed or variable, automatic, or manual).

5.3.3.9 If a significant portion of the User's Demand may be supplied from an alternative Connection Point, the relevant information on the Demand transfer capability shall be provided by the User including the following:

(a) the alternative Connection Point

(b) the demand normally supplied from each alternative Connection Point

(c) the demand which may be transferred from or to each alternative connection point.

(d) the control (e.g. manual or automatic) arrangements for transfer including the time required to effect the transfer for forced outage and planned maintenance conditions.

5.3.3.10 If the User has an Embedded Generating Plant and/or significantly large motors, the short circuit contributions of the Embedded Generating Units and the large motors at the Connection Point shall be provided by the User. The short circuit current shall be calculated in accordance with the IEC Standards or their equivalent national standards.

5.4 Detailed Planning Data

5.4.1 Embedded Generating Unit and Embedded Generating Plant Data

5.4.1.1 The following additional information shall be provided for the Embedded Generating Units of each Generating Plant:

(a) derated capacity (MW) monthly if applicable

(b) additional capacity (MW) obtainable from Generating Units more than Net Declared Capacity

(c) minimum stable loading (MW)

(d) reactive power capability curve

(e) stator armature resistance

(f) direct axis synchronous,

(g)transient and sub transient reactance.

(h)quadrature axis synchronous, transient, and sub transient reactance.

(i)direct axis transient and sub transient time constants.

(j) quadrature axis transient and sub transient time constants

(k) turbine and Generating Unit inertia constant (MWsec/MVA)

(l) rated field current (amps) at rated MW and MVAR output and at rated terminal voltage, and short circuit and open circuit characteristic curves.

5.4.1.2 The following information on Step- up Transformers shall be provided for each Embedded Generating Unit:

(a) rated MVA

(b) rated Frequency

(c) rated voltage (kV)

(d) voltage ratio

(e) positive sequence reactance (maximum, minimum, and nominal tap)

(f) positive sequence resistance (maximum, minimum, and nominal tap)

(g) zero sequence reactance

(h) tap changer range

(i) tap changer step size; and

(j) tap changer type: on load or off circuit.

5.4.1.3 The following excitation control system parameters shall be submitted:

(a) DC gain of Excitation Loop

(b) rated field voltage.

(c) maximum field voltage

(d) minimum field voltage

(e) maximum rate of change of field voltage (rising)

(f) maximum rate of change of field voltage (falling)

(g) details of Excitation Loop described in diagram form showing transfer functions of individual elements.

(h) dynamic characteristics of over excitation limiter, and

(i) dynamic characteristics of under excitation limiter.

5.4.1.4 The following speed-governing parameters for reheat steam Generating Units shall be submitted:

(a) high pressure governor average gain (MW/Hz)

(b) speeder motor setting range

(c) speed droop characteristic curve

(d) high pressure governor valve time constant

(e) high pressure governor valve opening limits.

(f) high pressure governor valve rate limits

(g) reheater time constant (Active Energy stored in reheater)

(h) intermediate pressure governor average gain (MW/Hz)

(i) intermediate pressure governor setting range.

(j) intermediate pressure governor valve time constant

(k) intermediate pressure governor valve opening limits.

(l) intermediate pressure governor valve rate limits

(m) details of acceleration sensitive elements in high pressure and intermediate pressure governor loop

(n) a governor block diagram showing the transfer functions of individual elements.

5.4.1.5 The following speed-governing parameters for non-reheat steam, gas turbine, geothermal, and hydro Generating Units shall be submitted:

(a) governor average gain

(b) speeder motor setting range

(c) speed droop characteristic curve

(d) time constant of steam or fuel governor valve or water column inertia.

(e) governor valve opening limits

(f) Governor valve rate limits

(g) time constant of turbine.

5.4.1.6 The following plant flexibility performance data for each Generating Plant shall be submitted:

(a) rate of loading following weekend Shutdown (Generating Unit and Generating Plant)

(b) rate of loading following an overnight Shutdown (Generating Unit and Generating Plant)

(c) block load following synchronizing

(d) rate of Load Reduction from normal rated MW

(e) regulating range, and

(f) load rejection capability while still Synchronized and able to supply load.

5.4.1.7 The following auxiliary Demand data shall be submitted:

(a) normal unit-supplied auxiliary load for each Generating Unit at rated MW output and

(b) each Generating Plant auxiliary Load other than (a) above and where the station auxiliary Load is supplied from the Distribution System.

5.4.2 User System Data

5.4.2.1 Large Customers connected to the Distribution System shall submit to the DL the following load characteristics:

(a) maximum demand on each phase at peak load condition,

(b) the voltage unbalance, and

(c) the harmonic content.

5.4.2.2 The DL, and the User shall exchange information, including details of physical and electrical layouts, parameters, specifications, and protection, needed to assess transient Over voltage effects in the Distribution System or the User System.

5.4.2.3 The User shall provide any additional planning data that may be requested by the DL.

5.5 Network Investment Criteria

5.5.1 Introduction

5.5.1.1 Distribution tariffs should be sufficient to allow the necessary investments in the networks to be carried out in a manner allowing these investments to ensure the viability of the networks.

5.5.1.2 The DL shall invest in the Distribution System when the required development meets the technical and investment criteria specified by MERA.

5.5.1.3 The need to invest must first be decided on technical grounds. All investments must be the least life cycle cost technically acceptable solution, that is, shall provide for standard supply:

a). Minimum quality as per MBS.

b). Minimum reliability and operational requirements as determined by this code and by MERA.

5.5.1.4 The investment choice must be justified by considering technical alternatives on a least- life cycle cost approach. Least life cycle cost is the discounted least cost option over the lifetime of the equipment, considering the technical alternatives for investment, operating expenses and maintenance.

5.5.1.5 Calculations to justify investment shall assume a typical project life expectancy of 25 years, except where otherwise dictated by plant life or project life expectancy.

5.5.1.6 The following key economic and financial parameters shall be determined by MERA approved process:

a). Discount rate

b). Customer interruption cost (cost of unserved energy)

c). Other parameters, such as tariffs and additional economic parameters.

5.5.2 General Investment Criteria

5.5.2.1 Investments should be prudent (that is justified) as a least life-cycle cost solution after considering, where applicable, alternatives that consider the following:

a). The investment that will minimize the cost of the energy supplied and the customer interruption cost (cost of unserved energy).

b). Current and projected demand on the network.

c). Reduction of life-cycle costs e.g. reduction of technical losses, operating

and maintenance costs and telecommunication projects

d). Current condition of assets and refurbishment and maintenance

requirements.

e). Demand and supply options.

f). Any associated risks.

5.5.2.2 General (shared) network investments shall be evaluated on the least-life cycle economic cost. Economic cost will consider the least life cycle total cost of the electricity related investment to both the DL and the customer.

5.5.2.3 Investments made by the DL dedicated to a particular customer shall be evaluated on a least life-cycle DL cost. DL cost will consider only the least-life cycle investment cost to the DL.

5.5.2.4 The DL shall evaluate investments in terms of the following categories:

a). Shared network investments

b). Dedicated customer connections.

c). Statutory investments.

d). International connections (cross-border connections)

5.5.3 Least economic cost criteria for shared network investments

5.5.3.1 Shared network investments are:

a). Investments on shared infrastructure (not dedicated) assets.

b). Investments required to provide adequate upstream network capacity.

c). Investments required to maintain or enhance supply reliability and/or quality to attain the limits or targets, determined in this code, on existing network assets.

d). Refurbishment of existing standard dedicated connection assets.

5.5.3.2 All shared network investments are to be justified on least economic cost.

In determining the least economic cost for shared network investments the investment must be justified to minimise the cost to the electricity industry and not just to the DL.

5.5.4 Least life cycle cost criteria for standard dedicated customer connections

5.5.4.1 A standard connection is defined as the lowest life-cycle costs for a technically acceptable solution and will be charged for as prescribed by the DL.

5.5.4.2 Dedicated customer connections are:

a). New connection assets created for the sole use of a customer to meet the customer's technical specifications.

b). Dedicated assets are assets that are unlikely to be shared in the DL's planning horizon by any other end-use customer.

5.5.4.3 All dedicated connection investments are to be justified on the technically acceptable least life-cycle costs.

5.5.4.4 Where the investment meets the least life-cycle cost, the customer shall be required to pay a standard connection charge as described in the Tariff Code.

