THE KENYA ELECTRICITY GRID CODE

PART 2: KENYA NATIONAL GRID DISTRIBUTION CODE (KNDGC)

May 2022

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1 PREAMBLE

1.1 INTRODUCTION

The term Grid Code is widely used to refer to a document or set of documents that legally establishes technical and other requirements for the connection to and use of an electrical transmission and distribution system in a manner that will ensure safe, secure, reliable and efficient operation.

This preamble provides the background and rationale for the development of the *Kenya National Distribution Cod*e (*KNDGC*) and summarises its provisions. The *KNDGC* underwent a rigorous approval process involving the *Energy and Petroleum Regulatory Authority,* the *Ministry of Energy* the *Attorney General* and the *Parliament.*

The *Kenya National Distribution Code has* been developed to define the rules and regulations for various *Users* for accessing and using the *Distribution System*. The objective of the *KNDGC* is to improve the ability of Kenya's power system to be planned and operated safely, reliably, efficiently, and economically in a transparent and non-discriminatory manner. It establishes the obligations of the *Generation Licensee*s, *Distribution Network Service Provide*rs (DNSP), *Retail Supply Licensees* and other *Distribution Network User*s of the *Distribution System* for accessing and using the *Distribution System*. More specifically the *KNDGC*:

(a) Defines the reciprocal obligations, responsibilities and accountabilities of all of the *Users* to ensure open, transparent, non-discriminatory and economic access and use of the system while maintaining its safe, secure, reliable and efficient operation;

(b) Defines minimum technical requirements for the *Users*; and

(c) Sets out the information exchange obligations of the *Users*

1.2 STRUCTURE OF THE KNDGC

The *KNDGC* is organized into nine chapters as follows:

(a) **Preamble:** This chapter outlines the purpose of the *Kenya National Distribution Code (KNDGC)*, and how the various parts of the *KNDGC* are relevant to the different *Distribution Network User*s of the *Distribution System.*

(b) **Glossary and Definitions:** This chapter provides the definitions of terms pertinent to this *KNDGC*. Defined terms are italicised and capitalised throughout the *KNDGC* and hold the meanings as defined. However, if a term is not capitalised or italicised, it shall still hold the definition as provided in the Glossary.

(c) **General Conditions:** This chapter presents the provisions which are of general application to all parts of the *KNDGC* including the provisions necessary for the overall administration and review of the various aspects of the KNDGC. This chapter also deals with those aspects of the KNDGC not covered in other chapters, including the resolution of disputes, bilateral

agreements, confidentiality, non- compliance and the revision of the *KNDGC* through the *Kenya National Distribution Code Review Committee.*

(d) **Governance:** The Governance Chapter summarises the main documents and organisations that provide the authority governing the planning, construction, and operation of the *Kenya National Distribution System*.

(e) **Distribution System Planning**: This chapter specifies the technical and design criteria and procedures for the planning and development of the *Kenya National Distribution System*.

(f) **Distribution System Connection Requirements:** This chapter defines the minimum standards for the methods of connection to the *Distribution System.*

(g) **Distribution System Operations:** This chapter addresses the various operational components, including demand management, interruptions, incident reporting, safety matters and system emergencies.

(h) **Metering:** This chapter specifies the technical and operational criteria in carrying out the obligation of providing metering services to all *Distribution Network User*s.

(i) **Performance Standards:** This chapter describes the technical and operational standards and the indicators that are used to measure the system's performance.

1.3 SCOPE OF THE KNDGC

The *KNDGC* establishes the technical aspects of the planning, connection, operation, and use of the *Kenya National Distribution System* and the relationships between the *Distribution Network Service Provider*(s) and *Distribution Network User*s of the *Distribution System.*

Upon the request from *Distribution Network User*s, the *DNSP* must provide a connection to the *Distribution System and* deliver electric energy to the *Distribution Network User* in accordance with the applicable laws, its licence and this *KNDGC*, at a level of service quality consistent with the applicable Performance Standards described in the *KNDGC*. Once connected to the *Distribution System*, the *Distribution Network User*s must comply with the conditions and standards specified in the *KNDGC* to avoid adverse effects on the *Distribution System or* other *Distribution Network User*'s systems.

The *KNDGC* shall be read in conjunction with the relevant legislation, including the *Energy Act* of *2019* and *Energy (Electricity Supply) Regulations of 2021*. These legislative instruments shall be utilised in conjunction with the Licences issued to generators, transmission companies and *DNSP*s and all applicable codes and regulations adopted by the *Authority* and the *Ministry of Energy.* All *Licences that* are issued after enactment of the *KNDGC* shall include the obligation of parties to comply with the *KNDGC* requirements.

1.4 OBJECTIVE OF THE KNDGC

(a) To establish the relationships and harmony of the different licensees governed by the KNDGC and KNTGC.

(b) To provide a framework for the planning, development, connection, operation, maintenance and performance standards for the distribution system

(c) To give effect to the provisions of the Energy Act, 2019.

(d) To promote safety standards for the distribution system.

(e) To provide for coordinated and economical management of the distribution system.

(f) To establish the mechanism to promote non-discriminatory access to the distribution system.

(g) To enhance service delivery through competition

2 GLOSSARY AND DEFINITIONS

2.1 INTRODUCTION

This chapter contains a glossary of terms and a list of abbreviations and units used in the *KNDGC*.

2.2 GLOSSARY

Table 2-1 provides a summary of the terms and definitions used in the *KNDGC*.

Table 2-1 Glossary and Definitions

Term	Definition
Active Energy	The electrical energy produced, flowing or supplied by an electrical circuit during a time interval, and being the integral with respect to time of Active Power, measured in units of Watt-Hours.
Act	Means the Energy Act, 2019
Active Power	Instantaneous power derived from the product of voltage and current and the cosine of the voltage phase angle measured in units of Watts
Aerial Bundled Cable	Insulated cable used in substitution for multiple bare conductors.
Ancillary Services	means services that are essential to the management of power system security, facilitate orderly trading in electricity and ensure that electricity supplies are of acceptable quality and, without limitation, these services may include: (a) the provision of sufficient regulating capability to meet fluctuations in load occurring within a scheduling interval; (b) the provision of sufficient contingency capacity reserve to maintain power system frequency in the event of network or generation outages; (c) the provision of reactive power support to guard against power system failure through voltage collapse; and (d) the provision of black start capability to allow restoration of power system operation after a complete failure of the power system or part of the power system
Application for Connection	The application made by a User for connection to a Distribution Network
Authorised Personnel	A person adequately trained, and possessing technical knowledge and experience and appointed in writing to carry out specific operation and/or work on the power system

Term	Definition
Authority	The Energy and Petroleum Regulatory Authority established under the Energy Act, 2019
Black Start	The procedure necessary for recovery of the Kenya National Transmission System from Total Shutdown or Partial Shutdown
Black Start Capability	Ability of a Generating Plant to move at least one of its units to Start-Up from Shutdown without an external electrical power supply and to energise a part of the Kenya National Transmission System and be Synchronised to the System upon instruction from the Transmission Licensee or Distribution Licensee
Capacitor Bank	Electrical equipment used to generate reactive power and support voltage levels on transmission or distribution lines in periods of high load
Chairperson	The person duly appointed by the Authority to be Chairperson of the Kenya National Distribution Code Review Committee, or the person appointed by the Chairperson to be his alternate, or the person appointed to act as Chairperson of a meeting of the Kenyan National Distribution Code Review Committee in the absence of the Chairperson or his alternate
Check Meter	A kWhr meter used for measuring electrical usage for the purpose of meter data validation in the process of producing bills and credit notes for Customers
Clearance Space	A space surrounding a distribution power line, which should be clear of obstructions and vegetation at all times
Confidential Information	Information which is or has been provided under or in connection with the Kenya National Distribution Code and which is stated under the Code or by the *Authority* to be Confidential Information
Connection Agreement	Agreement between a DNSP and a Distribution Network User by which the User is connected to the Distribution System and/or receives Distribution Services
Connection Applicant	An individual or an entity who wants to establish or modify connection to the Distribution System and/or who wishes to receive Distribution Services
Connection Point	The physical point at which a User is connected to the Kenya National Distribution System; the electrical node on a distribution system where a User's assets are physically connected to the DNSP's assets
Consumer	any person supplied or entitled to be supplied with electrical energy

Term	Definition
Control System	A set of devices used for monitoring and controlling the operation of a power system or equipment including Generating Plants connected to a transmission or distribution network
Customer	A person obtaining services from a Distribution Licensee and/or Retail Supply Licensee
Current Rating	Maximum current that may be permitted to flow (under defined conditions) through a transmission or distribution line or other item of equipment that forms part of a power system
Current Transformer (CT)	A transformer for use with meters and/or protection devices in which the current in the secondary winding is, within prescribed error limits, proportional to and in phase with the current in the primary winding
Demand	The rate at which electrical energy is delivered or used over a specified period, usually expressed in kW or kVA or multiples thereof such as MW or MVA, or other suitable units
Derogation	A waiver issued by the *Authority* to suspend a Distribution Licensee's or Distribution Network User's obligations to implement or comply with a provision or provisions of the KNDGC
Disconnection	The operation of switching equipment or other action so as to prevent the flow of electricity at a connection point
Dispatch	The process of precisely matching generation with load in real time
Dispute	As defined in the Energy (Complaints 7 Dispute Resolution) Regulations, 2012
Dispute Notice	A written notice issued by either Party to a Dispute outlining the matter of such Dispute
Distribution Area	Area in which the DNSP is licensed to distribute electricity
Distribution Licence	Has the definition ascribed to it under the Act
Distribution Licensee	A Person granted a Licence by the *Authority* to own and/or operate a Distribution System in Kenya under the Act
Distribution Line	A power line, including underground cables, that is part of a distribution network
Distribution Losses	Electrical Energy Losses incurred in distributing electricity over a distribution network
Distribution Network	Has the same meaning as Distribution System

Term	Definition
Distribution Network Service Provider	A person that owns and/or operates a Distribution System and provides Distribution Services and is licensed under the Act
Distribution Network User	A Customer, Generation Licensee, or any User of the Distribution Network
Distribution Power Line	An electric delivery line (overhead or underground), operated by a distribution network service provider
Distribution Service	The service of delivering energy through a distribution network to Customers, and the operation and maintenance of the Distribution System
Distribution System	Has the meaning as per the Act
Droop	The ratio of speed deviation or frequency deviation to change in active power output.
Electric Industry	The industry in Kenya involved activities including the importation, exportation, generation, transmission, distribution and retail supply of electricity
Electric Power Industry Safety Code	Kenya Standard National Electric Safety Code KS 1587: 2007
Electric Supply Line	as per the Act
Electrical Energy Loss	Energy dissipated in the production, transportation and/or use of electricity
Electrical Infrastructure	All the assets consisting of the power system.
Electrical Installation	As defined in the Act
Embedded Generator	A Generating Plant connected within a distribution network and not having direct access to the transmission network
Energisation	Operation of switching equipment or the start-up of a Generating Plant resulting in a non-zero voltage beyond a connection point or part of the transmission or distribution network
Tribunal	The Energy and Petroleum Tribunal (EPT) established under the Act
Environmental, Health and Safety Obligations	Obligations placed on Licensees by the Act and by other applicable statutes and regulations in Kenya

Term	Definition
Estimated Equipment Data	The best estimate of the values and parameters and information pertaining to a Distribution Network User's equipment provided to the DNSP for the purpose of distribution system planning
Excitation Control System	Automatic control system (including excitation limiting devices and any power system stabiliser) that provides field excitation for the Generating Plant
Financial Year	The period commencing on 1st July in one calendar year and terminating on 30th June in the following calendar year
Fire Control Authority	Fire Service under the control of any local or public authority or any other authorisation entity in Kenya
Fire Hazard Rating	Rating assigned by the Fire Control *Authority* designating propensity for ignition and spread of fire
Flicker	The impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time
Force Majeure	Causes beyond the reasonable control of and without the fault or negligence of the Party claiming Force Majeure. It shall include failure or interruption of the delivery of electric power due to causes beyond that Party's control, including Acts of God, epidemic, pandemic, wars, sabotage, riots, hurricanes and other actions of the elements, civil disturbances and strikes
Frequency (Hz)	Number of cycles for alternating current electricity occurring in each second. The term Hertz (Hz) corresponds to cycles per second
Generation Licence	means a licence authorising a person to generate electrical energy;
Generation Licensee	For the purposes of the KNDGC, an entity licensed by the *Authority* to own, operate and maintain generation assets and generate electricity within the Kenya National Distribution System
Generating Plant	Any electric power facility or apparatus delivering electrical energy to the Kenya National Distribution System. Also referred to as an Embedded Generating Plant. Generating Plants shall be understood to be comprised of one or more generating units which make up the total plant capacity and may be individually controllable. Controllability of generating units shall be addressed in the Connection Agreement.
Governor System	Manual or automatic control system which maintains the desired system frequency by adjusting the mechanical power output of the turbine of a Generating Plant

Term	Definition
Grid	The network of transmission systems, distribution systems and connection points for the movement and supply of electrical energy from Generating Stations to Consumers
Harmonic Distortion	The sinusoidal voltages and currents having frequencies that are integral multiples of the fundamental frequency
Hazard Space	Space outside the clearance space and re-growth space in which trees or limbs due to their unsafe condition are a potential hazard to the safety of a distribution power line under the range of weather conditions
High voltage (HV)	A nominal voltage above 33 kV as in the Act
Independent Power Producers (IPP)	An entity, which is not a public utility, but owns facilities to generate electric power for sale to utilities and/or Customer
Individual Contract	An agreement for the sale of electricity to a Consumer negotiated under the Act
Interconnection	A transmission line/group of transmission lines that connects the transmission network in one region or jurisdiction to another region or jurisdiction
Interruptible Load	A load that can be disconnected manually or automatically and can be provided for the restoration or control of power system frequency to mitigate contingency events or shortages of supply
Kenya Gazette	\ means the Kenya *Gazette* published by authority of the Government of Kenya, and includes any supplement thereto;
Kenya National Transmission Grid Code	The set of requirements placed upon the Users of the Kenya National Transmission System
Kenya National Transmission System	The electricity transmission system of Kenya including all Users connected to that system
System Operator (SO)	The entity responsible for the overall coordination of the planning and operation of the Kenya National Transmission System, including the scheduling and dispatch of Generating Plants connected to it
Kenya Standard (KS)	As defined in the Act
Licence	Licence as defined in the Act
Licensee	Holder of a Licence under the Act

Term	Definition
Limited Frequency-Sensitive Mode Overfrequency (LFSM-O)	Means a generating plant, energy storage system or HVDC system operating mode which will result in active power output reduction in response to a change in system frequency above a certain value.
Load	A connection point or defined set of connection points at which electrical power is delivered: (a) in relation to a public electricity supplier, the energy required by a Customer to whom the public electricity supplier sells electricity; (b) in relation to an Embedded Generator, the energy supplied or to be supplied by an Embedded Generator to the distribution system; and (c) in relation to a Customer, the energy supply required by the Customer in respect of an electrical installation
Load Shedding	A method of reducing power system demand by disconnecting load from the power system
Loading Level	The level of electric power output or consumption of a Generating Plant or Load
Loss Factor	Multiplier used to describe the additional electrical energy loss for each increment of electricity used or transmitted
Low Voltage (LV)	A nominal voltage up to and including 1kV as per the Act
Main Meter	The primary meter nominated to provide electrical energy measurements at a defined Metering Point
Medium Voltage (MV)	A nominal voltage of more than 1 kV but not more than 33 kV as per the Act.
Meter	As per the Act
Metering Data	The data obtained from a Metering Installation, the processed data or substituted data and the records of data stored in metering equipment collected by a distribution network service provider, retail supplier or consumer
Metering Database	A database of metering data controlled by a DNSP or retail supplier
Metering Equipment	Equipment installed or to be installed to safely measure, record and, in certain cases, collect and read records of the amount of electricity (in the nature of apparent energy and reactive energy) supplied from a Distribution Network Service Provider's Distribution System to an

Term	Definition
	electrical installation of a Customer including Meters, Current Transformers and Voltage Transformers, wiring and any computing or communications equipment designed to facilitate electronic access
Metering Point	The point of physical connection of the device measuring the electrical energy
Metering System	Collection of all components and arrangements installed/existing between each metering point and the metering database
Ministry	The Ministry responsible for matters related to energy
Monitoring Equipment	Instruments and devices used to record the actual performance of Plant for comparison with expected performance
Nameplate Rating	Maximum continuous output or consumption of an equipment as specified by the manufacturer
Network	The apparatus, equipment, plant and buildings used to convey, and control the conveyance of, electricity to wholesale/retail Customers
Network Service	Transmission/Distribution service associated with the conveyance and controlling the conveyance, of electricity through the Network
Network User	A User of the Kenya National Distribution System
Normal Operating Frequency Band	Range of frequency of the power system so specified in the KNDGC
Normal Operating Frequency Excursion Band	In relation to the frequency of the power system, the range specified as being acceptable for infrequent and momentary excursions of frequency outside the normal operating frequency band
Occupier	A person who is in actual occupation of the land or if no one is in actual occupation of the land, the Owner of the land
Outage	Disconnection or separation, planned or unplanned, of one or more elements of the Kenya National Transmission System or the Kenya National Distribution System that renders the element unavailable for use
Owner	The land proprietor as defined in the Land Act, 2012
Ownership Boundary	The point or points at which supply is given or taken between the Distribution System and Distribution Network Users
Party	In a general sense refers to any person or entity with the specific meaning ascribed in the related provision of the Kenya National Distribution Code
Peak Load	Maximum load

Term	Definition
Plant	In relation to a connection point, includes all equipment involved in generating, utilising or transmitting electrical energy
Point of Supply	(a) the load side terminals of the service protection equipment at the end of an underground electric supply line; or (b) the first Connection Point of an overhead electric supply line on the land, being: (i) where the electric supply line is carried onto the land by one or more poles, the first pole on the land carrying that electric supply line; (ii) where the electric supply line is connected directly to premises on that land, that connection to the premises; or where it is not possible to determine a point of supply in accordance with (i) or (ii) above, the point at which the electric supply line crosses the boundary of the land.
Power Factor	Ratio of the active power to the apparent power at a metering point
Power Station	A facility in which a Generation Licensee's Generating Plants are located
Power Purchase Agreement (PPA)	A contract, usually long term, between parties for the sale of electrical energy at predetermined prices or price formulae
Power System	As per the Act
Power System Demand	Total load (in MW) supplied by the power system
Professional Engineer	As defined by the Engineers Act, 2011
Profile	With respect to the output from a Generating Plant or the electricity consumption by a load or power system demand, the quantification of the variation of that output, consumption, or demand over a given period of time
Protection System	A system, which includes equipment, used to protect a User's facilities from damage due to an electrical or mechanical fault or due to certain conditions of the power system
Prudent Utility Practice	The practices generally accepted and followed by electric utility industry of a region conforming to the design, construction, operation, maintenance, safety and legal requirements which are attained by exercising that degree of skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from skilled and

Term	Definition
	experienced operators engaged in the same type of undertaking under the same or similar conditions
Pruning and Clearing Cycle	The frequency of successive pruning or clearing which the distribution network service provider judges as optimal for maintaining the clearance space taking account of recurrent costs, community values, negotiation with the landowner, the type of vegetation and utility and amenity in the area
Public Lighting	Street lighting provided by a governmental body or agency in Kenya
Ramp Rate	Rate of change of electricity produced from a Generating Plant
Reactive Energy	A measure, in var-hours (varh) of the alternating exchange of stored energy in inductors and capacitors, which is the time-integral of the product of voltage and the out of phase component of current flow across a connection point
Reactive Plant	Plant which is capable of providing or absorbing reactive power
Reactive power	Rate at which reactive energy is transferred.
Reactive Power Capability	Maximum rate at which reactive energy may be transferred from a Generating Plant to a Connection Point as specified in the connection agreement.
Reactor	A device, similar to a transformer, specifically arranged to be connected into the transmission system during periods of low load demand or low reactive power demand to counteract the natural capacitive effects of long transmission lines in generating excess reactive power and so correct any transmission voltage effects during these periods
Regional Control Centre	A control centre responsible for the operation of the distribution network in a region of Kenya
Registered Equipment Data	Validated actual values of parameters and information about the Distribution Network User's equipment, as filed with the DNSP at the time of connection
Regrowth Space	Space beyond the clearance space, to be cleared to allow for anticipated vegetation regrowth for the period of the pruning and clearing cycle
Reliability	The probability of a system, device, plant or equipment performing its function adequately for the period of time intended, under the operating conditions encountered

Term	Definition
Variable Renewable Power Plant	A Generating Plant whose primary energy source is from wind or solar energy and whose generation output is variable in nature
Reserve	A measure of available capacity over and above the capacity needed to meet normal peak demand levels. In case of a Generating Plant, it is the capacity to generate more energy than the system normally requires. For a transmission company, it is the capacity to handle additional energy transport if demand levels rise beyond expected peak levels
Service Line	Any portion of any electric supply line through which electrical energy is or is intended to be supplied by a Licensee: (a) to a customer either directly from the premises of the Licensee, or from a distributing main; or (b) from a distributing main to a group of customers on the same premises or on adjoining premises supplied from the same point of the distributing main up to the point where such electric supply line reaches the supply terminals.
Series or Shunt Capacitor	A type of plant connected to a network to generate reactive power
Shunt Reactor	A type of plant connected to a network to absorb reactive power
Single Contingency	Also known as an unplanned outage, it indicates loss or failure of a small part of the power system (e.g. a transmission line), or the loss/failure of individual equipment such as a Generating Plant or transformer
Static VAR Compensator	It is an automatic voltage regulating device with the ability to generate/absorb reactive power and rapidly respond to voltage fluctuations in a power system
Substation	A facility where two or more electric supply lines are switched for operational purposes. It may include one or more transformers so that some connected electric supply lines operate at different nominal voltages to others
Retail Supply licence	As per the Act
Switchyard	A facility where two or more electric supply lines are switched for operational purposes.
Synchronisation	The act of electrically connecting a Generating Plant to the power system or two separate AC power systems

Term	Definition
Synchronous Generator	Alternating current generators of most thermal and hydro (water) driven power turbines which operate at the equivalent speed of frequency of the power system in its satisfactory operating state
Transformer	A passive electrical device that transfers electrical energy from one electrical circuit to another through the process of electro-magnetic induction.
Transmission	As per the Act
Transmission Network	Infrastructure that supports the transportation of electricity from the point of generation to the distribution system with the ultimate objective of bringing to the end users or consumers
User	Any person connected to or making use of the Kenya National Distribution Network as a Generation Licensee with a Generation Plant connected to the Distribution Network (an Embedded Generator), a Distribution Licensee, Transmission Licensee, Retail Supply Licensee or Consumer
Voltage	As per the Act
Voltage Transformer (VT)	A transformer for use with meters and/or protection devices in which the voltage across the secondary terminals is, within prescribed error limits, proportional to and in phase with the voltage across the primary terminals

2.3 LIST OF ABBREVIATIONS

The table below provides a summary of the abbreviations used the *KNDGC.*

Table 2-2: Abbreviations used in the KNDGC

Abbreviation	Meaning
AC	Alternating Current
ACE	Area Control Error
AGC	Automatic Generation Control
AS	Ancillary Services
AVR	Automatic Voltage Regulator
COMESA	Common Market for Eastern and Southern Africa
CT	Current Transformer
DC	Direct Current

Abbreviation	Meaning
DER	Distributed Energy Resources
DNSP	Distribution Network Service Provider
DR	Demand Response
EAC	East African Community
EHV	Extra High Voltage
ENA	Energy Network Association
GC	General Conditions
GD	Glossary and Definitions
GoK	Government of Kenya
GPS	Global Position System
HV	High Voltage
HVDC	High Voltage Direct Current
IC	Interconnected System
ICCP	Inter-Control Centre Communications Protocol
IEC	International Electro-technical Commission
ISO	International Standard Organisation
KEGC	Kenya Electricity Grid Code
Kenya National TSO	Kenya National Transmission System Operator
KNDGC	Kenya National Distribution Grid Code
KNDS	Kenya National Distribution System
KNTGC	Kenya National Transmission Grid Code
KNTS	Kenya National Transmission System
KS IEC	Kenya Standard IEC
PSS	Power System Stabiliser
PV	Photo Voltaic
RCC	Regional Control Centre
RPP	Renewable Power Plant
SCADA	Supervisory Control and Data Acquisition

Abbreviation	Meaning
TCP/IP	Transmission Control Protocol/Internet Protocol
TSO	Transmission System Operator
UM	Voltage Maximum
UN	Voltage Nominal

2.4 LIST OF UNITS

The table below provides a summary of the units used in the *KNDGC*.

Table 2-3: List of Units

Symbol	Unit
Amp	Ampere
GW	Gigawatt (1,000,000,000 W)
GWh	Gigawatt-hour
h, hrs	Hour
Hz	Hertz
Kbps	Kilobits per second
kV	Kilovolt
kVA	Kilovolt-ampere
kvar	Kilovars
kW	Kilowatt
kWh	Kilowatt-hour
Mbps	Megabits per second
mHz	Milli-hertz (1/1000 Hz)
Min	Minute
Ms	Milli-second (1/1000 s)
MVA	Megavolt-ampere
Mvar	Megavars
Mvarh	Megavar-hour
MW	Megawatt
MWh	Megawatt-hour
s, sec	Second
TW	Terawatt (1,000,000,000,000 W)

Symbol	Unit
V	Volt
VAR	Volt Ampere Reactive
W	Watt

3 GENERAL CONDITIONS

3.1 INTRODUCTION

The General Conditions (GC) set out the over-riding principles to be used in the operation of the *Kenya National Distribution System* and form the basis for the decisions of a reasonable and prudent operator should specific events not be covered by the relevant code. The GC describes the provisions necessary for the overall administration and review of the various aspects of the *KNDGC*. The GC also deal with those aspects of the *KNDGC* not covered in other chapters, including the resolution of disputes, bilateral agreements, confidentiality, non-compliance and the revision of the *KNDGC* through recommendations of a *Kenya National Distribution Code Review Committee*.

3.2 SCOPE

The objective of the General Conditions is to establish the conditions applicable to all chapters of the *KNDGC* and, to the extent possible, ensure that the various chapters and sections of the *KNDGC* work together for the benefit of the *Distribution Network Service Provider*s and all *Distribution Network User*s, and apply consistently to all *Distribution Network User*s.

3.3 OBJECTIVE

The objective of the General Conditions is to establish the conditions applicable to all chapters of the *KNDGC* and, to the extent possible, ensure that the various chapters and sections of the *KNDGC* work together for the benefit of the *Distribution Network Service Provider*s and all *Distribution Network User*s, and apply consistently to all *Distribution Network User*s.

3.4 IMPLEMENTATION AND ENFORCEMENT

The *Authority* is responsible for the implementation and enforcement of the *KNDGC*.

The *Authority* may, in certain cases, need access to services and facilities of *Distribution Network User*s or *DNSP*s, or to issue instructions to *Distribution Network User*s or *DNSP*s to implement and enforce the *KNDGC*. Accordingly, all *Distribution Network User*s and *DNSP*s are required not only to abide by the letter and spirit of the *KNDGC*, but also to provide the *Authority* with such rights of access, services and facilities and to comply with any instructions of the *Authority*.

Each *DNSP* and *Distribution Network User* shall act in good faith and in accordance with *Prudent Utility Practice*.

This Kenya National Distribution Code will be applied and used together with the *Kenya National Transmission Grid Code* and all other applicable policies and procedures that govern the use of the Kenya power system.

3.5 SAFETY AND ENVIRONMENT

Nothing in or pursuant to this *KNDGC* shall be taken to require a *Party* to do anything which could or would be unsafe or contrary to the *Party's Environmental, Health and Safety Obligations as prescribed by all applicable laws and regulations.*

3.6 UNFORESEEN CIRCUMSTANCES

The *KNDGC* cannot predict and address all possible operational situations. In case of circumstances unforeseen in the *KNDGC,* or in the case of difference in interpretation, the *DNSP* has the right (and all *Distribution Network User*s must accept) to act in the course of the reasonable and *Prudent Utility Practice* discharge to its responsibilities within the following general principles and priorities:

(a) As first priority, preserve or restore the integrity of the *Distribution System* or the *Transmission System*, including the avoidance of breakdown, separation or collapse (total or partial);

(b) Compliance by the *DNSP* with the *Energy Act*, conditions of its *Distribution Licence* and the *KNDGC;*

(c) Preserve the safety of the public and workforce to prevent personal injury;

(d) Protect equipment and apparatus to prevent damage to plant;

(e) The achievement of objectives specifically identified in the *KNDGC*.

In case of an unforeseen circumstance that cannot be resolved with the general principles defined in the previous conditions, the DNSP shall act according to the following:

(a) The application of a policy aimed at the equitable sharing amongst Distribution Network Users of any temporary restriction that might be necessary in exceptional circumstances; and

(b) The application of Prudent Utility Practice

If circumstances not envisioned by the provisions of the *KNDGC* should arise, the *DNSP*s shall, to the extent reasonably practicable in the circumstances, consult promptly and in good faith with the *Authority* and all affected *Distribution Network User*s in an effort to reach agreement as to what should be done. If agreement between the *DNSP* and *Authority* and affected *Distribution Network User*s cannot be reached in the time available, the issue shall be reviewed by the *Authority* to determine what shall be done in accordance to this *KNDGC.* The *Authority* may refer the matter to the *Kenya National Distribution Code Review Committee*, which may make recommendations to the *Authority* on the resolution of the issue.