5.5.4.5 For dedicated connections, customers will be allowed to choose a contractor other than the DL, provided that an agreement is reached between the DL and the customer prior to the project being undertaken detailing the conditions.

5.5.4.6 For certain customer groupings, as approved by MERA, the investments shall be justified collectively as per customer grouping and not per customer.

5.5.4.7 The DL will refurbish / replace / reconfigure all equipment to meet standard supply criteria at no cost to the customer and this will be allowed to be recovered in the use of system (network) charges. This will be a non-discriminatory approach where no consideration will be given to the special or unique requirements of the customer.

5.5.5 Investment criteria for premium customer connections

5.5.5.1 A premium connection is where a customer contracts with the DL for additional specific requirements not justified in the investment criteria for standard dedicated customer connections.

5.5.5.2 The DL shall investigate these additional requirements and will provide a least life-cycle cost solution.

5.5.5.3 If the customer agrees to the solution, all costs to meet the customer requirement more than what is considered the least life-cycle cost investment is payable as a premium connection charge by the customer as prescribed by the DL. Such costs shall be appropriately pro-rated, if a portion of the investment can be justified based on improved reliability or reduction of costs.

5.5.5.4 The refurbishment of identified premium connection assets will occur when the equipment is no longer reliable or safe for operation. The DL must justify the need for refurbishment of the premium assets to the customer, and the customer must agree to the continuance of the premium supply.

5.5.5.5 At the time of refurbishment, should the customer have any requirements that cannot be met in terms of the standard connection, any additional investment will be seen as a premium connection.

5.5.5.6 Where the refurbishment of a supply in accordance with current technical standards will result in additional cost to the customer, an engineering solution that minimises the sum of the DL's and the customer's costs will be found. This least economic cost option will be implemented but any expenditure more than the DL least life-cycle cost solution under General Investment Criteria and standard customer connection criteria as per (5.2.2 and 5.2.4 above) will be borne by the customer through a new premium connection charge and shall not be recovered through use-of-system (network) charges.

5.5.5.7 For premium connections, customers will be allowed to choose a contractor other than the DL, provided that an agreement is reached between the DL and the customer prior to the project being undertaken detailing the conditions.

5.5.6 Statutory or strategic investments

5.5.6.1 DL will be obligated to make statutory investments in terms of clause 5.2.6.3 below.

5.5.6.2 Statutory and strategic investments will be motivated on a least economic cost basis, as defined in 5.2.3.

5.5.6.3 Strategic and statutory projects include the following:

a). Investments formally requested in terms of published government policy but not considered dedicated customer as under (section 5.2.4) standard connection.

b). Projects necessary to meet environmental legislation, e.g. the construction of oil containment dams;

c). Expenditure to satisfy the requirements on the DL to comply with the Factories Act; this classification is intended to ensure the safety of operating and maintenance personnel who are exposed to possible danger when busy with activities related to electricity distribution.

d). Possible compulsory contractual commitments.

e). Servitude acquisition.

f). Generators.

5.5.7 Investment criteria for international connections

The investment for international customers shall be in terms of the criteria set out for a dedicated connection, but the DL shall charge a connection charge that ensures that there are no cross-border subsidies.

5.5.8 Excluded services

5.5.8.1 Excluded services may be competitive or provided by the DL as a monopoly service.

5.5.8.2 Monopoly services are those mandatory services to ensure a standard of work that meets quality of supply, reliability, and safety standards.

5.5.8.3 Excluded services include the following:

a). Design and construction of the customers own local system outside the boundary point of connection from the DL.

b). Recoverable works such as inspection and maintenance of non-DL owned installations, line relocation and other requested recoverable works.

c). The construction and maintenance of public lighting assets.

5.5.8.4 For excluded services, customers will be allowed to choose a contractor other than the DL, provided that an agreement is reached between the DL and the customer prior to the project being undertaken detailing the conditions. These conditions will set out the following:

a). The assets the customer is allowed to work on or not.

b). The terms and conditions for the approval of the network design.

c). The terms and condition for the inspection and the work done prior to any agreement to take over and/or commission the supply.

d). The charges to be raised by the DL for monopoly related services.

5.5.8.5 The fees charged by the DL for excluded services may be regulated.

6 DISTRIBUTION OPERATIONS AND MAINTENANCE CODE

6.1 Operations

6.1.1 Introduction

This section describes operational procedures and responsibilities of the distribution system participants.

6.1.2 Objective

The objective of this section is to set out the responsibilities and roles of the participants as far as the operation of the Distribution System is concerned and more specifically issues related to:

a) economic operation, reliability, and security of the Distribution System

b) operational authority, communication, and contingency planning of the Distribution System

c) management of power quality

d) operation of the Distribution System under normal and abnormal conditions; and

e) field operation, maintenance, and maintenance coordination/ outage planning, and safety of personnel and public.

6.2 Responsibilities

6.2.1 DL

a) The DL shall operate the Distribution System to achieve the highest degree of reliability and shall promptly take appropriate remedial action to relieve any condition that may jeopardize reliability.

b) The DL shall co-ordinate voltage control, demand control, operating on the distribution System, and security monitoring to ensure safe, reliable, and economic operation of the distribution system.

c) In the event of an embedded generator having to shut down or island plant because of a disturbance on the distribution network, the DL shall carry out network restoration to minimize the time required to resynchronize the embedded generating units.

d) Ensuring that the availability and reliability of every power station supply is always maximized under normal and abnormal conditions.

e) The DL may shed customer load to maintain system integrity. Following such action, the customer load shall be restored as soon as possible after restoring and maintaining system integrity.

f) The DL shall operate the Distribution System as far as practical so that instability, uncontrolled separation, or cascading outages do not occur.

g) The DL is responsible for efficient restoration of the Distribution System after supply interruptions. The restoration plans shall be prioritized in accordance with customer requirements and as prescribed in the governing legislations.

h) The DL shall continuously monitor and operate the Distribution System.

i) The DL shall establish and implement operating instructions, procedures, standards and guidelines to cover the operation of the Distribution System under normal and abnormal system conditions.

j) The DL shall operate the distribution System within defined technical standards and equipment operational ratings.

k) The DL shall ensure adequate and reliable communications to all major users of the distribution System.

6.2.2 Embedded Generators and Other Customers

a) When conditions on the Distribution System, under normal or abnormal conditions, become such that it may jeopardize plant or personnel, customers shall immediately disconnect from the distribution system.

b) The Embedded Generator shall ensure that its generating units are operated within the capabilities defined in the Connection Agreement entered with the DL.

c) The Embedded Generator shall reasonably cooperate with the DL in executing all the operational activities during an emergency generation condition.

d) Customers shall assist the DL in correcting quality of supply problems caused by the Customer's equipment connected to the Distribution System.

e) Customers shall always operate their appliances or equipment in a manner that ensures their compliance with the conditions specified and agreed with the responsible DL.

f) All customers must declare any generating plant that may be paralleled with the Distribution network via switching and specify the interlocking mechanism to prevent inadvertent parallel operation with the DL's network.

g) Embedded generators with Type 1 generating units shall have the required protection to trip in the event of a momentary supply loss causing an island condition to prevent paralleling out of synchronism due to auto-reclose functionality on the DL's network.

6.3 Operational Authority

a) The DL shall have the authority to instruct operations on the Distribution System. Operational authority for other networks operators shall lie with the respective asset owners.

b) Network control, as it affects the interface between the DL and a customer, shall be in accordance with the operating agreements between the participants.

c) Except where otherwise stated in this code, no participant shall be permitted to operate equipment of another participant without the permission of such other participant. In such an event the asset owner shall have the right to test and authorize the relevant operating staff in accordance with its own standards before such permission is granted.

d) Notwithstanding the provisions of clause 6.2.1 of this code, participants shall retain the right to safeguard their own equipment.

6.4 Operating Procedures

a) The DL shall develop and maintain operating procedures for the safe operating of the Distribution System, and for assets connected to the Distribution System. These operating procedures shall be adhered to by participants when operating equipment on the Distribution System or connected to the Distribution System.

b) Each customer shall be responsible for their own safety rules and procedures at least in compliance with the relevant safety legislation. Customers shall ensure that these rules and procedures are compatible with the DL developed procedures defined in clause 6.4 (a) above.

c) Customers and the DL shall enter into operating agreements, where not included in the supply agreement, as defined in the service provider licences.