The *DNSP* shall promptly refer any unforeseen circumstance identified, together with the determinations and interpretations made, to the *Authority* for consideration.

Each *Distribution Network User* shall comply with all instructions given to it by the *DNSP* following a determination for an unforeseen circumstance or a difference in interpretation, provided that such instructions are consistent with the technical characteristics of the *Distribution Network User*'s system and the principles established in the *KNDGC*, and do not endanger the safety of its equipment or staff

3.7 FORCE MAJEURE

In situations of *Force Majeure*, the provisions of the *KNDGC* may be suspended in whole, or in part, pursuant to any directions given by the *Authority*.

Neither *Party* shall be held to have defaulted in respect of any obligation under the *KNDGC* if prevented or delayed from performing that obligation, in whole or in part, because of a *Force Majeure* event. If a *Force Majeure* event prevents or delays a *Party* from performing any of its obligations under the *KNDGC*, that *Party* shall:

(a) Promptly notify any other *Party* involved and the *Authority* of the *Force Majeure* event and its assessment in good faith of the nature and the effect that the event will have on its ability to perform any of its obligations and the measures that the *Party* proposes to take to alleviate the impact of the *Force Majeure* event. If the immediate notice is not in writing, it shall be confirmed in writing as soon as reasonably practicable. The notice shall be posted on the *Authority* website.

(b) Not be entitled to suspend performance of any of its obligations under the *KNDGC* to any greater extent or for any longer time than the *Force Majeure* event requires it to do;

(c) 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;

(d) Keep the other *Party* and the *Authority* continually informed of its efforts, and

Provide written notice to the other *Party* and the *Authority* when it resumes performance of any obligations affected by the *Force Majeure* event. The notice shall be published on the *Authority* website

3.8 COMPLIANCE

(a) All *DNSP*s and *Distribution Network User*s shall comply with the *KNDGC*.

(b) *DNSP*s shall inform the *Authority* of any non-compliance report without delay, but no later than thirty (30) days after becoming aware of the item unless there is a significant risk to the safety of the public, electrical workers, and/or *Kenya National Distribution System or the Kenya National Transmission System*, which then must be reported immediately.

(c) The *Authority* may require a *User* to provide it with information that it deems necessary for the proper administration of the *KNDGC*. This information shall, upon request, be treated as confidential.

(d) Upon a report or suspicion of non-compliance, the *Authority* may seek to:

(i) Resolve the issue through negotiation

(ii) Take action in terms of the procedures for handling contraventions

(iii) Consider an application for amendment

(iv) Consider an application for exemption

(e) Application for exemption or suspension of obligations under the *KNDGC* is treated under Section 3.9 Non-Compliance.

3.9 NON-COMPLIANCE

If a *DNSP* or *Distribution Network User* finds that it is, or will be unable to comply with any provision of this *KNDGC*, then that party shall without delay, but not later than thirty (30) days after discovery, report such non-compliance to the *Authority* or the *DNSP* as appropriate. After which the provisions of 3.10 shall apply.

3.9.1. Non-Compliance Situations

If the *DNSP* or a *User* fails to fulfil all the provisions established in this *KNDGC*, it shall be considered a Non-Compliance situation.

A Non-Compliance situation will include, but is not limited to:

(a) Failure to provide the *Authority*, on time, all required information in the *KNDGC*

(b) Providing the *Authority* incomplete or inaccurate data or reports, in particular inaccuracies or other problems verified by the audits of the *Authority*

(c) Failure to implement in time the procedures and information systems required in the *KNDGC*

(d) Failure or unsuitable delays in the execution of the approved remedial actions and plans to comply with KNDGC provisions following the approval of a *Derogation* and mitigation plan

3.9.2. Penalties

If the *Authority* determines that the *User* is in a non-compliance situation for which *a Derogation* has not been filed or is in the process of being filed, or for which a *Derogation* has not been approved by the *Authority*, or is in violation of the terms of an approved *Derogation*, the *Authority* will determine and apply applicable penalty for the non-compliance situation. The amount of the penalty will be determined by the *Authority* depending on the type and the level of non-compliance, taking into consideration the following factors:

(a) Severity of the non-compliance and any environmental, health, and safety impacts

(b) Instances of repeated and deliberate non-compliance

(c) Penalties shall be comparable to those specified in other laws, regulations, and applicable contracts

(d) Penalties shall be set at a level such that non-compliance will not be economically preferable to compliance *(align with the Act).*

The *Authority* shall also consider that the *User* may be in non-compliance with its licence conditions, and may suspend or revoke the licence

3.10 DEROGATION

The *Authority* may issue *Derogations* suspending a *User*'s obligations to implement or comply with the *KNDGC* to such an extent as may be specified in the *Derogations.*

If a *DNSP* or *Distribution Network User* finds that it is, or will be, unable to comply with any provision of the *KNDGC*, then they shall, without delay, report such non-compliance. The applicant may request an exemption from the *KNDGC* requirement, or request additional time to correct the non-compliance item.

When the issuance of this *KNDGC*, or an amendment to this *KNDGC*, causes a *DNSP* to be in non-compliance with the *KNDGC* relating to facilities already connected or approved to be connected to the *Distribution System*, and the *DNSP* believes either that it would be unreasonable (including on the grounds of cost and technical considerations) to remedy such non-compliance or that it should be granted an extended period to remedy such non-compliance, the *DNSP* shall promptly submit a Request for *Derogation* to the *Authority* for review and resolution (as described in Section 3.12 Derogation.) The burden of proof shall rest with the *DNSP* to show good reason why it cannot comply.

Likewise, when the issuance of this *KNDGC*, or an amendment to this *KNDGC*, causes a *Distribution Network User* to be in non-compliance with the *KNDGC* relating to facilities already connected or approved to be connected to the *Distribution System*, and the *Distribution Network User* believes either that it would be unreasonable (including on the grounds of cost and technical considerations) to remedy such non-compliance or that it should be granted an extended period to remedy such non-compliance, the *Distribution Network User* shall promptly submit a Request for *Derogation* to their *DNSP* for review and resolution. The burden of proof shall rest with the *Distribution Network User* to show good reason why it cannot comply.

3.10.1. Request for Derogation

A *Derogation* Request form must be prepared and submitted along with any supporting documentation and evidence that supports the request as soon as the non-compliance issue is discovered.

3.10.1.1. DNSPs and Generation Licensees

A *DNSP* or *Generation Licensee* seeking a *Derogation* shall submit *Derogation* Request forms (see Appendix A Derogation Request and Mitigation Plan Forms) along with any supporting evidence to the *Authority* for their review and determination. The request shall contain:

(a) Name of *Party* applying for *Derogation*;

(b) Contact information, name and signature of CEO or other corporate officer delegated by the CEO;

(c) Whether the *Derogation* request is for a permanent exemption from a *KNDGC* requirement or a request for a time extension to achieve compliance;

(d) The specific provision of the *KNDGC* (section title and number) with which the *DNSP* or *Generation Licensee* is, or will be, unable to comply;

(e) The date of the discovery of the non-compliance and the date of reporting the non-compliance;

(f) The nature and extent of the non-compliance;

(g) The cause for the non-compliance;

(h) Identification and description of the system, facility, equipment, process, procedure or specific connection point in respect of which *Derogation* is sought.

(i) A description of any health and safety implications and the associated risk management measures

(j) A description of the proposal for restoring compliance (where applicable) with the *KNDGC* requirement(s), including details of actions to:

  (i) Mitigate risks to *Customers* or other *Users*

  (ii) Restore compliance (including timetable of works)

(k) A description of the reasonable alternative actions that have been considered

(l) A statement of the expected duration of the non-compliance

The *DNSP* or *Generation Licensee* is required to justify the *Derogation* request in terms of both the specific circumstances and the expected duration. *Licensees* are advised to give as much notice as possible when making *Derogation* requests since *Derogations* will not be granted unless the *Authority* is satisfied that the request is justified.

3.10.1.2. Consumers

A *Customer* seeking a *Derogation* shall submit the *Derogation* form along with any supporting evidence to their *DNSP* for review and determination. The *DNSP* determines whether to approve

the *Derogation*, and records the decision in the *Derogation* register, which is reviewed by the *Authority* every three (3) months.

The request shall contain:

(a) Details of the applicant, including the full name and service address of the *Customer* concerned;

(b) Details of the system, facility, equipment, process, procedure or specific connection point in respect of which *Derogation* is sought and the nature and extent of non-compliance;

(c) The reason for the non-compliance;

(d) The planned remedial actions that will be taken to remedy the non-compliance, including the date that compliance will be achieved; or

(e) An explanation of why an exemption of the *KNDGC* requirement will not pose a risk to the *Distribution Network*, other *Distribution Network Users*, utility workers or the public.

Customers may appeal determinations on *Derogations* as made by the *DNSP* to the *Authority*

3.10.2. Derogation Review

Upon receipt of any request for *Derogation*, the *Authority* or *DNSP*, as applicable, shall promptly consider such a request provided that the *Authority* or *DNSP* considers that the grounds for the *Derogation* are reasonable. In its consideration of a *Derogation* request, the *DNSP* or the *Authority*, as applicable, may contact the relevant *DNSP* or *Distribution Network User* to obtain clarifications, request additional information or to discuss changes to the request, and review possible remedial actions to achieve compliance.

The *Authority* may initiate at its own initiative, or at the request of a *DNSP* or in view of a *Distribution Network User* complaint, a review of any existing *Derogations*, and any *Derogations* under consideration where a relevant and material change in circumstance has occurred.

The *Authority* may also seek the views and advice of an *Independent Expert* on the proposed *Derogation*, as set out in Section 3.12 of this chapter.

3.10.3. Derogation Reporting

Every six (6) months, the *DNSP* shall report to the *Authority*:

(a) The list of *Derogations* requested during the last half year, including requests by the *DNSP*, and the status of each request;

(b) The list of approved *Derogations* during the last half year indicating type of *Derogation* and party; and

For each approved *Derogation*, the progress of remedial actions in achieving compliance.

3.10.4. Derogation Register

The *Authority* shall:

(a) Keep a register of all *Derogation*s that have been granted to *DNSP*s and *Generation Licensees*, identified by name,

(b) Publish a current register of all *Derogation*s that have been granted to *DNSP*s and *Distribution Network User*s on the *Authority* website, the relevant provision of this *KNDGC*, the period of the *Derogation* and a record of the completed mitigation, where applicable.

The *DNSP* shall:

(a) Keep a register of all *Derogations* which have been granted to *Distribution Network Users*, identifying *User* name, the relevant provision of this *KNDGC*, a record of the completed mitigation and the period of the *Derogation;* and

(b) On request from the *Authority* or any *Distribution Network User*, provide a copy of such register of *Derogation*s.

3.10.5. Transitional Provisions

Transitional Provisions are intended to facilitate compliance and reduce the need for *Derogation* requests to suspend obligations under *KNDGC* provisions.

Transitional Provisions are provisions of the *KNDGC* approved by the *Authority* that shall not apply either in whole or in part to some or all *Users*. They differ from a *Derogation* in that:

(a) They cover potentially many *Users*

(b) They can be sought by a group of *Users* with similar needs to suspend obligations

(c) In appropriate circumstances, the *Authority* can initiate a Transitional Provision

Situations which might require the use of Transitional Provisions include, but not limited to:

(a) The effective date of the *KNDGC* and its impact on requirements, such as multiple *Generating Plants* that need equipment upgrade in order to reach compliance

(b) Discovery of a common-mode problem with equipment.

Transitional Provisions may require a plan of how the affected *Users* are going to reach compliance, or reasons why they should be permanently exempt.

3.11 DISPUTE RESOLUTION

3.11.1. Mutual Discussion

If a *Dispute* arises between *the Authority* and any *User* or between *Users* in connection with, or arising out of, the interpretation, implementation or breach of any provision in this *KNDGC*, any *Party* may issue to the other *Party* a written notice (the "*Dispute Notice*") outlining the matter in

Dispute. Following issue of a *Dispute Notice* both *Parties* 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 *Kenya National Distribution Code Review Committee* to consider the disputed *KNDGC* provisions and offer recommendations on resolution of the *Dispute*.

3.11.2. Determination by the Authority

If the *Dispute* cannot be settled within thirty (30) business days after issue of the *Dispute Notice*, either *Party* 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 *Parties* shall be attached;

(b) Upon receipt of a request for referral, the *Authority* shall 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 manner in which 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. The *Authority* may also seek the views and advice of an *Independent Expert* on settlement of the *Dispute* as set out in Section 3.11.3 of this chapter.

The determination by the *Authority* shall be legally binding on all *Parties*.

Determinations by the *Authority* are subject to appeal before the *Tribunal* as provided under the *Act.*

3.12 INDEPENDENT EXPERT OPINION

If any matter is referred to an *Independent Expert*, he shall be appointed by the *Authority* as appropriate. Such person shall be an expert with specialised skills in the matter under consideration and must not have any material relationship with any of the *Parties* to the matter. When referring a matter to an *Independent Expert* a written brief shall be prepared containing:

(a) A description of the *Derogation* requested or the matter on which the *Independent Expert* is required to express an opinion or give advice;

(b) All the relevant documentation;

(c) All the relevant correspondence between *Parties*, and

(d) A request that the *Independent Expert* drafts an opinion setting out a possible solution to the issue.

The *Independent Expert* shall determine the procedure to be followed for the purpose of preparing an opinion. The venue for the *Independent Expert's* inquiries will be agreed between the *Parties* to the matter under consideration. Modern technologies such as video conferencing may be used to ensure that the process is as cost efficient and equitable as possible.

The *Independent Expert* must within fifteen (15) business days of his appointment accept submissions from the *Parties* in dispute and must state his determination of those matters within sixty (60) business days of his appointment.

Responsibility for the entire cost of the *Independent Expert* shall be:

(a) In the case of referral pursuant to Section 3.9 in this chapter, *Party* or *Parties* seeking revision of the *KNDGC* shall equally divide the entire cost;

(b) In the case of referral pursuant to Section 3.10 in this chapter, the *Party* or *Parties* seeking *Derogation* shall equally divide the entire cost;

In the case of referral pursuant to Section 3.11 in this chapter, the disputing Parties shall equally divide the entire cost.

3.13 KNDGC INTERPRETATION

In the event that any *User* requires additional interpretation of the wording or application of any provision of the *KNDGC*, they may make a request to the *Authority* for such interpretation. Provided that the request is reasonable, the *Authority* shall provide the *User* with an interpretation of the relevant provision. In the event that a *User*, acting reasonably, deems that an interpretation provided by the *Authority* is unreasonable or inappropriate, the matter shall be resolved as provided in Section 3.11 Dispute Resolution of the *KNDGC*

3.14 HIERARCHY

In the event of any conflict between the provisions of the KNDGC and any contract, bilateral agreement or arrangement between a Transmission Licensee, Distribution Licensee, or other Users, the provisions of the KNDGC shall prevail unless the KNDGC expressly provides otherwise.

In the event of any inconsistency between the KNDGC and the Kenya National Transmission Grid Code, the latter shall prevail to the extent of such inconsistency unless the contrary intention is explicit in the KNDGC.

3.15 CONFIDENTIALITY

All data relating to and exchanged among Parties concerning the Kenya National Distribution System shall be considered to be Confidential Information. The Authority shall consult with the DNSPs and Users in regard to the publication of any of the data exchanged. Aggregate data may be made available when requested by a User. These data shall be used only for the purpose specified in the request and shall be treated by the User as confidential. All such disclosure of

Confidential Information shall be subject to a written Confidentiality Agreement duly signed by the DNSPs and Users. Such Confidential Information shall not be disclosed to other parties without the express written consent of the parties to the Confidentiality Agreement.

3.15.1. Confidential Information

Each Party shall use all reasonable endeavours to keep confidential any Confidential Information which comes into the possession or control of that Party or of which the Party becomes aware. The information owner may request the receiver of information to enter into a Confidentiality Agreement before information established to be confidential is provided.

A Party:

(a) Shall not disclose confidential information to any person except as permitted by the *KNDGC and consistent with the provisions of section 211 of the Act*

(b) Shall only use or reproduce confidential information for the purpose for which it was disclosed or another purpose contemplated by the *KNDGC*;

(c) Shall not permit unauthorised persons to have access to *Confidential Information.*

Each *Party* shall use all reasonable endeavours:

(a) To prevent unauthorised access to *Confidential Information* which is in the possession or control of that *Party*; and

(b) To ensure that any person to whom he discloses *Confidential* Information observes the provisions of this Section 3.15.1 in relation to that information.

To control unauthorised access to confidential information and to ensure secure information exchange. *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).

3.15.2. Exceptions

This section does not prevent:

(a) The disclosure, use or reproduction of information if the relevant information is at the time generally and publicly available other than as a result of breach of confidence by the *Party* who wishes to disclose, use or reproduce the information or any person to whom the *Party* has disclosed the information;

(b) The disclosure, use or reproduction of information to the extent required by law or by a lawful requirement of any government or governmental body, authority or agency having jurisdiction over a *Party* or his related bodies corporate; or

(c) The disclosure, use, or reproduction of information if required in connection with legal proceedings.

3.15.3. Application of Confidentiality to the Authority

For the purpose of Section 3.15, other than Section 3.15.4, *Party* includes the *Authority* and any council, committee or other body established by the *Authority* under the *KNDGC*.

3.15.4. Indemnity to the Authority

Each *Party* indemnifies the *Authority* against any claim, action, damage, loss, liability, expense or outgoing which the *Authority* pays, suffers, incurs, or is liable for in respect of any breach by that *Party* or any officer, *Agent* or employee of that *Party* of this Section 3.15.4 of the *KNDGC*.

3.15.5. Party Information

Each Party shall develop and, to the extent practicable, implement a policy to protect information that he acquires pursuant to his various functions from use or access which is contrary to the provisions of the KNDGC.

3.15.6. Information on Kenya National Distribution Code Bodies

The *Authority* shall develop and implement policies concerning:

(a) The protection of information which *KNDGC* bodies acquire pursuant to their various functions from use or access by *Parties* or *KNDGC* bodies which is contrary to the provisions of the *KNDGC*; and

(b) The dissemination of such information where appropriate to *Parties* and other interested parties.

4 GOVERNANCE

4.1 INTRODUCTION

The objective of this Governance chapter is to describe the provisions necessary for the overall administration and review of the various aspects of the *KNDGC*. This chapter also summarises the main documents and organisations that provide the authority governing the planning, construction, and operation of the *Kenya National Distribution System.*

This *KNDGC* shall be read in conjunction with the relevant legislation including the *Energy Act of 2019* and the *Energy (Electricity Supply) Regulations of 2021* and any applicable amendments related to the administrative authority for the *KNDGC*. The *KNDGC* requirements shall also be applied in conjunction with the licences issued to *Generation Licensees*, Transmission companies and *Distribution Network Service Provider*s and regulations that relate to the Electricity Supply Industry adopted by the *Authority* and the Ministry of Energy. All *Distribution Licences* and agreements concluded after implementation of the *KNDGC* shall include the obligation of parties to comply with *KNDGC* requirements.

This chapter also describes the methodology that will be used to:

(a) To ensure that all *Distribution Network User*s are represented in reviewing and making recommendations to the development and revision of the *KNDGC* requirements;

(b) Facilitate the monitoring and auditing of compliance with the *KNDGC*;

(c) To specify the processes used for the settlement of disputes

4.2 GOVERNANCE DOCUMENTS

The primary laws defining governance are the Kenya's *Energy Act No. 1 of 2019* and the *Energy (Electricity Supply) Regulations, 2021*. The *Energy Act* established the *Authority*, the Rural Electrification and Renewable Energy Corporation (REREC), the Nuclear Power and Energy Agency (N*u*PEA) and the *Tribunal*. The organisations with governance functions include the *Authority*, the *Tribunal*, and the *Ministry of Energy.*

4.3 KENYA NATIONAL GRID CODE REVIEW COMMITTEE

The *Authority* shall constitute and maintain the *Kenya National Grid Code Review Committee* in accordance with the relevant provisions of the *Energy (Electricity Supply) Regulations of 2021.*

The role of the *Kenya National Grid Code Review Committee* shall be as stipulated in the *Energy (Electricity Supply) Regulations of 2021.*

4.4 REVISIONS TO THE KENYA NATIONAL DISTRIBUTION CODE

The Authority is responsible for the review of the operations and revision of the KNDGC and will be informed by the recommendations of the *Kenya National Grid Code Review Committee.*

Any Distribution *Network User, Kenya National Grid Code Review Committee* member, DNSP, Transmission Licensee, the System Operator, the Ministry of Energy or the Authority may propose revisions to the KNDGC.

Before approving any proposed revisions to the KNDGC, the Authority will be guided by the Grid Code Review Committee recommendations on the matter and any representations made by Parties. In considering the proposed revisions, the Authority may also seek the opinion of an Independent Expert

The Authority shall, as required, prepare and issue amended versions of the *KNDGC* containing such revisions as have been approved by the *Authority*. All revisions to the *KNDGC* shall be recorded in the *Kenya National Distribution Code Revision Register*, which shall indicate the date, chapter amended and the reason for the change. An up to date *KNDGC* including all approved revisions shall be published on the *Authority* website along with the *Kenya National Distribution Code Revision Register*. The revised version of the *KNDGC* shall take effect from the date on which it is published on the *Authority* website, or such other later date as specified by the *Authority*

4.5 KENYA NATIONAL DISTRIBUTION CODE AUDITS

4.5.1. Customer Request

A *User* may request from the *DNSP*, or a *DNSP* may request from a *User*, any material in the possession or control of that participant relating to compliance with a section of the *KNDGC*. The requesting participant may not request such information in relation to a particular section of the *KNDGC* within six (6) months of a previous request made under this section in relation to the relevant section.

4.5.2. Information Requirements

A request under this section shall include the following information:

(a) Nature of the request

(b) Name of the representative appointed by the requesting participant to conduct the investigation

(c) The time or times at which the information is required.

4.5.3. Withholding of Information

The relevant participant may not unreasonably withhold any relevant information requested. It shall provide a representative of the requesting participant with such access to all relevant documentation, data, and records (including computer records or systems) as is reasonably requested. This information shall be treated as confidential if requested. Any request or investigation shall be conducted without undue disruption to the business of the participant.

4.6 CONTRACTING

The *KNDGC* shall be one of the standard documents that form part of the contract between *DNSPs* and each of their *Customer*s. *DNSPs* shall contract with *Customer*s for any services specified in the *KNDGC*

4.7 REGISTRATION OF LICENSEES

4.7.1. Users

Distribution Network Service Providers shall ensure that agreements between *DNSPs* and *Users* after the implementation of the *KNDGC* shall include an obligation on *Users* to comply with *KNDGC* requirements.

4.7.2. Licensed Entities

The *Authority* shall ensure that all *Licensees* comply with *KNDGC* requirements.

4.7.3. Registration of Kenya National Distribution Code Licensees

No entity shall have access to the *Kenya National Distribution System* before obtaining a licence from the *Authority*. The *Authority* shall be responsible for creating and maintaining a register of *Licensees*. Distribution Network Service-providers shall ensure that *Users, excluding consumers,* are registered as *Licensees* before entering into a contract for services with such *Users*.

A *User* who no longer holds a licence from the *Authority* shall be removed from the register of *Licensees*.

4.8 NOTICES

4.8.1. Service of Notices under the Kenya National Distribution Code

A notice is properly given under the *KNDGC* to a person if:

(a) It is personally served; or

(b) A letter containing the notice is prepaid and posted to the person at an address (if any) supplied by the person to the sender for service of notices or, where the person is a *User*, an address shown for that person in the register of *Users* to whom licences have been issued under the *Act* and maintained by the *Authority* or, where the addressee is the *Authority*, the registered office of the *Authority*; or

(c) It is sent to the person in electronic format to a number or reference which corresponds with the address referred to in Section 4.8.1(b) or which is supplied by the person to the *Authority* for service of notices; or

(d) It is published in a newspaper with wide circulation in the area where the person is resident or in a daily newspaper circulated generally;

(e) It is communicated verbally to the person and that communication is recorded or thereafter confirmed in writing; or

(f) The person receives the notice.

4.8.2. Time of Service

A notice is treated as being given to a person by the sender:

(a) Where sent by post in accordance with Section 4.8.1(b):

(i) to an address in the central business district of Nairobi, on the second business day after the day on which it is posted;

(ii) to any other address, on the third business day after the day on which it is posted;

(b) Where sent in electronic format in accordance with Section 4.8.1(c):

(i) Where the notice is of a type in relation to which the addressee is obliged under the *KNDGC* to monitor receipt by electronic mail outside of, as well as during, business hours, on the day when the notice is recorded as having been first received at the electronic mail destination; and

(ii) In all other cases, on the day when the notice is recorded as having been first received at the electronic mail destination, if a business day or if that time is after 1600 Hr (addressee's time), or the day is not a business day, at 0900 Hr on the following business day; or

(c) Where published in a newspaper in accordance with Section 4.8.1(d), on the next day after the date of publication of the notice;

(d) In any other case, when the person actually receives the notice.

4.8.3. Counting of Days

Where a specified period (including, without limitation, a particular number of days) shall elapse or expire from or after the giving of a notice before an action may be taken neither the day on which the notice is given nor the day on which the action is to be taken may be counted in reckoning the period.

4.8.4. Reference to Addressee

In this section, a reference to an addressee includes a reference to an addressee's officers, *Agents*, or employees or any person reasonably believed by the sender to be an officer, *Agent* or employee of the addressee.

4.9 ENFORCEMENT

4.9.1. Investigations

(a) A *User* shall, if requested by the *Authority*, supply it with information relating to any matter concerning the *KNDGC* in such form, covering such matters and within such reasonable time as the *Authority* may request.

(b) If a *User* fails to comply with a request by the *Authority* for information as described in section 4.9.1(a), the *Authority* may appoint a person to investigate the matter and to prepare a report or such other documentation as the *Authority* may require. A *User* shall assist the person to undertake the investigation and to prepare the report or other documentation. In addition, a *User* shall, at the request of the person appointed, direct third-parties to make available such information as the person may reasonably require.

(c) The cost of the investigation and of preparing the report or other documentation prepared by the person appointed shall be met by the *User* directed to supply the information under Section 4.9.1(a) unless the *Authority* otherwise determines.

(d) Any report or other documentation referred to in this Section 4.9.1 may be used in any proceeding involving the *Authority* under the *Act* or for the purpose of commencing any such proceeding.

(e) The *Authority* shall develop and implement guidelines in accordance with the *KNDGC* consultation procedures governing the exercise of the powers conferred on it by this Section 4.9.1.

(f) The guidelines referred to in Section 4.14.1(e) shall set out the circumstances that a *User* will be required to bear the cost of providing the information sought by the *Authority* under this Section 4.9.1, including where no breach of the *KNDGC* by the relevant *User* has occurred.

4.9.2. Entry and Inspection

The *Authority* and its authorised officers and representatives shall have such rights of entry to premises and installations as may be granted under the *Act*.

4.9.3. Functions of the Authority

The functions of the Commission are set out in the Energy Act.

4.9.4. Alleged Breaches of the Kenya National Distribution Code

(a) If a *User* considers that another *User* may have breached or may be breaching this *KNDGC* or any provision in their *Connection Agreement*, the aggrieved *User* may, in accordance with this *KNDGC* or the terms of their *Connection Agreement*:

(i) Give notice to the person in breach to immediately take steps to remedy and/or stop the breach, as the case may be;

(ii) Subject to Section 4.9.4, impose any sanctions on the person in breach as provided in this *KNDGC* or their *Connection Agreement* and

(iii) Without limitation to his powers, use reasonable endeavours to give effect to any sanctions so imposed.

(b) If the *Authority* considers that:

(i) A *User* may have breached or may be breaching the *KNDGC*; and

(ii) In the circumstances and if the breach is established, it would be appropriate that a sanction or sanctions be imposed on that *User*, the *Authority* shall notify the *User* of the alleged breach and details of the sanctions which may be imposed if the breach is established.

(c) If the *Authority* receives written information from a *User* or any other person which alleges a breach of the *KNDGC* by a *User*, the *Authority* shall within five (5) business days of receipt of the information determine whether, based on that information, there would appear prima facie to be a breach of the *KNDGC*.

(d) If the *Authority* considers that a *User* may be the subject of a *disconnection* order it shall:

(i) Promptly notify the *Users* which the *Authority* considers may be affected; and

(ii) Without limitation to its powers, use reasonable endeavours to give effect to any arrangements notified to the *Authority* by the *Users* for ensuring the continuation of *supply* to the relevant purchasers of electricity

4.9.5. Sanctions

The nature of sanctions that may be imposed under the *KNDGC* and the circumstances in which a *User* or the *Authority* may implement any sanction that has been imposed, shall be set out in regulations.

4.9.6. Actions of the Authority

(a) The *Authority* may direct a *User* or any person to do or refrain from doing anything that the *Authority* thinks necessary or desirable to give effect or assist in giving effect to any of its orders.

(b) Without limiting the generality of Section 4.9.6(a), the *Authority* may direct a *Distribution Network Service Provider* to *disconnect* a *User* from any *distribution system* in order to assist in giving effect to any of its orders.

(c) A *User* or any person shall comply with a direction given under Section 4.9.6(a).

4.9.7. User Actions

If any partner, *Agent*, officer, or employee of a *User* does any act or refrains from doing any act which if done or not done (as the case may be) by a *User* would constitute a breach of the *KNDGC*, such act or omission shall be deemed for the purposes of this Section 4.9.7 to be the act or omission of the *User* concerned.