6.5 Operation Liaison

a) The DL shall be responsible for ensuring adequate operational liaison with other connected participants.

b) The participants shall appoint competent personnel to operate their network, and where needed shall establish direct communication channels amongst themselves to ensure the flow of operational information between the participants.

c) If any participant experiences an emergency, the DL may call upon other participants to assist to an extent as may be necessary to ensure that such emergency does not jeopardize the integrity of the Distribution System.

d) Pursuant to clause 6.4 (c) above, the relevant participant shall ensure that the emergency notification contains sufficient details in describing the event including the cause, timing, and recording of the event to assist the DL in assessing the risk and implications to the distribution system and all the affected Customers' equipment.

e) For planned events, which have an identified operational effect on the Distribution System, or on Customers' equipment connected to the Distribution System, the relevant participant shall notify the DL.

f) Where it is possible for a customer to parallel supply points or transfer load or embedded generation from one point of supply to another by performing switching operations on the customer's network, the operating agreement shall cover at least the operational communication, notice period requirements and switching procedures for such operations.

g) The DL and customers shall agree on the bus-bar configuration(s) at each point of supply during normal and emergency conditions. The DL shall keep updated records of such agreements.

6.6 Emergency and Contingency Planning

a) The DL shall develop and maintain emergency and contingency plans to manage the system contingencies and emergencies that affect the operation of the Distribution System and the Interconnected Power System. Such plans shall be developed in consultation with all affected participants, and shall be consistent with internationally acceptable best practices, and shall include but not be limited to:

i) under-frequency load shedding,

ii) Prevention of voltage slide and collapse,

iii) meeting any national disaster management requirements including the necessary minimum load requirements,

iv) forced outages at any POC,

v) restoration and continuation of supply to every power station during normal and abnormal conditions is to be classified as a high priority, and

vi) supply restoration.

b) Emergency plans shall enable the safe and orderly recovery from a partial or complete system collapse, with minimum impact on customers.

c) All contingency and emergency plans shall be reviewed biannually or in accordance with changes in network conditions.

d) All contingency and emergency plans shall be verified by audits, if possible, by using on-site inspections and actual tests. In the event of such tests causing undue risk or undue cost to a participant, the DL shall take such risks or costs into consideration when deciding whether to conduct the tests.

Any tests shall be carried out at a time that is least disruptive to the participants. The costs of these tests shall be borne by the respective asset owners. The DL shall ensure the co-ordination of the tests in consultation with all affected participants.

e) The DL shall, in consultation with the transmission licensee and system and marketing operator, set the requirements and implement:

i) Automatic and manual under frequency load shedding in accordance with the System and Market Operator’s requirements.

ii) Automatic and manual under voltage load shedding to prevent voltage collapse.

iii) Manual load shedding to maintain network integrity.

f) Participants shall make available loads and schemes to comply with these requirements.

g) The DL shall be responsible for determining emergency operational limits on the Distribution System, updating these periodically and making these available to the participants.

h) The DL shall conduct network studies, which may include but not be limited to load flow, fault level, stability, and resonance studies to determine the effect that various component failures would have on the reliability of the Distribution System.

6.7 Operations during abnormal condition

a) During abnormal operating conditions the DL shall be obliged to take necessary precautionary measures to prevent network disturbances from spreading and to restore supply to consumers as quickly as possible.

b) The DL shall cooperate with the system and marketing operator and TL in taking corrective measures in the event of abnormal conditions on the Distribution System. The corrective measures shall include both supply-side and demand-side options. Where possible, warnings shall be issued by the DL to affected participants on expected utilization of any contingency resources.

c) The DL shall be entitled to disrupt some sections of the network in the event of a prolonged disturbance resulting from unsuccessful corrective measures undertaken.

d) Termination of the use of emergency resources shall occur as the order of return being determined by the most critical loads, first in terms of safety and then plant.

e) During emergencies that require load shedding, the request to shed load shall be initiated in accordance with procedures prepared by the DL.

6.8 Independent Action by Participant

Each participant shall have the right to reduce supply or demand, or disconnect a POC under emergency conditions, if such action is necessary for the protection of life or equipment and shall give advance notice of such action where possible.

6.9 Demand and Voltage Control

a) The DL shall implement demand control measures when:

i) Instructed to by the System and Marketing Operator.

ii) Abnormal conditions exist on the Distribution System.

iii) Multiple outage contingency exists resulting in island grid operation; and

iv) Any other operational event the DL deems to warrant the implementation of demand control measures for the safe operation of the Distribution System.

b) Demand control shall include but not limited to:

i) Customer demand management

ii) Automatic under-frequency load shedding

iii) Automatic under-voltage load shedding

iv) Emergency manual load shedding, and

v) Voluntary load curtailment.

c) The DL shall develop load reduction procedures, which shall be regularly updated, to reduce load in a controlled manner taking cognizance of the type of load.

d) The DL shall maintain system voltage within statutory limits at the points of supply or otherwise as agreed in the operating/ supply agreement.

6.10 Fault Reporting and Analysis

a) The end-user customers and embedded Generators shall report the loss of major loads (> 5MVA) or generation (as agreed by the participants) to the DL within 15 minutes of the event occurring. Notice of the intention to reconnect such load shall be given with at least 15 minutes advance notice to enable the DL to take any necessary action required.

b) The DL shall investigate all incidents that materially affected the quality of supply to another participant. The DL shall initiate and coordinate such an investigation and make available the findings of such investigation to affected participants on request.

c) The findings of such an investigation shall include where relevant:

i) Date and time of the incident.

ii) Location of the incident.

iii) Duration of the incident.

iv) Equipment involved.

v) Cause of the incident in compliance with applicable national standards.

vi) Demand control measures undertaken specifically recording the customer MWs shed and energy lost as a result of the measures taken.

vii) Supply restoration details.

viii)Embedded Generation interrupted.

ix) Under-frequency Load Shedding response.

x) Estimated date and time of return to normal service.

xi) Customer load tripped MW and energy lost when incident occurred or as a direct result of incident not including any Demand Control Measures taken.

xii) Estimated number of customers having lost supply.

xiii)Recommendations.

d) Any participant shall have a right to request an independent audit of the findings, at its own cost. If these audit findings disagree with the original findings, the participant may follow the dispute resolution mechanism as specified in the Governance section.

6.11 Maintenance Program

a) The DL shall have a maintenance philosophy against which their maintenance practices and programs are compiled and documented in accordance with applicable national standards. These documented maintenance programs must be auditable.

b) The DL shall compile at least an annual maintenance plan in line with the budget period.

c) Accurate records of maintenance done shall be kept for a period of at least 5 years.

d) Scheduling of planned outages should coincide with the maintenance requirements of other participants connected to the affected network.

e) All participants that may be affected by the planned outages will be informed at least 2 days or 48 hours in advance.

6.12 Testing and Monitoring

a) A participant has the right to request to test and / or monitor any equipment at the POC to the Distribution System to ensure that the participants are not operating outside the technical parameters specified in any part of the Distribution Code and other applicable standards which the participants are required to comply with. Such testing and / or monitoring shall be carried out as mutually agreed by the parties.

b) A participant found to be operating outside the technical parameters shall, within such time agreed upon by the parties involved, remedy the situation, or disconnect from its network the equipment causing problems.

c) Any dispute arising out of the test and monitoring process shall be resolved through the dispute resolution mechanism in the Governance section.

6.13 Safety Coordination

a) The DL shall comply with relevant legislation and develop Operating Regulations to ensure safety of personnel, whilst operating on the Distribution System or any equipment connected to the Distribution System.

b) Where operational boundaries exist, there shall be a joint agreement on operating procedures to be complied with by all affected participants.

c) There shall be written authorization of personnel who operate on or work on live equipment forming part of or connected to the Distribution System.

d) The "Operating Regulations" referred to in clause 6.13 (a) of this code shall include rules and regulations for the safe operating of plant, continuity of supply and authorization of personnel related to the operating of HV, MV and LV equipment.

6.14 Disconnection and Reconnection

6.14.1 Non-compliance

A DL may disconnect supply to a customer if:

a) the customer has not fulfilled an obligation to comply with this Code

b) the DL has given the customer a written notice of disconnection in accordance with the existing legislation and

c) the customer fails to comply with a written notice of non-compliance issued by the DL or any arrangement entered by the DL and the customer which the customer

has failed to comply with including non-compliance with the DL applicable standards.