4.9.8. Publications

(a) The *Authority* shall publish a report at least once every six (6) months setting out a summary for the period covered by the report of:

(i) Matters which have been referred to it;

(ii) All its findings during that period; and

(iii) Any sanctions it applied under the *Act*.

(b) In considering the circulation of a report under Section 4.9.8(a), the *Authority* shall have regard to *KNDGC* objectives.

(c) In addition to the regular publication described in Section 4.9.8(a), the *Authority* may publish a report on any one or more matters that have been referred to it, its findings in relation to those matters and any sanctions imposed in relation to those matters. A decision by the *Authority* to publish a report under this Section 4.9.8(c) is a reviewable decision.

(d) No User, or former *User* is entitled to make any claim against the *Authority* for any loss or damage incurred by the *User* or former *User* from the publication of any information pursuant to Section 4.9.8(a) or (c) if the publication was done in good faith. No action or other proceeding will be maintainable by the person or *User* referred to in the publication against the *Authority* or any person publishing or circulating the publication on behalf of the *Authority* and this section operates as leave for any such publication except where the publication was not done in good faith.

4.9.9. System Security Directions

(a) Notwithstanding any other provisions of the *KNDGC*, a *User* shall follow any direction issued by or on behalf of the *SO*, which the *SO* is entitled to issue in exercising its powers under the Operations Chapters of the *KNDGC* relevant to maintaining or restoring *Power System Security*.

(b) Any event or action required to be performed pursuant to a direction issued under the Operations Chapters of the *KNDGC* on or by a stipulated day is required by the *KNDGC* to occur on or by that day, whether or not a business day.

(c) Any failure to observe such a direction will be deemed to be a breach of the *KNDGC*.

(d) Any *User* who is aware of any such failure or who believes any such failure has taken place shall refer the allegation to the *Authority* in accordance with the procedures contained in Section 4.9.4.

4.10 MONITORING AND REPORTING

4.10.1. Monitoring Objectives

(a) The *Authority* is responsible for monitoring compliance with and shall use its reasonable endeavours to ensure the effectiveness of the *KNDGC* in accordance with its objectives.

(b) The *Authority* shall undertake such monitoring as it considers necessary:

(i) To determine whether *Users* are complying with the *KNDGC*;

(ii) To assess whether the dispute resolution, *KNDGC* enforcement, *KNDGC* change and other mechanisms are working effectively in the manner intended;

(iii) To determine whether in its operation, the *KNDGC* is adequately giving effect to objectives specified in the *KNDGC*; and

(iv) To collect, analyse, and disseminate information relevant and sufficient to enable the Authority to comply with its reporting and other obligations and powers under the *KNDGC*.

(c) The *Authority* shall ensure that, to the extent practicable in light of the objectives set out in Section 4.10.1(b), the monitoring processes which it implements under this Section 4.10:

(i) Are consistent over time;

(ii) Do not discriminate unnecessarily between *User*s;

(iii) Are cost effective to both the *Authority* and all *User*s; and

(iv) Are publicised or information relating thereto is available to any person, subject to any requirements as a result of the confidentiality obligations

4.10.2. Reporting Requirements and Monitoring Standards

(a) The *Authority* shall establish:

(i) Reporting requirements for *Users* in relation to matters relevant to the *KNDGC*; and

(ii) Procedures and standards applicable to the *Authority* and *Users* relating to information and data received by or from *Users* in relation to matters relevant to the *KNDGC*.

(b) Prior to establishing requirements or standards and procedures referred to in Section 4.10.2(a), the *Authority* shall consult with such *Users* as the *Authority* considers appropriate. In formulating requirements or procedures and standards, the *Authority* shall take into consideration the monitoring objectives set out in Section 4.10. The reporting requirements and standards and procedures established by the *Authority* are reviewable decisions.

(c) Subject to Section 4.10.2(d), the *Authority* shall notify to all *Users* particulars of the requirements, procedures, and standards that it establishes under this Section 4.10.2.

(d) If the *Authority* establishes additional or more onerous requirements or procedures and standards which do not apply to all *Users* and the *Authority* considers that notification of those matters to all *Users* would contravene the confidentiality provisions in Section 3.15, the *Authority* shall notify only those *Users* to whom the requirements or procedures and standards apply.

(e) Each *User* shall comply with all requirements, procedures and standards established by the *Authority* under this Section 4.10.2 to the extent that they are applicable to him within the time period specified for the requirement, procedure or standard or, if no such time period is specified, within a reasonable time. Each *User* shall bear his own costs associated with complying with these requirements, procedures, and standards.

(f) In complying with his obligations or pursuing his rights under the *KNDGC*, a *User* shall not recklessly or knowingly provide, or permit any other person to provide on behalf of that *User*, misleading or deceptive data, or information to any other *User* or to the *Authority*.

(g) Any *User* may ask the *Authority* to impose additional requirements, procedures, or standards under this Section 4.10.2 on another *User* in order to monitor or assess compliance with the *KNDGC* by that *User*. When such a request is made, the *Authority* may but is not required to impose the additional requirements, procedures, or standards. A decision by the *Authority* to impose additional requirement procedures or standards is a reviewable decision. If the *Authority* decides to impose additional requirements, procedures, or standards, the *Authority* may determine the allocation of costs of any additional compliance monitoring undertaken between the relevant *Users*. *Users* shall pay such costs as allocated. In the absence of such allocation, the *User* subject to the additional requirements, procedures, or standards will bear his own costs of compliance.

(h) The *Authority* shall develop and implement guidelines in accordance with the *KNDGC* consultation procedures governing the exercise of the powers conferred on it by Section 4.10.2(g) which guidelines shall set out the matters to which the *Authority* shall have regard prior to deciding the allocation of costs of any additional requirements, procedures or standards imposed pursuant to Section 4.10.2(g) between the relevant *Users*.

4.10.3. Use of Information

(a) Subject to confidentiality obligations set out in the *Confidentiality* sections of the *KNDGC*, the *Authority* is entitled to use any data or information obtained as a result of any monitoring requirements imposed under Section 4.10.2 in pursuance of any of the *Authority's* powers or functions under the *KNDGC*. Without limitation, the *Authority* may use any such information in connection with or to initiate:

(i) A process to change or revise the *KNDGC*; or

(ii) An investigation under the *KNDGC*.

(b) A *User* may claim that the information provided to the *Authority* is confidential in nature to the *User* or that the *User* is under an obligation to another person to maintain the confidentiality of all or part of the information. Notwithstanding that the *Authority* may consider the claim by the *User* to be reasonable, if the *Authority* considers that its reporting obligations set out in the *KNDGC* make the disclosure of the information necessary or desirable, the *Authority* may disclose the information. In doing so, the *Authority* shall use all reasonable endeavours to ensure the information is disclosed only in a manner and to the extent that, as far as practicable, protects the confidential nature of the information and in no way is the *Authority* to be liable for publishing or disclosing any information under this Section 4.10.3.

(c) Prior to disclosing in accordance with Section 4.10.3(b) information which a *User* claims is confidential, the *Authority* shall first notify that *User* as soon as practicable after the *Authority* has made the decision to disclose the information.

(d) Any decision by the *Authority* under Section 4.10.3(b) to disclose information that is claimed by a *User* to be confidential is a reviewable decision and the *Authority* shall not disclose the information until twenty-eight (28) days after it has provided written notice to the relevant *User* that it intends to disclose the information.

4.10.4. Reporting

(a) Not later than 31st December in each calendar year, the *Authority* shall prepare and publish in the Authority's website an annual report for the previous *Financial Year* to all *Users* and interested parties. The annual report shall include:

(i) The *Authority*'s assessment of the extent to which the operation of the *KNDGC* during that period met the *KNDGC* objectives and of the strategic development of the *KNDGC* to meet industry objectives;

(ii) A summary of, and reasons for, any changes to the *KNDGC*;

(iii) A summary of identified material breaches of the *KNDGC* and the actions taken in response, including particulars of any sanctions imposed;

(iv) A summary of any disputes referred to the *Authority* or involving the *Authority* as a *Party*;

(v) A summary of material matters in relation to the dispute resolution under the *KNDGC* (without identifying the parties); and

(vi) The *Authority's* assessment of the matters set out in Section 4.15.1(b) which it is required to monitor.

(b) In addition to the annual report described in Section 4.10.4(a), the *Authority* may, if it considers it appropriate, provide an interim report to *Users* and interested parties on any one or more of the matters that should be contained in the annual report.

5 PLANNING

5.1 DISTRIBUTION PLANNING RESPONSIBILITY

The *Distribution Network Service Provider*(s) shall be responsible for Distribution Planning, including:

(a) Forecasting the future Demand on its *Distribution System* operating area;

(b) Analysing the impact of the connection of new facilities such as *Generating Plants* connected to the *Distribution System*, Loads, distribution lines, or substations.

(c) Planning the expansion of the *Distribution System* to ensure its adequacy to meet forecast Demand and the connection of new *Generating Plants* connected to the *Distribution System*, Loads ; and

(d) Identifying and mitigating deficiencies in Supply Quality, Power Quality and System Losses in the *Distribution System*

Distribution Planning shall be performed in coordination with the *System Operator* and submitted to the *Ministry*.

5.1.1. Planning Data

The *Distribution Network User*s of the *Distribution System*, including *Generating Plants* connected to the *Distribution System* and other entities that have a system connected to the *Distribution System*, shall cooperate with the *DNSP*s in providing and maintaining the Distribution Planning data.

5.1.2. 5-Year Distribution Plan

The *DNSP* shall, in accordance with the *Integrated National Energy Plan (INEP) Regulations*, develop and submit to the *Cabinet Secretary*, plans which shall be reviewed every 3 years

(a) Energy and Demand Forecasts;

(b) Distribution feeder routing and sizing

  (i) Detailed at above 11kV;

  (ii) Outline for 11kV

(c) Distribution Reactive Power compensation plan;

(d) Distribution Losses reduction plan;

(e) Other Distribution reinforcement plans; and

(f) A summary of the technical and economic analysis to justify the 5-Year Distribution Plan.

5.1.3. Submission, Consolidation and Maintenance of Planning Data

Any *Distribution Network User* applying for connection or a modification of an existing connection to the *Distribution System* shall submit to the *DNSP* the relevant Standard Planning Data and the

Detailed Planning Data, in accordance with the requirements prescribed in the Connections Chapter.

When requested, *Distribution Network User*s shall submit to the *DNSP* the relevant historical planning data for the previous year and/or the forecast planning data for the three (3) succeeding years. These shall include the updated Standard Planning Data and the Detailed Planning Data.

The required Standard Planning Data shall consist of information necessary for the *DNSP* to evaluate the impact of any *Distribution Network User* development on the *Distribution System*.

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 *DNSP* to assess any implication associated with the *Connection Point*s.

The Standard Planning Data and Detailed Planning Data shall be submitted by the *Distribution Network User* to the *DNSP* according to the following categories:

(a) Forecast Data

(b) Estimated Equipment Data

(c) Registered Equipment Data

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

The equipment data shall contain validated actual values of parameters and information about the *Distribution Network User*'s Equipment, usually required at the time of connection.

5.1.4. Energy and Demand Forecast

All *Distribution Network User*s with Medium Connections larger than 1 MVA and all Large Connections and connected at Medium or High Voltage shall annually provide the *DNSP* with its Energy and Demand Forecasts at each *Connection Point* for the five (5) succeeding years. The Forecast Data for the first year shall include monthly Energy and Power Forecasts, while the remaining four (4) years shall include only the annual Energy and Power Forecasts.

In the case of *Distribution Network User*s having *Generating Plants* connected to the *Distribution System*, they shall provide the net values of Energy and Power Forecast after any deductions to reflect the output of the *Generating Plant*. Such deductions shall be stated separately in the Forecast Data, including the projected Energy and Demand to be generated by each unit in the *Generating Plant*.

The *DNSP* shall consolidate and maintain the Distribution planning data according to the following categories:

(a.) Forecast Data

(b.) Estimated Equipment Data

(c.) Registered Equipment Data

If there is any change to its planning data, the *Distribution Network User* shall notify the *DNSP* of the change as soon as practicable. The notification shall contain the time and date when the change took effect, or is expected to take effect, as the case may be. 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.

The *Distribution Network User* shall give not less than forty-eight (48) hours' notice to the *DNSP* in the event that the Connection is no longer required.

5.1.5. Distribution System Planning

The *DNSP* shall conduct Distribution Planning studies and evaluations to ensure the safety and reliability of the *Distribution System* in order to:

(a.) Evaluate the requirement of *Distribution System* reinforcement projects;

(b.) Assure the requirement stated under the Technical Requirements section and in the Performance Standards Chapter are met for all the *Distribution Network User*s in the *Distribution System*; and

(c.) Evaluate any proposed *Distribution Network User* development, which is submitted (or is expected to be submitted) in accordance with the applications and procedures stated in the Connections Chapter.

The Distribution Planning studies shall be conducted to assess the impact on the *Distribution System* or to any *Distribution Network User* System, of the Load Forecast or any proposed Equipment change in the *Distribution System* or the *Distribution Network User* System, and to identify corrective measures to eliminate the deficiencies in the *Distribution System* or the *Distribution Network User* System.

The relevant technical studies and the required planning data specified in the following sections shall be used in the conduct of the Distribution Planning studies. The *DNSP* shall conduct distribution planning analysis which shall include:

(a.) The determination of optimum patterns for feeder development, taking into account existing supply points from the *System Operator* and those proposed in the Transmission Master Plan;

(b.) The development of optimum Distribution feeder configurations and switching controls;

(c.) The development of optimum Reactive Power compensation programmes; and

(d.) The cost effectiveness of loss reduction measures.

5.1.5.1. Planning Study Costing Methodology

The Distribution planning studies shall be performed using lifecycle costing methods. The cost of capital and the discount rate used in such analysis shall be consistent with what is prescribed in the *Authority's* approved tariff methodology for the corresponding *DNSP*.

5.1.5.2. Reactive Compensation

In addition to catering for Active Power Demand, Reactive components of power requirement should be studied and adequate measures should be taken by installing Reactive compensation equipment at different voltage levels in a phased manner to improve power factor and cause reduction of losses.

5.1.5.3. Substation Locations

The location of distribution substations and distribution transformer substations shall be rationally determined with the objective of containing voltage regulation and transmission and distribution losses within permissible and reasonable limits.

5.1.5.4. Voltage Regulation

The voltage regulation in the *Distribution System* shall be maintained at the levels prescribed in the Performance Standards Chapter and the distribution losses in the System shall be gradually reduced over the years to meet the targeted figure set out in the Performance Standard chapter.

5.1.5.5. Substation Standardisation

The capacity of transformers used in the *Distribution System* and the layout of bus bars, switchgear, transformers, capacitors, earthing, lightning arrestors, control panels, station battery, fire extinguishers and other accessories required for the safe operation of the substations shall as far as practicable be standardised by the *DNSP*.

5.1.5.6. Distribution Transformer Protection

Distribution transformers shall be provided with suitable fuses or circuit breakers on the low tension side for protection against overload and short circuit.