6.14.2 Health, Safety or Emergency

a) A DL may disconnect supply to a customer's supply address if supply otherwise would potentially endanger or threaten to endanger the health or safety of any person or the environment, or an element of the environment or if there is otherwise an emergency.

b) except in the case of an emergency, or where there is a need to reduce the risk of fire or where relevant regulations require otherwise, a DL must not disconnect a customer's supply under clause 6.14.2(a) unless the DL has:

i) given the customer written notice of the reason; and

ii) allowed the customer reasonable time in accordance with relevant legislations from the date of receipt of the notice to eliminate the cause of the potential danger.

c) The DL shall have the right to interrupt or disconnect supply if a threat of injury or material damage is anticipated because of the malfunctioning of the electrical installation equipment on the Customer's premises or on the Distribution System.

6.14.3 Retailer's request

a) A DL must disconnect supply to a customer's supply address if the customer's retailer has requested disconnection.

b) Upon the receipt of a valid request by the customer's retailer, where the DL can disconnect supply to the customer's supply address by de-energizing the customer's supply address remotely or manually and reasonably believes that it can do so safely, subject to clause 6.14.6.

c) Part (b) does not apply to a request for disconnection at a scheduled time.

6.14.4 Customer’s request

a) A DL must disconnect supply to a customer if the customer has requested disconnection and must make every effort to disconnect supply in accordance with the customer’s request.

b) Upon such a request, where the DL can disconnect supply to the customer by de-energizing the customer’s supply remotely or manually and reasonably believes that it can do so safely, subject to clause 6.14.6.

c) Paragraph (b) does not apply to a request for disconnection at a scheduled time.

d) Customer (connected at MV and HV levels) shall give written notice to the DL of any intended voluntary disconnection.

6.14.5 Illegal supply

A DL may disconnect supply to a customer immediately if:

a) The supply of electricity to a customer's electrical installation is used other than at the customer’s premises, except in accordance with the Act.

b) A customer takes the supplied electricity at a customer's premises to another supply premise

c) a customer tampers with, or permits tampering with, the meter or associated equipment, or

d) a customer allows electricity supplied to the customer’s supply address to bypass the meter.

6.14.6 No disconnection

a) A DL must not disconnect supply to a customer’s supply address except in the case of an emergency or under clause 6.14.5.

b) Despite any other provision of this Code, a DL must not disconnect supply to a customer

i) if the customer's supply address is registered as a life support machine supply address except in the case of an emergency, or

ii) for non-compliance under clause 6.14.1

6.14.7 Reconnection of Supply

a) If a DL has disconnected a customer following:

i) non-compliance with this Code under clause 6.14.1 and the customer has remedied the non- compliance, or

ii) danger under clause 6.14.2 has been eliminated by the customer; or

iii) a request from a retailer, on request by the customer or by a retailer on behalf of the customer, but subject to other applicable laws and codes and the customer paying any reconnection charge (determined by reference to its approved statement of charges), the DL must reconnect the customer in line with Customer Services Charter.

b) If a customer, or a retailer on behalf of a customer, makes a request for reconnection under clause 6.14.7 (a) (iii) to a DL:

i) before 3 pm on a working day, the DL must reconnect the customer on the day of the request, or

ii) after 3 pm on a working day, the DL must reconnect the customer on the next working day.

iii) where the DL can reconnect the customer by re-energizing the customer's supply

address remotely, subject to paragraphs (i) and (ii), the DL must make every effort to reconnect the customer within two hours of a request being validated by the DL.

c) Notwithstanding 6.14.7 (b) above, DL and a customer may agree later times and a customer must apply to the DL for reconnection.

A DL is not obliged to reconnect a customer under clause 6.14.7 (b) unless the DL reasonably believes that it can do so safely.

6.15 Commissioning and Connection

a) MV and HV customers shall supply commissioning programs to the DL control and operating facility at least 1 month in advance. Subsequently, a notice of first connection shall be given to the DL control and operating facility at least 2 weeks before actual connection. Details of the information required shall include but not be limited to the following:

i) Commissioning procedures and programs

ii) Documents and drawings required

iii) Proof of compliance with standards

iv) Documentary proof of the completion of all required tests

v) SCADA information, to be available and tested before commissioning

vi) Site responsibilities and authorities.

b) When commissioning equipment at the POC, the DL shall liaise with the affected participants on all aspects that could potentially affect their operation.

c) The DL and customers shall perform all commissioning tests required to confirm that the DL's and the customers' plant and equipment meet all the requirements of the Distribution Code before being connected to and energized from the Distribution system.

6.16 Outage Scheduling and Coordination

6.16.1 Responsibilities of the DL

a) DL shall, with reference to the National Grid outage plans compile the daily outage schedule which shall:

i) make every effort to cater for the planned maintenance and commissioning of new equipment.

ii) describe the planned outage.

iii) Identifies the risks and impact on network performance.

iv) describe the practical contingency plans devised to counter risks, and

v) define the roles and responsibilities of the personnel designated to manage and minimize the impact of these outages on the Distribution System and its users.

b) Notwithstanding clause 6.16.1 (a) above, the DL shall co-ordinate relevant outages with the system and marketing operator.

c) In addition to clause 6.16.1 (a) above, the DL may require information from the Customers regarding major plant and associated equipment, which may affect the performance of the Distribution System and may require additional resources to be committed during the outage planning process.

d) Customers with co-generation and Embedded Generators with the maximum capacity greater than 1MW shall furnish to the DL information on planned outages for the DL to properly plan, and coordinate its control, maintenance, and operation activities.

e) The Distribution outage schedule shall be submitted to Authority upon request.

6.16.2 Risk-related Outages

a) All risk-related outages shall be scheduled with an executable contingency plan in place. The compilation of the contingency plan is the responsibility of the Distribution Control Centers.

b) Contingency plans shall address:

i) Safety of equipment and personnel.

ii) Security and rating of equipment.

iii) Continuity of supply.

iv) Sensitivity of customers.

c) The Distribution control centers shall confirm that it is possible to execute the contingency plan successfully through modelling and simulation.

6.16.3 Communication of System Conditions, Operational Information and Distribution System Performance

a) The DL shall be responsible for providing participants with operational information as may be agreed from time to time. This shall include information regarding planned and forced outages on the Distribution System.

b) The DL shall inform participants of any network condition that is likely to impact the short and long-term operation of that participant.

c) The DL shall record operational information as specified in the Information Exchange section. This information shall be made available to all participants on request.

6.17 Planned Interruptions or Outages

For planned interruptions or outages, the DL shall act in accordance with its Customer Service Charter and provide the affected Customers with information relating to the expected date of the outage, time and duration of the outage, and shall establish reasonable means of communication to the Customers for outage related enquiries.

6.18 Unplanned Interruptions or Outages

a) In case of unplanned interruptions or outages the DL may require a customer to comply with reasonable and appropriate instructions from the DL and may further:

i) Require the customer to provide the DL emergency access to customer owned distribution equipment normally operated by the DL or DL owned equipment on customer's property.

ii) Interrupt supply to the customer to carry out maintenance on the Distribution System.

b) Subsequent to clause 6.18 (a), the DL shall plan to keep customers informed about

the expected duration and other details following unplanned interruptions.

6.19 Refusal/Cancellation of Outages

a) No participant may unreasonably refuse an outage request.

b) No participant may unreasonably postpone or cancel a previously accepted outage.

c) The direct costs related to the cancellation / postponement of an outage shall be borne by the respective asset owners.

6.20 Tele-control

Where Tele-control facilities are shared between the DL and other participants, the DL shall ensure that operating procedures are established in consultation with the participants.

7 DISTRIBUTION METERING CODE

7.1 Introduction

This section presents the rules and procedures governing handling of distribution meters.

7.2 Objectives

(a) to establish the requirements for metering the Active and Reactive Energy and Demand input to and/or output from the Distribution System.

(b) to ensure appropriate procedures for providing metering data for billing and settlement, and

(c) to ensure that a dispute settlement process is established and to resolve any billing and payment dispute quickly and satisfactorily.

(d) to provide information for planning and management decision-making.

7.3 Scope of Application

This section applies to all Distribution System Participants.