5.2 PLANNING STUDIES

The following system studies are expected to be carried out by the *DNSP* in order to develop the 5-Year Distribution Plan:

5.2.1. Voltage Drop Studies

Voltage drop studies shall be performed to determine that the expected voltages at the *Distribution Network User*'s *Connection Point*s comply with the requirements stated on the Technical Requirements section and in the Performance Standards specified in Chapter 9 of the KNDGC. It shall take into account the connection of new *Generating Plants* connected to the *Distribution System*, the Forecasted Load, and any planned expansion, reinforcement, or development in the *Distribution System*.

5.2.2. Short Circuit Studies

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

Three-phase short-circuit studies shall be performed for the most demanding scenario (either maximum or minimum generation) and for different system circuit configurations. Single line-to-earth 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, and to determine possible constraints in fulfilling the Power Quality standards set out in the Performance Standards. Alternative *Distribution System* circuit configurations may be studied to reduce the short circuit current within the limits of existing Equipment. 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.

5.2.3. Load Forecast

The *DNSP* shall annually forecast the Demand for Power and Energy within the area of supply. The *DNSP* shall formulate its long term Load Forecast taking the previous financial year ending June 30th as the Base Year and projecting the Demand over the succeeding ten (10) years.

The *DNSP* shall forecast Demand using *Prudent Utility Practice.* In conducting this Load Forecast the *DNSP* shall consider:

(a) Energy Sales per Tariff Class, adopting a suitable methodology to assess its trend, taking into account electricity prices, the growth in population, trends on the national economy, or any other parameter the *DNSP* consider suitable to forecast it;

(b) Assumed normal growth for non-specific loads, specific and identified loads of 1 MW and above and the effects, if any, due to Demand Side Management and loss reduction;

(c) Specific projects, either government or private sponsored (i.e. free zones, large tourist complex, etc.) that will imply the appearance of new loads in the *DNSP*'s licence area;

(d) Conservation programmes, Demand side management or off-peak usage programmes which the *DNSP* may be sponsoring, which are intended to optimize the overall system efficiencies;

(e) Public events that may have significant impact on demand;

(f) Expected schedules for *Generating Plant*s connected to the *Distribution System;*

(g) *Interconnection* with adjacent *DNSP*s, if exists; and

(h) Any other *information* under the *DNSP*'s knowledge that could have some influence in the Load Forecast.

5.2.3.1. Load Profiles

The *DNSP* shall create a data base of loads for each *Distribution Network User* category and for each distribution substation connected to its *Distribution System* and update it on an annual basis.

The *DNSP* shall develop a load research programme with the objective of obtaining *Distribution Network User* load profile data that describes the usage characteristics of specific appliances, *Distribution Network User*s, and group of *Distribution Network User*s. The load research will facilitate obtaining the following information:

(a.) Demand according to end use at System peak, daily, monthly, annually or seasonally;

(b.) Hourly end use Demand for the day of the System Peak, monthly, annual or seasonally;

(c.) Categorical diversity or coincidence factors and load factors;

(d.) Categorical non-coincident peak Demands; and

(e.) Total Energy consumption for each category by day, month, season or year.

5.2.3.2. Aggregate Energy Requirement at Transmission Connection Point

The *DNSP* shall compute the aggregate energy requirement at each of the *Connection Point*s with the Transmission System after accounting for System losses. Based on the metering data at each *Connection Point* with the Transmission System, the *DNSP* shall develop load curves for the area fed by the concerned HV/MV substation. By compiling data from each HV/MV substation feeding its *Distribution System*, the *DNSP* shall develop a System load curve for its area of supply by applying a suitable diversity factor. By reconciling actual Energy sales figures with the metering data at each substation, approximate losses in the System may be computed for any period. This data shall be furnished to the *Authority* as stated in the Performance Standards.

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

5.2.4. Distribution System Reliability Studies

Distribution Reliability studies shall be performed to determine the frequency and duration of *Distribution Network User* Interruptions in the *Distribution System* in order to assure the requirements stated in the Performance Standards is met. The historical Reliability performance of the *Distribution System* shall be determined from the *Distribution System* Interruption data.

5.2.5. Losses

System Losses studies shall be performed to identify, classify, and quantify the losses in the *Distribution System* and to propose measures to gradually reduce them if technically and economically feasible. It shall also be performed to determine the effects of any *Distribution Network User* or Distribution development on the efficiency of the *Distribution System*.

6 CONNECTIONS

6.1 PROCEDURES FOR CONNECTION OR MODIFICATION

6.1.1. Application

6.1.1.1. Application for Connection

Any *Distribution Network User* seeking a new or modified connection to the *Distribution System* will submit to the *DNSP* a Request for Connection Application. Suitable forms shall be provided by the *DNSP*, depending on the required Connection Capacity and the nature of the *Distribution Network User*'s Equipment to be connected. The DNSP shall provide non-discriminatory open access to its distribution system for use by any licensee, retailer or eligible consumer upon—

(a) payment of use of system charges as shall be prescribed in regulations made under this Act and such other fees; and

(b) compliance with such minimum requirements of the distribution licensee.

6.1.1.2. Application for Generating Plant Connection

Any *Distribution Network User* seeking to connect a *Generating Plant* to the *Distribution System* will submit to the *DNSP* a Request for *Generating Plant* Connection Application. Suitable forms shall be provided by the *DNSP*.

6.1.2. Distribution System Requirements

The *DNSP* shall furnish relevant *Distribution System* specifications and requirements to the applicant to assist them in the planning and procurement of equipment for their new or modified connection.

6.1.2.1. Application Requirements

*Distribution Network User*s shall contact the *DNSP* in advance if it is proposing to make any significant change to the connection, electric lines or electrical equipment, install or operate any generating equipment or do anything else that could affect the *Distribution System* or require alterations to the connection.

*Distribution Network User*s shall provide the *DNSP* with any information requested about the nature, or use by the *Distribution Network User*, of electrical equipment on the *Distribution Network User*'s premises. The *DNSP* will only ask for information that is needed by it in relation to its distribution licence or the *KNDGC*.

If the *DNSP* should determine that more detailed information is required, the *Distribution Network User* shall provide it upon request. The *DNSP* will only ask for information that is needed in relation to its Distribution Licence or the *KNDGC*.

*Distribution Network User*s shall make available to the *DNSP* all documentation submitted for approval by local authorities, and proof of the local authorities' approval. All single line diagrams as discussion below shall be approved by a licensed *Professional Engineer.*

6.1.2.2. Small Connections (10kVA and below)

For new or modified Small Connections, it is possible in most cases to assess whether a proposed connection is acceptable, and to determine the necessary supply arrangements, from analysis of the following limited Standard Planning Data provided by the *Distribution Network User*:

(a) The requested Connection Capacity in kVA;

(b) Type and electrical loading of equipment to be connected, e.g. number and size of motors, cookers, electrical space and water electrical heating, air conditioning, refrigeration; and

(c) The date when the new or modified connection is required.

The *DNSP* shall have an efficient process and procedure for the review and approval of these Small Connections.

6.1.2.3. Medium Connections (Up to 2 MVA)

For new or modified Medium Connections, the required Standard Planning Data provided by the *Distribution Network User* will include:

(a) Expected *Connection Point* to the *Distribution System*; geographical and electrical

(b) The date when connection is required

(c) Single line diagrams of existing and proposed arrangements of main plant and apparatus showing equipment rating and operating parameters

(d) Type and electrical loading of equipment to be connected, e.g. number and size of motors, electrical heating, air conditioning, refrigeration, etc.

(e) For all types of load:

  (i) Requested Connection Capacity (kVA)

  (ii) Maximum Active Power Demand (kW)

  (iii) Maximum Reactive Power requirements (kvar)

  (iv) Harmonics characteristics.

(f) For Fluctuating Loads:

  (i) The rate of change of the Demand;

  (ii) The switching interval; and

  (iii) The magnitude of the largest step change

(g) The maximum phase unbalance which the Demand would be expected to impose on the *Distribution System*

(h) The maximum flicker and harmonic content which will be imposed on the *Distribution System*

(i) Details of any load management scheme to be applied by the *Distribution Network User* on the *Distribution Network User* System

(j) Three-phase short circuit in-feed from all sources within the *Distribution Network User*'s System, based on Generation Set sub-transient reactance and the minimum zero phase sequence impedance of the *Distribution Network User*'s System.

(k) Reactive Power switching arrangements:

(i) Rated Capacity (MVAR);

(ii) Rated Voltage (kV);

(iii) Type (e.g., shunt inductor, shunt capacitor, static var compensator); and

(iv) Operation and control details (e.g. fixed or variable, automatic, or manual)

(l) Earthing arrangements

(m) Standard load profiles

(n) In the cases the *Distribution Network User* is connected to the *Distribution System* through a step up transformer:

(i) Rated MVA;

(ii) Rated voltages (kV);

(iii) Winding arrangement;

(iv) Positive and zero sequence resistance and reactance

(v) Tap changer range, step size and type (on-Load or off-Load); and

(vi) Basic Lightning Impulse Insulation Level (kV).

6.1.2.4. Large Connections (Greater than 2 MVA)

For new or modified Large Connections the Standard Planning Data supplied by the *Distribution Network User* will include:

(a) Load data

(b) Type of load and control arrangements (e.g. controlled rectifier or large motor drives and type of starter employed)

(c) Maximum load on each phase at the time of Peak Demand

(d) Demand profiles (48 x half hour average estimates) for Active and Reactive Power Demand for the day of *Distribution System* Peak Demand and for the day of the Transmission System Peak Demand

(e) In relation to Fluctuating Loads:

(i) The rates of change of Demand (Active Power and Reactive Power) both increasing and decreasing;

(ii) The shortest repetitive time interval between fluctuations in Demand, Active Power and Reactive Power;

(iii) The magnitude of the largest step changes in Active Power and Reactive Power, both increasing and decreasing;

(iv) Sensitivity of Demand to fluctuations in voltage and frequency of supply at the time of Peak Demand

(f) Equipment Data

(i) Circuit parameters (positive and zero sequence resistance and reactance; positive and zero sequence shunt subsistence) of the overhead lines and/or underground cables from the *Distribution Network User*'s substation to the Connection Point in the *Distribution System*

(ii) For transformers, percentage impedance, MVA rating, percent regulation, winding resistance, reactance, lighting impulse (kV), magnetising current characteristics, vector group, cooling class;

(iii) For the switchgear, including circuit breakers, Load break switches, and disconnect switches at the Connection Point and at the substation of the *Distribution Network User* (if they are different):

(1) Rated voltage (kV);

(2) Rated current (A);

(3) Rated symmetrical RMS short-circuit current (kA); and

(4) Basic Lightning Impulse Insulation Level (kV).

6.1.3. Generation Connections

Distribution Network Users seeking connection of a *Generating Plant* to the *Distribution System* or an energy storage system shall use the following procedures. This section applies both to all *Generating Plants*

6.1.3.1. Generating Plant (less than 50KW)

(a) *Distribution Network User*s seeking to connect a *Generating Plant* less than 50 KW, shall provide the following information:

(i) Inverter Manufacturer;

(ii) Model Number;

(iii) Nameplate rating (kW) (kVA) (AC Volts);

(iv) Single or Three phase;

(v) System Design Capacity (kW) (kVA);

(vi) Prime Mover: Photovoltaic/Turbine/Fuel Cell/Other;

(vii) Energy Source: Solar/Wind/Hydro/Other;

(viii) A single-line diagram of the Generating Plant;

(ix) Rated power factor (if applicable);

(x) Harmonics characteristics.

(b) *DNSP*s will use the following criteria to assess a *Generating Plant* of less than 50 kW connection application:

(i) For connection of a *Generating Plant* to a radial distribution circuit, the *Generating Plant* aggregated with all other generation capable of exporting energy on a line section will not exceed 15 percent of the line section's annual peak load as most recently measured at the substation or calculated for the line section. A line section is that portion of the radial distribution circuit to which the *Distribution Network User* seeks to connect and is bounded by automatic sectionalising devices or the end of a distribution line.

(ii) If the *Generating Plant* is to be connected on single-phase shared secondary, then the aggregate generation capacity on the shared secondary, including the *Generating Plant*, will not exceed 20 kilovolt-amps (kVA).

(iii) If the *Generating Plant* is single-phase and is to be connected on a transformer centre tap neutral of a 230-volt service, its addition will not create an imbalance between the two sides of the 230-volt service of more than 20 percent of nameplate rating of the service transformer.

6.1.3.2. Generating Plant (50 kW – 10 MW)

As appropriate for the size and type of *Generating Plant*, *Distribution Network User*s seeking to connect a *Generating Plant* of between 50 kW – 10 MW shall provide the following information:

(a) *Generating Plant* Specifications:

(i) Prime Mover: PV/Reciprocating Engine/Fuel Cell/Gas Turbine/Steam Turbine/Micro-turbine

(ii) Energy Source: Solar/Wind/Hydro/Diesel/Natural Gas/Fuel Oil/Other

(iii) Type of *Generating Plant*: Inverter/Synchronous/Induction

(iv) Nameplate Rating: kW or kVA

(v) Applicant Load: kW (if none, so state)

(vi) Typical Reactive Load if known

(vii) Maximum Physical Export Capability Requested: kW

(viii) List Energy Network Association (ENA) certified components of the Connection Equipment Package

(ix) Is the prime mover compatible with the Connection Equipment Package?

(b) *Individual Generating Plant* Data

(i) Manufacturer, Model Name and Number

(ii) Version Number

(iii) Nameplate Output Rating in kW:

(iv) Nameplate Output Power Rating in kVA:

(v) Rated Power Factor: Leading/Lagging

(vi) Total Number of *Generating Plant*s to be Connected

(vii) Elevation

(viii) List of adjustable set points for the protective equipment or software

(c) Inverter-*Based Generating Plant*

(i) Inverter Manufacturer, Model Name and Number

(ii) Maximum design fault contribution current: Instantaneous or RMS

(iii) Harmonics Characteristics

(iv) Start-Up Requirements

(v) Rotating Machines (of any type)

(vi) RPM Frequency

(vii) Neutral Earthing Resistor (where applicable)

(d) *Synchronous Generator*s

(i) Direct Axis Synchronous Reactance, Xd

(ii) Quadrature axis synchronous Reactance, Xq

(iii) Direct Axis Transient Reactance, X' d

(iv) Quadrature axis Transient Reactance, X' q

(v) Direct Axis Sub-Transient Reactance, X" d

(vi) Quadrature axis Sub-Transient Reactance X" q

(vii) Negative Sequence Reactance, X2

(viii) Zero Sequence Reactance, X0

(ix) KVA Base

(x) Field Volts

(xi) Field Amperes

(xii) Provide appropriate block diagram of excitation system, *Governor System and* power system stabiliser (PSS). A PSS may be determined to be required by applicable studies. A copy of the manufacturer's block diagram may not be substituted.

(e) *Induction Generator*s

(i) Motoring Power (kW)

(ii) I^2t or K (Heating Time Constant):

(iii) Rotor Resistance, Rr

(iv) Rotor Reactance, Xr

(v) Stator Resistance, Rs

(vi) Stator Reactance, Xs

(vii) Magnetising Reactance, Xm

(viii) Short Circuit Reactance, Xd

(ix) Exciting Current

(x) Temperature Rise

(xi) Frame Size

(xii) Design Letter

(xiii) Reactive Power Required in vars (No Load)

(xiv) Reactive Power Required in vars (Full Load)

(xv) Total Rotating Inertia, H: per Unit on a kVA Base

(f) *Transformer* and Protective Relay Specifications

(i) Will a transformer be used between the *Generating Plant* and the Connection Point?

(ii) Will the transformer be provided by the Connection *Customer?*

(iii) Transformer Data: (where applicable, for Connection *Customer*-Owned Transformer)

(iv) Is the transformer single- or three-phase?

(v) Size: kVA

(vi) If three phase:

(1) Transformer Primary: _____Volts _____Delta _____Wye _____Wye Earthed

(2) Transformer Secondary: ____Volts _____Delta _____Wye _____Wye Grounded

(3) Transformer Tertiary: _____Volts _____Delta _____Wye _____Wye Grounded

(g) *Transformer* Fuse Data (where applicable for Connection *Customer*-Owned Fuse)

(i) Manufacturer

(ii) Type

(iii) Size

(iv) Speed

(v) Attach fuse manufacturer's Minimum Melt and Total Clearing Time-Current Curves

(h) *Connecting* Circuit Breaker (where applicable)

(i) Manufacturer

(ii) Type

(iii) Load Rating (Amps)

(iv) Interrupting Rating (Amps)

(v) Trip Speed (Cycles)

(i) *Connection* Protective Relays (where applicable)

(i) If microprocessor, provide a list of functions and adjustable set points (min/ max)

(ii) Discrete Components (where applicable)

(iii) Manufacturer

(iv) Type

(v) Style/Catalogue Number

(vi) Proposed Setting

(vii) Copy of any Proposed Time-Overcurrent Coordination Curves

(j) *Current Transformer* Data (where applicable)

(i) Manufacturer

(ii) Type

(iii) Accuracy Class

(iv) Proposed Ratio Connection

(v) Copy of Manufacturer's Excitation and Ratio Correction Curves

(vi) Potential Transformer Data (where applicable)

(k) Attach copy of site electrical single-line diagram showing the configuration of all *Generating Plant* equipment, current and potential circuits, and protection and control schemes. This single-line diagram must be approved, by a licensed Professional Engineer.

(l) *Auxiliaries* Data

(i) Normal unit-supplied auxiliary Load for each *Generating Plant* at rated MW output; and

(ii) Each Generation Unit Auxiliary Load other than (a) above and where the station auxiliary Load is supplied from the *Distribution System*.

(m) Plant Flexibility Performance Data, as applicable

(i) Existence of Black Start Capability

(ii) Ramp Rates (Hot and Cold)

(iii) Starting time from shutdown

(iv) Rate of Load Reduction from normal rated MW; and

(v) Safe operating range

6.1.3.3. Generating Plants -Greater than 10 MW

As appropriate for the size and type of *Generating Plant*, *Distribution Network User*s seeking to connect a *Generating Plant* Greater than 10 MW shall provide the following information:

(a) *Generating Plant* Specifications

(i) Prime Mover: PV/Reciprocating Engine/Fuel Cell/Gas Turbine/Steam Turbine/Micro turbine

(ii) Energy Source: Solar/Wind/Hydro/Diesel/Natural Gas/Fuel Oil/Other

(iii) Type of *Generating Plant*: Inverter/Synchronous/Induction

(iv) Nameplate Rating: kW or kVA

(v) Applicant Load: kW (if none, so state)

(vi) Typical Reactive Load if known

(vii) Maximum Physical Export Capability Requested: kW

(viii) List Energy Network Association (ENA) certified components of the Connection Equipment Package

(ix) Is prime mover compatible with the Connection Equipment Package?

(b) Individual *Generating Plant* Data

(i) Manufacturer, Model Name and Number

(ii) Version Number

(iii) Nameplate Output Rating in kW: Summer/Winter

(iv) Nameplate Output Power Rating in kVA: Summer/Winter

(v) Rated Power Factor: Leading/Lagging

(vi) Total Number of *Generating Plant*s to be Connected

(vii) Elevation

(viii) Single- or Three-Phase?

(ix) List of adjustable set points for the protective equipment or software

(c) Inverter-Based *Generating Plant*

(i) Inverter Manufacturer, Model Name and Number

(ii) Maximum design fault contribution current: Instantaneous or RMS

(iii) Harmonics Characteristics

(iv) Start-Up Requirements

(v) Rotating Machines (of any type)

(vi) RPM Frequency

(vii) Neutral Grounding Resistor (where applicable)

(d) Synchronous *Generator*s

(i) Direct Axis Synchronous Reactance, Xd

(ii) Quadrature axis synchronous Reactance, Xq

(iii) Direct Axis Transient Reactance, X' d

(iv) Quadrature axis Transient Reactance, X' q

(v) Direct Axis Sub-Transient Reactance, X" d

(vi) Quadrature axis Sub-Transient Reactance X" q

(vii) Negative Sequence Reactance, X2

(viii) Zero Sequence Reactance, X0

(ix) KVA Base

(x) Field Volts

(xi) Field Amperes

(xii) Method of system/neutral earthing

(xiii) Provide appropriate block diagram of excitation system, *Governor System and* power system stabiliser (PSS). A PSS may be determined to be required by applicable studies. A copy of the manufacturer's block diagram may not be substituted.

(e) Induction *Generator*s

(i) Rated power output (kW)

(ii) Motoring Power (kW)

(iii) I^2t or K (Heating Time Constant):

(iv) Rotor Resistance, Rr

(v) Rotor Reactance, Xr

(vi) Stator Resistance, Rs

(vii) Stator Reactance, Xs

(viii) Magnetising Reactance, Xm

(ix) Short Circuit Reactance, Xd

(x) Exciting Current

(xi) Temperature Rise

(xii) Frame Size

(xiii) Design Letter

(xiv) Reactive Power Required in vars (No Load)

(xv) Reactive Power Required in vars (Full Load)

(xvi) Total Rotating Inertia, H: per Unit on a kVA Base

(f) Transformer and Protective Relay Specifications

(i) Will a transformer be used between the *Generating Plant* and the Connection Point?

(ii) Will the transformer be provided by the Connection *Customer?*

(iii) Transformer Data: (where applicable, for Connection *Customer*-Owned Transformer)

(iv) Is the transformer single- or three-phase?

(v) Size: kVA

(vi) If three phase:

(1) Transformer Primary: ___Volts ___Delta ___Wye ___Wye Grounded

(2) Transformer Secondary: __Volts ___Delta ___Wye ___Wye Grounded

(3) Transformer Tertiary: ___Volts ___Delta ___Wye ___Wye Grounded

(g) Transformer Fuse Data (where applicable for Connection *Customer*-Owned Fuse)

(i) Manufacturer

(ii) Type

(iii) Size

(iv) Speed

(v) Attach fuse manufacturer's Minimum Melt and Total Clearing Time-Current Curves

(h) Connecting Circuit Breaker (where applicable)

(i) Manufacturer

(ii) Type

(iii) Load Rating (Amps)

(iv) Interrupting Rating (Amps)

(v) Trip Speed (Cycles)

(i) Connection Protective Relays (where applicable)

(i) If microprocessor, provide a list of functions and adjustable set points (min/ max)

(ii) Discrete Components (where applicable)

(iii) Manufacturer

(iv) Type

(v) Style/Catalogue Number

(vi) Proposed Setting

(vii) Copy of any Proposed Time-Overcurrent Coordination Curves

(j) *Instrument Transformer* Data (where applicable)

(i) Manufacturer

(ii) Type

(iii) Rated burden

(iv) Accuracy Class

(v) Proposed Ratio Connection

(vi) Number of cores

(vii)Copy of Manufacturer's Excitation and Ratio Correction Curves

(viii) Potential Transformer Data (where applicable)

(k) Power VT

(i) Manufacturer

(ii) Type

(iii) Proposed Ratio Connection

(iv) Percentage impedance

(v) Rated kVA

(l) Attach copy of site electrical single-line diagram showing the configuration of all *Generating Plant* equipment, current and potential circuits, and protection and control schemes. The single-line diagram must be approved by a licensed Professional Engineer.

(m) Auxiliaries Data

(i) Normal unit-supplied auxiliary Load for each *Generating Plant* at rated MW output; and

(ii) Each Generation Unit Auxiliary Load other than (a) above and where the station auxiliary Load is supplied from the *Distribution System*.

(n) Plant Flexibility Performance Data, as applicable

(i) Existence of Black Start Capability

(ii) Rate of Loading following Shutdown

(iii) Rate of Load Reduction from normal rated MW; and

(iv) safe operating range

6.1.4. Processing of Applications

The *DNSP* shall establish the procedure for the processing of applications for connection or modification of an existing connection to the *Distribution System*. The *DNSP* shall process the *Application for Connection* or modification to an existing connection within thirty (30) days

Processing of applications shall include any necessary studies and analysis and the communication of a final determination to the *User*. Processing of applications shall begin upon submission of an accurate and complete application by the *User*.

Any *Distribution Network User* applying for connection or a modification of an existing connection to the *Distribution System* shall take all necessary measures to ensure that its proposed connection or modification fulfils all the technical requirements of the *KNDGC*, and shall not result in the degradation of the *Distribution System*.

6.1.5. System Impact Studies

Based on the data supplied by the *Distribution Network User* applicant, the *DNSP* shall conduct Distribution Impact Studies it considers appropriate, to evaluate the impact of the proposed connection or modification to an existing connection on the *Distribution System*. The evaluation should include:

(a) Impact of short circuit in feed to the Distribution Equipment;

(b) Capacity increase impacts on distribution equipment;

(c) Coordination of Protection System; and

(d) Impact of *Distribution Network User* development on Power Quality

Upon request of the *Distribution Network User*, the *DNSP* shall provide to the *Distribution Network User* adequate and sufficient information as appropriate regarding the *Distribution System* to enable the *Distribution Network User* to plan and prepare for a reliable connection to the *Distribution System*.

During the *Application for Connection* process, based on the results of the Impact Studies, the *DNSP* will propose and agree with the *Distribution Network User* the voltage level and point in the *Distribution System* to which a *Distribution Network User* will be connected in accordance with its

normal practice for the type of load to be supplied. The *DNSP* may on occasion specify a different Connection Point or connection voltage from normal in order to avoid potential disturbance caused by the *Distribution Network User*'s Equipment to other *Distribution Network User*s of the *DNSP* or for other technical reasons or may agree alternative methods for minimising the effects of disturbing loads.

6.1.6. Application Approval

After processing the application submitted by the *Distribution Network User*, the *DNSP* shall inform the *Distribution Network User* whether the proposed *Distribution Network User* connection is acceptable or not. If the *DNSP* identifies any degradation in system performance or a violation of technical requirements which can be remedied with system improvements, the Application will be approved upon completion of the improvements, and the *DNSP* shall inform the applicant of the finding and make available the associated information.

The *DNSP* shall include in its notification details of the modifications required to make the *Distribution Network User*'s application acceptable to the *DNSP*. The *DNSP* shall report this situation to the *Authority*.

6.1.7. Connection Agreement

The acceptance by the *Distribution Network User* of the *DNSP* proposal shall lead to the signing of a *Connection Agreement* or an amended *Connection Agreement*. If the *DNSP* and the *Distribution Network User* cannot agree on the proposed connection or modification to an existing connection, the *Distribution Network User* shall have the right to bring the matter before the *Authority* for resolution.

Before entering into a *Connection Agreement* and before connecting a *Distribution Network User*'s System at a Connection Point, it will be necessary for the *DNSP* to be satisfied that the *Distribution Network User*'s System at the boundary with the *Distribution System* will comply with all appropriate requirements of the *KNDGC*.

The *Connection Agreement* may include, but shall not be limited to, the following provisions for the submission of information and reports: Safety Rules, Test and Commissioning programmes, Electrical Diagrams, controllability of *Generating Plants*, statement of readiness to connect, and certificate of approval to connect. The information requirements shall be governed by the *Connection Agreement* between the *DNSP* and the *Distribution Network User*.

If a *Connection Agreement* or an amended *Connection Agreement* is requested, the *Distribution Network User* shall submit to the *DNSP* the Standard Planning Data describing the proposed *Distribution Network User* development.

Any *Distribution Network User* seeking to modify an existing connection to the *Distribution System* shall request an amended *Connection Agreement* with the *DNSP* prior to any modification

to the *Distribution Network User*'s System. The amended *Connection Agreement* shall include provisions for the submission of additional information required by the *DNSP*.

6.1.8. Submission of Information Prior to the Commissioning Date

The following shall be submitted by the *Distribution Network User* prior to the Commissioning date, pursuant to the terms and conditions and schedules specified in the *Connection Agreement*:

(a) Specifications of major Equipment not included in the Standard Planning Data and Detailed Planning Data;

(b) Details of the Protection arrangements and settings;

(c) Electrical Diagrams of the *Distribution Network User*'s Equipment at the Connection Point;

(d) Information that will enable the *DNSP* to prepare the Connection Point Drawings;

(e) Copies of all Safety Rules and Local Safety Instructions applicable to the *Distribution Network User*'s Equipment;

(f) A list of the names and contacts of designated representatives, including the confirmation that they are fully authorised to make binding decisions on behalf of the *Distribution Network User* for Significant Incidents;

(g) Proposed Maintenance Programme; and

(h) Test and Commissioning procedure for the Connection Point and the *Distribution Network User* Development.

Distribution Network Users connected at Low Voltage shall be required to submit only the items in (a); *Distribution Network Users* connected at Medium and High Voltage shall be required to submit all of the specified information.

6.1.9. Commissioning of Equipment and Connecting to Distribution System

Upon completion of the *Connection Agreement* and installation of the equipment at the *Connection Point*, the *Distribution Network User* shall be subjected to the test and Commissioning procedures developed by the *Distribution Network User* and approved by the *DNSP*.

The *Distribution Network User* shall then submit to the *DNSP* a statement of readiness to connect, which shall include a certified test and Commissioning report. The *DNSP* shall be entitled to witness the tests. The *DNSP* shall withhold agreement to energise the *Distribution Network User*'s Equipment where test results do not demonstrate compliance with the *KNDGC*.

Upon acceptance of the *Distribution Network User*'s statement of readiness to connect, the *DNSP* shall issue a certificate of approval to connect. The physical connection to the *Distribution System* shall be made only after the certificate of approval to connect has been issued by the *DNSP* to the *Distribution Network User*.

Equipment at connections points shall be subject to re-testing every four (4) years or as may be necessary following major equipment malefaction and health and safety issues.