7.4 Provision of Metering Systems

7.4.1 A DL shall provide, install, and maintain a meter installation for retail billing and settlement purposes for each customer connected to its distribution system.

7.4.2 The DL shall install maximum demand metering (kVA) for customers with an installed capacity greater than 50kVA.

7.4.3 The DL shall provide a check meter to any customer whose installed capacity is 5MVA and above, which shall be connected through independent CTs, VTs and ancillary equipment.

7.4.4 The DL shall identify the types of meters that are available to a customer, the process by which a customer may obtain such a meter and the types of charges that would be levied on a customer for each meter type.

7.4.5 At all times the DL shall have its meters sealed at the critical points i.e. Calibration point and Installation point.

7.4.6 At no time shall the customer tamper with the meter seals, as this is an offence, which attracts prosecution under the Electricity Act.

7.4.7 The DL shall install only calibrated date-stamped meters and ancillary equipment. The standards used for calibration shall be stated in the test certificates from MBS.

7.5 Provision of Metering Services

7.5.1 On request from a customer the DL shall connect a check meter or carry out in-situ tests to determine the accuracy of the meter. The customer that requests check metering shall compensate the DL for all incremental costs associated with that meter, or the cost of in -situ test. If it is a check meter, which is installed, it shall be removed from circuit upon conclusion of the matter and the period shall not exceed 30 days. If it is in-situ test the customer has a right to receive a test certificate of the meter in question.

7.5.2 The DL shall, for a fee, on a written request, provide maximum demand customers with profile data on written request for demand side management studies. The information shall not be for third parties. Any energy consultants shall receive profile data upon payment of a fee determined at the time of need.

7.5.3 The DL shall have an inspection and maintenance program for poly-phase metering installations and document the inspection and results of the inspection.

7.5.4 The DL shall provide metering services and exercise appropriate diligence in detecting and acting upon instances of tampering with metering and service entrance equipment. Upon identification of possible meter tampering, the DL shall take appropriate action, which may lead to prosecution.

7.5.5 The DL shall respond to customer metering disputes and shall establish a fair and reasonable charge for costs associated with resolution of these disputes. If a

complaint is substantiated, the charge shall not be applied. In resolving a dispute, the DL may involve a mutually agreed arbitrator at any time during the dispute resolution process.

7.5.6 The Authority may act as mediator or arbitrator in any matter in respect of which a licensee or customer requests the Authority to act as such.

7.6 Metering Requirements for Embedded Generators

7.6.1 The DL shall install a four-quadrant meter at the interface with an embedded Generator.

7.6.2 The DL shall require an embedded Generator connected to the distribution system to install its own four-quadrant meter in accordance with the DL's metering requirements and to provide the technical details of the metering installation.

7.6.3 Where an embedded Generator 's metering installation does not conform to measurement standards, the DL shall require the embedded Generator to have the metering installation, tested and apply an agreed measurement correction factor to meter readings until conformance is achieved.

7.6.4 Where practical, metering for embedded Generators shall be installed at the POC. If it is not practical to install the meter at the POC, the DL shall apply loss factors to the generation output in accordance with the loss factors applied for retail settlements and billing.

7.4 Metering Requirements at Bulk Supply Interfaces

7.7.1 The DL shall install a four-quadrant meter at every interface with the transmission network.

7.7.2 DL may install a check meter and the maintenance of such (check meter) equipment shall be the responsibility of the DL.

7.7.3 The installed meter shall be synchronized with the DL's meter.

7.7.4 The installation of the meter shall be at the point of interface practically but in any other case both parties shall agree upon the position.

7.8 Metering Data Manipulation

7.8.1 Metering data collected by the DL shall be subjected to a validating, estimating, and editing (VEE) process if a customer has queried the validity of the electricity bill.

7.8.2 The DL shall establish a VEE process according to industry practice and provide assurance that correct data is submitted to the settlement process.

7.8.3 The DL shall document and make available its VEE process and criteria, and allow scrutiny of its process by customers, retailers, and the Authority.

7.9 Metering Equipment Standards

7.9.1 Voltage Transformers

All voltage Transformers shall comply with the MBS Standards or their equivalent standards for metering and shall have an accuracy class of 0.3 or better. The burden in each phase of the voltage Transformer shall not exceed the specified burden of the said voltage Transformer. It shall be connected only to a revenue meter with a burden that will not affect the accuracy of the measurement.

7.9.2 Current Transformers

All current Transformers shall comply with the MBS Standards or their equivalent standards for metering and shall have an accuracy class of 0.3 or better. The burden in each phase of the current Transformer shall not exceed the specified burden of the said current Transformer It shall be connected only to a revenue meter with a burden that will not affect the accuracy of the measurement. The current transformer's rated secondary current shall be either 1 or 5 amperes. The neutral conductor shall be effectively grounded at a single point.

7.10 Meters

7.10.1 The meter shall conform to the type of circuit of the Distribution System where it is connected. The meter shall measure and locally display the kW, kWh, kVAR, kVARh, and cumulative demand with the optional features of time-of-use, maintenance records, and pulse output.

7.10.2 A cumulative record of the parameters measured shall be available on the meter. Bidirectional meters shall have two such records available. If combined Active and Reactive Energy meters are provided, then a separate record shall be provided for each measured quantity and direction. For electronic meters, the loss of auxiliary supply shall not erase these records.

7.10.3 Pulse output shall be provided for each measured quantity. The pulse output shall be from a three-wire terminal with pulse duration of the range 40-80 milliseconds (preferably selectable) and with selective pulse Frequency or rate. The pulse output shall be galvanically isolated from the voltage and current transformers being measured and from the auxiliary supply input terminals.

7.11 Other Accessories

7.11.1 The metering Equipment shall be placed in a cubicle and shall be secured with seals and lock to prevent unauthorized interference with a provision for the register to be visible and accessible for monitoring.

7.11.2 All wiring from the instrument transformers' secondary terminal box to the metering Equipment cubicle shall be placed in a rigid conduit.

7.11.3 The DL shall seal all meters. All seals placed or removed on metering System shall be recorded and the records kept by the DL.

7.12 Metering Equipment Testing and Maintenance

7.12.1 Instrument Transformer Testing

7.12.1.1 Test on the Instrument Transformers shall be conducted by the DL during the Test and Commissioning stage. The tests shall be carried out in accordance with the practices of the DL or relevant standards or guidelines approved by the Authority.

7.12.2 Meter Testing and Calibration

Test and calibration of meters shall be conducted by the DL during the Test and Commissioning stage and as the need arises. If both parties cannot agree on the accuracy of the meter, the Authority shall act as arbiter.

7.12.3 Maintenance of Metering Equipment

7.12.3.1 The DL shall maintain all metering Equipment. In addition, it shall keep all test results, maintenance programs, and sealing records.

7.12.4 Traceability of Metering Standard

The DL shall ensure that all Equipment used in the measurement of meter accuracy or in the establishment of test condition for the determination of meter accuracy shall be calibrated and traceable to MBS or to any reputable international standard body. The traceability shall be carried out in accordance with the guidelines approved by the Authority.

7.13 Meter Reading and Metering Data

7.13.1 Meter Reading and Recording Responsibility

7.13.1.1 Meter leading and recording shall be done by the DL and the records will be kept at the offices of the DL.

7.14 Metering Disputes.

a) If the DL receives a complaint about the accuracy of metering data or the calculation of any substitute or estimated metering data from the Distribution Network User, the DL shall investigate.

b) The investigation shall include a review of all available information, including any information supplied by the Distribution Network User.

c) If the DL determines that there is an inaccuracy due to Meter error, malfunction, or error in the metering data, the DL shall take appropriate steps to remedy the defect, including repair or replacement of equipment and adjustment of metering data.

d) Appropriate adjustments shall also be made to the Distribution Network User's bill.

e) In the event of a dispute, the dispute shall be settled using the procedure specified in this code.

8 DISTRIBUTION PROTECTION CODE

8.1 Introduction

This Section specifies the minimum protection requirements as well as typical settings, to ensure adequate performance of the distribution system as experienced by the customers. DL shall always install and maintain protection installations that comply with the principles and specifications of this Section.

8.2 Objective

To define the minimum protection requirements for any equipment connected to the Distribution System. This is done to:

(a) ensure agreed power quality to customers

(b) minimise damage to primary plant

(c) prevent damage to healthy equipment that conducts fault current during faults

(d) restore supply over the remaining healthy network

(e) sustain stability and integrity of the distribution system

(f) limit safety hazards to the power utility personnel and the public.

8.3 General principles

8.3.1 Protection schemes are generally divided into equipment protection, and system protection.

8.3.2 The main functions of equipment protection are to detect and disconnect a fault on the protected circuit selectively and rapidly. The System protection responds to a System condition as opposed to a System fault e.g. under frequency, voltage slide,

out of step or sub synchronous resonance and undertake appropriate automatic actions to maintain power network integrity.

8.3.3 The protection functions are considered adequate when the protection relays perform correctly in terms of:

a) Dependability
b) Security
c) Speed of operation
d) Selectivity
e) Sensitivity

8.3.4 All Distribution System users shall ensure correct and appropriate settings of protection to achieve effective isolation of faulty equipment within the clearance time specified in clause 8.6 of this Distribution Code.

8.3.5 Protection settings at the Connection Point shall not be altered, or protection bypassed and/or disconnected without consultation and agreement of DL and the User.

8.3.6 In the case where protection is bypassed and/or disconnected, by agreement, then the cause must be rectified, and the protection restored to normal condition as quickly as possible.

8.3.7 If an agreement has not been reached the electrical equipment will be removed from service forthwith.

8.3.8 The Authority shall monitor and enforce compliance to all matters covered by this section of the Distribution Code.

8.4 Protection Coordination at POC

8.4.1 DL shall be responsible for co-ordination of protection at the Connection Point and shall investigate any malfunction of protection or other unsatisfactory protection issues at the POC.

8.4.2 Distribution System Users shall take prompt action to correct any protection malfunction on their system.

8.5 Testing of Protection Equipment

8.5.1 DL shall conduct periodic testing of equipment and systems to ensure these are performing to the designed specifications. Periodic tests must be performed within a period of two years.

8.3.2 Each Distribution System User is responsible for tests on own equipment and test results shall be submitted to DL. The tests are to be done as per the test procedures detailed under this Section of the Distribution Code and as specified from time to time by DL.

8.6 Fault Clearance Times

8.6.1 From a stability consideration, the maximum fault clearance times for faults on any Distribution System User's system directly connected to the Distribution System, or any faults on the Distribution System itself, are as follows:

Allowable Maximum Clearance Times:

33 kV 250 milliseconds

11 kV 250 milliseconds

8.6.2 Higher voltages have generally faster clearance times because of the critical nature of such faults on the overall system. However, appropriate discrimination should be observed when protection settings are applied. The grading margin between two points shall be 250milliseconds.

8.7 Generator Protection Requirements

8.7.1 All Generating Units and all associated electrical equipment of the Generator connected to the Distribution System shall be protected by adequate protection so that the Distribution System does not suffer due to any disturbance originating from the Generating Unit.

8.7.2 The minimum protection for the generators shall constitute the following:

a) Over current and Earth Fault
b) Differential Protection
c) Reverse power protection
d) Over voltage protection
e) Negative phase sequence

8.8 Distribution Line Protection Requirements

8.8.1 For the purposes of this Distribution Code, Distribution shall refer to all Connection Points at 33kV and below.

8.8.2 All 33 kV and 11kV lines at Connection points shall be provided with a minimum of Over Current and Earth Fault protection with or without directional features.

8.8.3 Line protection shall be provided by definite time and inverse definite minimum time (IDMT) Over-Current and Earth Fault Relays.

8.8.4 All distribution feeders should be equipped with additional differential Relays to provide more sensitive protection for high impedance faults.

8.8.5 DL protection schemes shall be configured in liaison with TL to ensure proper fault discrimination.

8.9 Plain Radial Feeders

8.9.1 non-directional time lag Over Current and Earth Fault Relay with suitable settings to obtain discrimination between adjacent relay stations.

8.10 Parallel Feeders/ Ring Feeders

8.10.1 Directional time lag Over Current and Earth Fault Relays.

8.11 Long Feeders/Transformer Feeders

8.11.1 For long feeders (above 5 km) or transformer feeders, the Over Current Relays should incorporate a high set instantaneous element.

8.12 Transformer Protection Requirements

8.12.1 Generating Station

8.12.1.1 All windings of Auto Transformers and power transformer of HV class shall be protected by differential and Balanced Earth Fault (BEF)/ Restricted Earth Fault (REF) Relays. In addition, there shall be back up time lag Over Current and Earth Fault protection.

8.12.1.2 For transformers operating in parallel, Back up Over Current and Earth Fault protection shall have a directional feature at the Connection Point.

8.12.1.3 Over Current Earth Fault Relays should incorporate a high set instantaneous element.

8.12.1.4 In addition to electrical protection, gas operated relays, winding temperature protection and oil temperature protection shall be provided.

8.12.2 Distribution system at POC

8.12.2.1 For smaller transformers of HV class on the Distribution System Differential Protection shall be provided for 10 MVA and above along with back up time lag Over Current and Earth Fault protection (with directional feature for parallel operations).

8.12.2.2 Transformers of 1.6 MVA and above and less than 10 MVA shall be protected by time lag Over Current, Earth Fault and instantaneous REF relays. In addition, all transformers of 1.6 MVA and above shall be provided with gas-operated relays, winding temperature, and oil temperature protection.

8.13 Over voltage Protection

8.13.1 Over voltages in the system are caused by lightning surges, switching surges and sudden load throw off. Over voltage surges cause possible failure of insulation on transformers, motors and other related electrical equipment.

8.13.2 They also cause possible flashovers on highly stressed points external or internal to equipment.

8.14 Protection against Lightning Over voltages

This shall be achieved through the following:

8.14.1 Rod Gaps

These shall be applied across insulator string or bushing insulators. The gap shall be set to allow the breakdown of the insulation medium at voltages above 140% of nominal as specified in the DLs Guidelines for Protection.

8.14.2 Horn Gaps

These shall be applied above overhead lines or substations to provide effective protection against direct strike on live conductors, towers and substation equipment. Horn Gaps shall be set to provide effective protection against direct strikes on live conductors, towers and substation equipment as specified by DL.

8.14.3 Lightning Masks

These shall be applied above buildings to protect them against direct lightning strikes. All substation buildings shall be provided with lightning masks for protection against direct lightning strikes. The lightning masks shall be designed as specified by DL.

8.14.4 Surge Arrestors

These shall be applied on lines terminating at the substations and on the transformer terminals so that they divert over voltages to earth without causing short circuits. The surge arrestors shall be as specified by DL.

8.15 Protection Against Switching Surges at POC

8.15.1 Where it is recommended through studies shunt reactors and or pre-closing resistors on circuit breakers shall be installed to protect against switching surges.

8.15.2 All distribution circuits at the Connection Point shall be equipped with surge suppressors and arrestors to limit over voltages.

8.16 Protection of Compensating Equipment

8.16.1 Protection of Reactors

All reactors shall be protected at the minimum, by Over Current and Earth Fault Protection, Differential Protection, Restricted Earth Fault Protection, Gas operated and temperature relays.

8.16.2 Protection of Capacitors

All Capacitors shall be protected by a minimum of Overcurrent and Earth Fault Relays.

8.16.3 Protection of Static Var Compensators

All Static Var Compensators shall be protected by Over Current and Earth Fault Relays.

8.17 Safety Protection Requirements

8.17.1 Fire Protection

8.17.1.1 All electrical energized equipment can cause fire if proper usage and handling procedures are not adhered to.

8.17.1.2 All DL substations and Connection Points should be equipped with appropriate electrical fire extinguishers located at strategic points at each substation. These shall be tested on annual basis.

8.17.1.3 Firefighting system shall where appropriate be automatic and in all instances be adequate.

8.17.1.4 Fireguards should be created and maintained around the perimeter of every substation and connection point.

8.17.1.5 All fuels capable of causing fire such as petrol and diesel should be stored at sites away from electrical plant in every substation and Connection Point.

8.17.1.6 Adequate precautions shall be taken, and protection shall be provided against fire hazards to all indoor equipment.

8.18 Personnel Protection

8.18.1 All personnel that must carry out any works at the POC or DL's Substation shall abide by the standard Safety Rules and any other Safety requirements that shall be put in place by DL from time to time.

8.18.2 As a protection measure to personnel against electrical hazards the following shall be always observed:

8.18.2.1 Visitors

- All visitors to the POC or DL substation shall obtain the relevant authority and shall be guided by a Senior Authorized Person with an LOA or Visitors Live Enclosure Permit.

8.18.2.2 Equipment Switching

All switching in DL substations shall be carried out by a DL Senior Authorised Person under the recorded Instruction of a DL Control Engineer.

8.18.2.3 Carrying out Works at the Connection Point

All works at the Connection Point or any part of the DL Network shall be carried out under any of the following standard Safety Documents or any document that shall be specified by DL from time to time, depending on the nature of works being carried out:

- Limitation of Access Document
- Permit to Work Document
- Live Line Permit to Work Document
- Sanction for Test Document
- Visitors Live Enclosure Permit

9 INFORMATION EXCHANGE CODE

9.1 Introduction

The section defines obligations of participants about the provision and exchange of planning, operational and maintenance information in implementing the Malawi Distribution Grid Code.

9.2 Information Exchange Interface

9.2.1 The parties shall identify the following for each type of information exchange:

a) The name and contact details of the person(s) designated by the information owner to be responsible for provision of the information.
b) The names, contact details of, and the parties represented by persons requesting the information.
c) The purpose for which the information is required.
d) The parties shall agree on appropriate procedures for the transfer of information.

9.2.2 Participants where necessary, shall exchange information, prior to commissioning, of new or altered equipment connected at the POC or changes to the operational regimes that could have an adverse effect on the distribution system to enable proper modifications to any affected participants networks and related systems.

9.3 Provision and exchange of Information during the planning and connection process

9.3.1 The DL shall have a supply application form, which shall request, at minimum, the information stipulated in this section.

9.3.2 Customers requesting supply at low voltage shall provide the DL with the information relating to:

a) New or change in connected loads.
b) Type of load to be connected to the Distribution System.
c) Proposed network connection point address.

9.3.3 Customers requesting supply at HV or MV shall provide the DL with adequate information and among others including the following:

a) Requested supply voltage.
b) Expected and / or projected maximum demand (in kVA).
c) Expected load power factor.
d) Switched customer capacitor banks and reactors, which could affect the Distribution System.
e) Whether the load can produce Harmonics as specified by equipment manufacturers
f) The nature and type of process the supply is requested for.
g) Minimum required fault levels
h) Start-up requirements
i) Whether the customer has any standby generator.

9.3.4 The DL may request Customers to provide information on the Customer's proposed installation and equipment at the POC.

9.3.5 Participants shall exchange information relating to the protection of Distribution System and customer equipment protection coordination at the POC.

9.3.6 Upon any reasonable request, the DL shall provide customers or potential customers with any relevant information that they require to properly plan and design their own networks/installations.

This may include but not limited to:

a) Nominal voltage at which connection will be made.
b) Method of connection, extension and/or reinforcement details.
c) The maximum and minimum fault levels.
d) Method of earthing.
e) Maximum installed Capacity at the POC.
f) Specification of any accommodation of equipment requirement.
g) Individual customer limits relating to:
    i. Harmonic Distortion

ii. Voltage Flicker

iii. Voltage Unbalance

h) Expected lead time of providing connection (following formal acceptance of terms for supply).

i) An indication of network single contingency capability.

j) An indication of current network performance and power quality.

k) Cost of connection.

l) Range of current approved tariff structures.

9.4 Operational Information

9.4.1 Commissioning and notification

9.4.1.1 Customers shall confirm that all information given in the application for supply and additional information subsequently requested by the DL is correct before the commissioning.

9.4.1.2 The commissioning dates shall be negotiated between the parties. Participants will agree on the type of operational data to be submitted prior to commissioning, which shall include test and commissioning report.

9.4.1.3 The asset owner (DL or Customer) shall ensure that all equipment records, that affect the integrity of the Distribution System or relevant to the interconnection, are maintained for reference for the duration of the operational life of the plant. On request from the DL, information shall be made available within a reasonable time.

9.4.1.4 The DL shall indicate to the customer what information is relevant in terms of this section.

9.4.2 Sharing of Assets and Resources

9.4.2.1 DL sharing assets and resources shall enter into agreements for the provision and sharing of their assets, resources, services, and information.

9.4.3 Additional Information Requirements

9.4.3.1 Should one participant, acting reasonably, determine those additional measurements and/or indications are needed in relation to another participant's plant and equipment, the requesting participant shall consult with the affected participant(s) to agree on the way the need may be met.

9.4.3.2 The costs related to the modifications for the additional measurements and/or indications shall be for the account of the causal participant.

9.4.4 Communication and Liaison

9.4.4.1 Participants shall establish a communication channel for exchange of information required for distribution operations, which may include the installation of DL's SCADA equipment at the customer's or DL's installation to facilitate the flow of information and data to and from the DL and / or Transmission control facilities.

9.4.4.2 Each participant shall designate a person with delegated authority to perform the duties of information owner in respect of the granting of access to information covered in this code to third parties. A party may, at its sole discretion, designate more than one person to perform these duties.

9.4.4.3 The DL shall take reasonable steps to exchange information with the DL's affected customers for distribution system and transmission system outages.

9.4.4.4 Customers shall exchange information with the DL within an agreed lead time on all operations on their installations, which may have an adverse effect on the Distribution System including any planned activities such as plant shutdown, or scheduled maintenance.

9.4.4.5 The communication facilities standards shall be set and documented by the DL. Any changes to communication facilities standards impacting on participant equipment shall be brought to the attention of the participant well in advance of the proposed upgrade.

9.4.4.6 Any back up or emergency communication channels established by the DL and deemed necessary for the safe operation of the Distribution System shall be agreed upon by the DL and the participant affected.

9.4.5 Data Storage and Archiving

9.4.5.1 The obligation for data storage and archiving shall lie with the information owner.

9.4.5.2 The systems that store the data and/or information to be used by the participants shall be of their own choice and for their own cost.

9.4.5.3 All data storage systems must be able to be audited by the Authority. The systems must provide for clear and accessible audit trails on all relevant operational transactions. All requests that require an audit on a system shall be undertaken with reasonable notice to the parties.

9.4.5.4 The information owner shall keep all information, except voice recorded information, in its original format for a period of at least five (5) years (unless otherwise specified differently in other parts of this code) commencing from the date the information was created.

9.4.5.5 Participants shall ensure reasonable security against unauthorized access, use and loss of information for the systems that contain the information.

9.4.5.6 DL shall use a voice recorder for historical recording of all operational voice communication with participants. These records shall be available for at least three (3) months except where there is an incident involved, in which case the requirements of any applicable legislation shall apply. The DL shall make the voice records of an identified incident in dispute available within a reasonable time after such a request from a participant and/or the Authority.

9.4.5.7 An audit trail of all changes made to archive data should be maintained. This audit trail shall identify every change made, and the time and date of the change. The audit trail shall include both before and after values of all content and structure changes.

9.5 Confidentiality of information

9.5.1 Information exchanged between participants governed by this code shall not be confidential, unless otherwise stated.

9.5.2 Participants receiving information shall use the information only for the purpose for which it was supplied.

9.5.3 The information owner may request the receiver of information to enter into a confidentiality agreement before information, established to be confidential, is provided.

9.5.4 Confidential information shall not be transferred to a third party without the written consent of the information owner. Parties shall observe the proprietary rights of third parties for the purposes of this code. Access to confidential information within the organizations of parties shall be provided as reasonably required.

9.5.5 The participants shall take all reasonable measures to control unauthorized access to confidential information and to ensure secure information exchange.

9.5.6 Parties shall report any leak of information that is governed by a confidentiality agreement as soon as practicable after they become aware of the leak and shall provide the information owner with all reasonable assistance to ensure its recovery or destruction (as deemed appropriate by the information owner).

10 ASSETS MANAGEMENT

10.1 Introduction

This section covers assets management issues including customers' electrical installations and equipment, and DL's equipment on customer's premises.

10.2 Good Asset Management

The DL shall be obliged to:

i. assess and record the nature, location, condition, and performance of its distribution network assets.

ii. develop and implement plans for the acquisition, creation, maintenance, operation,

refurbishment, repair, and disposal of its distribution network assets:

a). *in compliance with the laws and other performance obligations which apply to the provision of distribution services including those contained in this Code.*

b). to minimize risks associated with the failure or reduced performance of assets, and

c). in a way which minimizes costs to customers considering distribution losses and

iii. develop, test, or simulate and implement contingency plans (including where relevant plans to strengthen the security of supply) to deal with events which have a low probability of occurring but are realistic and would have a substantial impact on customers.

10.3 Customer's Electrical Installation and Equipment

a) A customer shall ensure the following:

i) that, the customer's electrical installation and any equipment within it complies with this Code and is maintained in a safe condition, and

ii) that, protection equipment in the customer's electrical installation is always effectively coordinated with the electrical characteristics of the distribution network.

iii) that the distribution network and the reliability and quality of supply to other customers are not adversely affected by the customer's actions or equipment.

iv) not allow a supply of electricity to its electrical installation to be used other than at the customer's premises nor supply electricity to any other person.

iii) not tap electricity supplied to another customer

iv) not to bypass the meter for the electricity supply

v) not allow electricity supplied under a domestic tariff to be used for non-domestic purposes, and

vi) not allow electricity supplied under a specific purpose tariff to be used for another purpose.

10.4 Distribution Licensee's Equipment on Customer Premises

a) A customer must:

i) not interfere, and must ensure not to allow interference with the DL distribution network including any of the DL's equipment installed in or on the customer's premises, and

ii) provide and maintain on the customer's premises any reasonable or agreed facility required by its DL to protect any equipment of the DL.

b) Provided official identification is produced by the DL's representatives on request, a customer must always provide to the DL representatives convenient and unhindered access:

i) to the DL's equipment for any purposes associated with the supply, metering, or billing of electricity, and

ii) to the customer's electrical installation for the purposes of the inspection or testing of the customer's electrical installation in order to assess whether the customer is complying with this Code or connecting, disconnecting or reconnecting supply, and safe access to and within the customer's premises for the purposes described in this code.

11 GENERAL CONDITIONS

11.1 Liability

11.1.1 A DL shall only be liable to a customer and a customer shall only be liable to a DL for any damages which arise directly out of the willful misconduct or negligence:

i) of the DL in providing distribution services to the customer

ii) of the customer in being connected to the DL's network, or

iii) of the DL or Customer in meeting their respective obligations under this Code, their licenses, and any other applicable law.

11.1.2 Notwithstanding Clause 10.1 (a), neither the DL nor the customer shall be liable under any circumstances whatsoever for any loss of profits or revenues, business interruption losses, loss of contact or loss of goodwill, or for any indirect, consequential, incidental, or special damages, including but not limited to punitive or exemplary damages, whether any of the said liability, loss or damages arise in contract, tort or otherwise. The DL shall carry out public awareness to its customers on the use of appropriate equipment to control loss or damage, which may result from poor quality or reliability of electricity supply within its distribution network.

11.1.3 A customer shall be liable to the DL for any loss or damage resulting from the use of electricity in a manner that will make the DL's system unsafe.

11.2 Force Majeure

11.2.1 Neither party shall be held to have committed an event of default in respect of any obligation under this Code if prevented from performing that obligation, in whole or in part, because of a force majeure event.

11.2.2 If a force majeure event prevents a party from performing any of its obligations under this Code and the applicable Connection agreement, that party shall:

i) Promptly notify the other party of the force majeure event and its assessment in good faith of the effect that the event will have on its ability to perform any of its

obligations. If the immediate notice is not in writing, it shall be confirmed in writing as soon as reasonably practicable.

ii) Not be entitled to suspend performance of any of its obligations under this Code to any greater extent or for any longer time than the force majeure event requires it to do.

iii) Use its best efforts to mitigate the effects of the force majeure event, remedy its inability to perform and resume full performance of its obligations.

iv) Keep the other party continually informed of the efforts to mitigate the effects of the force majeure event, and

v) Provide written notice to the party when it resumes performance of any of its obligations affected by the force majeure event.

11.2.3 Notwithstanding any of the foregoing, settlement of any strike, lockout, or labour dispute constituting a force majeure event shall be within the sole discretion of the party to the agreement involved in the strike, lockout, or labour dispute. The requirement that a party must use its best efforts to remedy the cause of the force majeure event, mitigate its effects, and resume full performance under this Code shall not apply to strikes, lockouts, or labour disputes.

11.3 Health, Safety & Environments

11.3.1 DL shall show good utility practice in operating and maintaining its distribution network and shall abide by the safety rules and regulations that apply to routine work.

11.3.2 DL shall implement an industry recognized health and safety programme that includes training and regularly conducted audits. This programme also will include Public Education and Public Safety Initiatives.

11.3.3 Any problems that a DL identifies as part of the audit shall be remedied as soon as possible or in accordance with the DL's health and safety program.

11.3.4 DL shall have a corporate policy that addresses environmental stewardship that applies to all the DL's operations. A documented program supporting procedures and appropriate training should be in place to ensure compliance with environmental regulations and indicate a proactive approach to environmental damage avoidance.

11.3.5 Before any civil works are undertaken, due notice in writing shall be given to all utilities whose services may be in conflict with the proposed cable route, e.g. telephone, water, sewage, road and railway, etc. Where cables are to be installed in roads, footpaths, or streets, it is advisable to liaise closely with the roads authority and police to ensure that all necessary measures are taken to minimize the hazards and disruptive effects of installation works.

11.3.6 Working signs, bollards, danger tapes, light and watchmen shall be provided where necessary to ensure ample advance warning of, and restrict public access to, the works area. Warning lights and signs shall be displayed along pits and trenches, on both sides. Steel plate or wooden planks shall be provided across the trench at entrances to residences.

11.3.7 DL shall ensure that a line marker is placed and maintained as close as practical over each buried underground cable:

i) at each crossing of a public road and railway, and

ii) whenever necessary to identify the location of the buried underground cable to reduce the possibility of damage or interference.

11.3.8 DL shall ensure that the following is written legibly on a background of a sharply contrasting colour on each line marker:

i) the word “Warning”, “Caution”, or “Danger” followed by the words “MV Cable” or “LV Cable”, and

ii) the name of the Distribution Utility and telephone number, on which the Distribution Utility can be always reached.

12 WAYLEAVES AND SERVITUDES

12.1 Obtaining Wayleaves and Servitudes

12.1.1 A DL shall place any line or cable above or below ground into, out of or across any land including State land. Wayleaves shall be obtained in compliance with the prevailing Malawi Electricity Act and relevant regulations.

12.1.2 Property developers shall provide for servitudes for use by the DL to place lines/cables. This shall be at no cost to the DL. Land shall also be made available for substations sites and no fees should be levied against the DL.

12.1.3 Should future developments require alteration/lowering/ exposing/repositioning of overhead lines, cables, or equipment, then the cost shall be borne by the developer/owner in compliance with the prevailing Malawi Electricity Act and relevant regulations.

12.2 Clearance and Maintenance of Wayleaves and Servitudes

12.2.1 Purpose

This clause provides for the control of trees and any structure adjacent to power lines. The purpose of this clause is to protect the security of the supply of electricity and the safety of the public.

12.2.2 Underground Cable Safety

12.2.3.1 To permit the safe repair or operation of an underground cable, a DL may sever and remove any tree roots that are within 1.5 meters of that cable.

12.2.3 Obligation to enforce Compliance on Wayleaves' rights.

12.2.3.1 The DL shall enforce compliance for wayleave rights for distribution power lines in accordance with the Electricity By Laws.

12.2.3.2 To ensure that landowners are aware of their responsibilities and liabilities under this Code, the DL shall issue to electricity customers, at least annually,

information notice outlining the dangers of contact between trees / structures and live power lines and the operation of this Code.

12.2.3.3 The DL must, without delay, undertake any necessary work on a tree (including the roots) if the DL becomes aware that there is immediate danger to persons or property from a line.

12.2.3.4 For the purposes of removing danger to persons or property, a DL may cut or trim the tree to the extent necessary to remove the danger.

12.2.3.5 Where there is a structure encroaching in the Wayleaves rights, the DL shall issue a notice to the encroacher to remove or adjust the structures.

12.2.3.6 If the encroacher fails to comply with such a notice within the timeframe stipulated in the communique, the DL apply to MERA for an order of removal or adjustment of the structure as stipulated under section 41(4) in the Electricity Act (CAP 73:01).

13 APPENDIX