6.1.10. Ownership Boundaries

The point(s) at which supply is provided between the *Distribution System* and *Distribution Network User*s will be agreed between the *DNSP* and the *Distribution Network User* as required. For MV connections, including connections between the *DNSP* and the *Distribution Network User*, and where necessary bus bar connected supplies at LV, the *Connection Point*s will be subject to specific agreement between the parties in each case.

The respective ownership of Plant or Apparatus will be recorded in a written agreement between the *DNSP* and the *Distribution Network User* as required. In the absence of a separate agreement between the parties to the contrary, construction, Commissioning, control, operation, and maintenance responsibilities shall be the responsibility of the owner of the Plant or Apparatus.

Where there are supplies to *Generating Plant*s connected to the *Distribution System* that operate in parallel with the *Distribution System* and all supplies at MV, the *DNSP* with the *Distribution Network User*'s agreement, will prepare a description of the site responsibilities, included in the *Connection Agreement*, with an electrical equipment diagram showing the agreed *Ownership Boundary* at any point.

The description of the site responsibilities within the *Connection Agreement* shall detail the demarcation of responsibility for safety of persons carrying out work or testing at sites having a *Connection Point* to the *Distribution System* and/or circuits that cross an *Ownership Boundary* at any point.

Copies of these documents will be retained by the *DNSP* and the *Distribution Network User*. Changes in the boundary arrangements proposed by either *Party* must be agreed in advance and will be recorded on the *DNSP*'s electrical equipment diagrams.

6.1.11. Electrical Diagrams and Drawing Requirements

The *DNSP* shall specify the procedure and format to be followed in the preparation of the Electrical Diagrams and/or *Connection Point* Drawings as required for any *Connection Point*. The *Distribution Network User* shall prepare and submit to the *DNSP* an Electrical Diagram and/or *Connection Point* Drawings for all the Equipment on the *Distribution Network User*'s side of the *Connection Point*, in accordance with the schedule specified in the *Connection Agreement* or amended *Connection Agreement*. The *DNSP* shall provide the *Distribution Network User* with an Electrical Diagram for all the equipment on the *DNSP*'s side of the *Connection Point*, in accordance with the schedule specified in the *Connection Agreement* or amended *Connection Agreement*.

6.1.11.1. Preparation of Electrical Diagrams

Where the *Connection Point* is at the *Distribution Network User*'s site, the *Distribution Network User* shall prepare and distribute a composite Electrical Diagram and *Connection Point* Drawing for the entire *Connection Point*. Otherwise, the *DNSP* shall prepare and distribute the composite Electrical Diagram and *Connection Point* Drawing for the entire *Connection Point*.

The Electrical Diagrams and the *Connection Point* Drawing shall provide an accurate record of the layout and circuit connections, ratings and identification of Equipment, and related apparatus and devices at the *Connection Point*. The *Connection Point* Drawing shall represent, as closely as possible, the physical arrangement of the Equipment and their electrical connections. If possible, all the Equipment at the *Connection Point* shall be shown in one Electrical Diagram. When more than one Electrical Diagram is necessary, duplication of identical information shall be minimised. The Electrical Diagrams shall represent, as closely as possible, the physical arrangement of the Equipment and their electrical connections.

6.1.11.2. Changes to Electrical Diagrams and Connection Point Drawing

Where the *DNSP* or a *Distribution Network User* decides to add new Equipment or carry out modification to existing installation the *DNSP* or the *Distribution Network User*, as the case may be, shall provide the other party with a revised Electrical Diagram and *Connection Point* Drawing, at least one (1) month prior to the proposed addition or change.

Where the modification involves the replacement of existing Equipment, the revised Electrical Diagram and/or *Connection Point* Drawing, as appropriate, shall be provided to the other party in accordance with the schedule specified in the amended *Connection Agreement*. The revised Electrical Diagram and/or *Connection Point* Drawing shall incorporate the new Equipment to be added, the existing Equipment to be replaced or modification to existing installation.

6.1.11.3. Validity of Electrical Diagrams and Drawings

The composite Electrical Diagram prepared by the *DNSP* or the *Distribution Network User* shall be the Electrical Diagram to be used for all operational and planning activities associated with the *Connection Point*.

If a dispute involving the accuracy of the composite Electrical Diagram arises, a meeting between the *DNSP* and the *Distribution Network User* shall be held as soon as possible, to resolve the dispute.

6.2 TECHNICAL REQUIREMENTS FOR CUSTOMERS

6.2.1. Supply Quality Standards

The *DNSP* shall plan and operate its *Distribution System* to ensure that at any *Distribution Network User*'s *Connection Point*, the Supply Quality Standards specified in the Performance Standards Chapter are complied with. Supply Quality Standards shall comply with the specifications or standards of Kenya Bureau of Standards or where no such standards exist, any international standards as approved by Kenya Bureau of Standards. *Distribution Network User*s seeking connection to the *Distribution System* or modification of an existing connection shall ensure that their equipment does not suffer damage as a result of unscheduled outages that can occur on the *Distribution System* from time to time.

6.2.2. Frequency Variations

The *DNSP* shall ensure that within the power system frequency range of 48.75 to 51.25 Hz all of its' power system equipment will remain in service unless that equipment is required to be switched to give effect to load shedding or is required by the *System Operator* to be switched for operational purposes. Facilities shall not be required to operate in a sustained manner outside the range of the normal operating frequency excursion band but should remain in service for three (3) seconds in the range of 48.0 Hz to 52 Hz. The *System Operator* may use load shedding facilities to aid recovery of frequency to within the normal frequency tolerance band.

6.2.3. Voltage Levels

Nominal and Operational Voltages on the *Distribution System* are shown in Table 6-1.

Table 6-1: Distribution Nominal Voltages

Voltage Category	Voltage Range
Low Voltage (LV)	1kV and below
Medium Voltage (MV)	Above 1kV up to 33kV
High Voltage (HV)	Above 33kV

6.2.4. Voltage Variations

The Long Duration Voltage Variation at any *Connection Point* during Normal Conditions shall be within the limits indicated in the Performance Standards Chapter and reproduced in the following table. For the purpose of this section, Voltage Variation shall be defined as the deviation of the root-mean-square (RMS) value of the voltage from its nominal value, integrated through a 15 minutes' period, and expressed as a percentage.

Table 6-2: Voltage Variations

Voltage Level in kV	Steady State Change
Less than 1.0 kV	± 6% to **Urban Consumers** ± 10% to **Rural Consumers**
1.0 kV to 66kV	± 10%

6.2.5. Transient and Short Duration Voltage Variations

A Short Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one-half cycle of the power Frequency but not exceeding one minute.

Transient Voltages shall be defined as the high-frequency overvoltage that is generally shorter in duration compared to the Short Duration Voltage Variations.

Under fault and circuit switching conditions, the rated frequency component of voltage may fall or rise transiently. The fall or rise in voltage will be affected by the method of earthing of the neutral point of the *Distribution System* and voltage may fall transiently to zero at the point of fault. The *Distribution System* and the *Distribution Network User* System shall be designed and operated to include devices that will mitigate the effects of transient over-voltages on the *Distribution System* and the *Distribution Network User* System. The *DNSP* and the *Distribution Network User* shall take into account the effect of electrical transients when specifying the insulation of their electrical Equipment according to the IEC 60664 and IEC 60071.

6.2.6. Voltage Unbalance

A *DNSP* or *Distribution Network User* shall balance the current drawn in each phase at each of its *Connection Points* so as to achieve average levels of negative sequence voltage at all *Connection Points* that are equal to or less than the values set out in Table 6-3 below, provided that at any nominal voltage the negative sequence voltage averaged over any one-minute period shall not exceed 2% in any hour.

Table 6-3: Negative Sequence Voltage Levels

Nominal Voltage(kV)	Averaging Time	Maximum Negative Sequence *Voltage* (%)	
		Normal Conditions	Single Contingency
>100	30 minutes	0.5	0.7
	10 minutes	1.0	1.0
10-100	10 minutes	1.3	1.3
<10	10 minutes	2.0	2.0

It is not a breach if larger negative sequence voltages occur for a short period resulting from a fault, single pole interruption, line switching, transformer energisation, series or shunt *Capacitor Bank Energisation* or *Shunt Reactor Energisation* within the power system.

6.2.7. Harmonics

*DNSP*s shall ensure that the Individual Harmonic Content and the Total Harmonic Distortion of the voltage at any *Connection Point* shall not exceed the limits prescribed in Table 5-4.

Table 6-4: Harmonics

Harmonic Order (n)	LV < 1000 V	MV
(odd non-multiples of 3)		
5	6.0	5.0
7	5.0	4.0
11	3.5	3.0
13	3.0	2.5
(odd multiples of 3)		
3	5.0	4.0
9	1.5	1.2
15	0.4	0.3
21	0.3	02
>21	0.2	-
(even)		
2	2.0	1.8
4	1.0	1.0
6 to 24	0.5	0.5
Total Harmonic Distortion:	8%	5%

IEEE Standard 519 establishes harmonic limits on THD to be 8% and 5% of the fundamental voltage respectively for the LV and MV systems. For special load (e.g., hospital, airport), IEEE Standard 519 requires these limits to be 5% and 3% of the fundamental voltage respectively for the LV and MV systems. IEEE Standard 519 also stipulates that the harmonic limits can be relaxed to 10% for dedicated loads such as converter loads for equipment manufacturers where operation at higher distortion is allowable.

Distortion of the System voltage waveform, caused by certain types of equipment, may result in annoyance to *Distribution Network User*s or damage to connected apparatus. In order to limit these effects, *Distribution Network User*s' equipment connected to the *Distribution System* shall comply with the emission limits generated by total *Distribution Network User*'s connected equipment at the *Connection Point* and shall not exceed the limits prescribed in Table 6-5.

Table 6-5: Emission Limits

Harmonic Order (n)	Low Voltage Contracted Power less than 10 kW	Low Voltage Contracted Power greater than 10 kW	Medium Voltage
	%	%	%
(odd non-multiples of 3)			
5	2.28	12	12
7	1.54	8.5	8.5
11	0.66	4.3	4.3
13	0.42	3.0	3.0
17	0.26	2.7	2.7
19	0.24	1.9	1.9
23	0.20	1.6	1.6
25	0.18	1.6	1.6
> 25	4.5/n	0.8 +0.8*25/n	0.8 +0.8*25/n
(odd multiples of 3)			
3	4.6	16.6	16.6
9	0.8	2.2	2.2
15	0.3	0.6	0.6
21	0.21	0.4	0.4
> 21	4.5/n	0.3	0.3
(even)			
2	2.16	10.0	10.0
4	0.86	2.5	2.5
6	0.60	1.0	1.0
8	0.46	0.8	0.8
10	0.37	0.8	0.8
12	0.31	0.4	0.4
> 12	3.68/n	0.3	0.3
Total	240 V **Distribution Network Users**: 5 A 400 V **Distribution Network Users**: 14 A	20.0%	20.0%

Under certain circumstances, the *DNSP* may agree to other limits or levels.

Measurements may be taken by the *DNSP* at the *Distribution Network User*'s *Connection Point* and will continue for at least 24 hours and taken at 10 minute intervals.

6.2.8. Flicker

The *Flicker* Severity at the *Connection Point* of any *Distribution Network User* shall not be above the maximum values stated in KS IEC 61000-3 Standard for more than 3% of the measured period.

The maximum emission limits produced by any *Distribution Network User* shall be below the maximum values stated in KS IEC 61000-3 Standard.

6.2.9. Remedial measures for noncompliance with Harmonic & Flicker limits

In the event that the Distribution Network User's Equipment operates outside the above specified limits causing annoyance or other injurious effects either to another Distribution Network User, or to the Distribution System, the DNSP shall give reasonable notice to remedy the defect and the Distribution Network User shall remedy the defect at its own expense. In determining the period of notice, the DNSP shall have regard to the nature and degree of non-compliance, the nature and degree of annoyance or other injurious effects as well as the prescriptions stated in the Distribution Performance Standards. The DNSP shall have the right to disconnect the Distribution Network User's Equipment in the event that the Distribution Network User does not comply with such notice.

6.2.10. Earthing Requirements

The method of earthing at the *Distribution Network User's* system shall comply with the Earthing Standards and specifications of the *DNSP*. The *DNSP* shall supply to the *Distribution Network User* these standards when applying for connection. Where there are multiple sources of power, the *Distribution Network User* shall ensure that the effects of circulating currents with respect to the earthed neutral are either prevented or mitigated.

6.2.11. Equipment Short Circuit Rating

The *DNSP* shall inform the *Distribution Network User* of the design maximum Short Circuits Levels of the *Distribution System* at the *Connection Point*. The *Distribution Network User* shall consider the design maximum Short Circuits Levels at the *Connection Point* in the design and Operation of the *Distribution Network User* System.

6.2.12. Monitoring and Control Equipment Requirements

The *DNSP* and the *Distribution Network User* shall agree on the mode of monitoring and control. Where required, the *DNSP* shall provide, install, and maintain a telemetry outstation and all associated Equipment needed to monitor the *Distribution Network User*'s system. Where the *Distribution Network User* consents that the *DNSP* shall control the switchgear in the *Distribution Network User's* system, the *DNSP* shall install the necessary control outstation, including the control interface for the switchgear.

6.2.13. Equipment and Maintenance Standards

All Equipment at the *Connection Point* shall comply with the requirements of the IEC Standards or their equivalent Kenyan national standards. All equipment at the *Connection Point* shall be designed, manufactured, and tested in accordance with the quality assurance requirements of the ISO 9000 family.

All Equipment at the *Connection Point* shall be operated and maintained in accordance with *Prudent Utility Practice* and in a manner that shall not pose a threat to the safety of any personnel or cause damage to the equipment of the *DNSP* or the *Distribution Network User*.

The *DNSP* shall maintain an appropriate log containing the test results and maintenance records relating to its equipment at the *Connection Point* and shall make this log available when requested by the *Distribution Network User* or the *Authority*.

The *Distribution Network User* shall maintain a log containing the test results and maintenance records relating to its equipment at the *Connection Point* and shall make this log available when requested by the *DNSP*.

6.2.14. Power Factor

All MV and HV *Distribution Network User*s and other LV *Distribution Network User*s (as may be determined by the *Authority* from time to time) of the *Distribution System* shall maintain a Power Factor not less than 0.9 lagging at the *Connection Point*, unless a different value has been agreed to in the *Connection Agreement*.

The *DNSP* shall correct feeder and substation feeder bus Reactive Power Demand to a level which will economically reduce feeder loss. The *Distribution System* shall be designed to have a Power Factor of not less than 0.9 at each *Connection Point* with the *Transmission System* unless a different value has been agreed to in the *Connection Agreement*.

6.2.15. Under Frequency Relays for Automatic Load Shedding

The *Connection Agreement* or amended *Connection Agreement* shall specify the manner in which Demand subject to Automatic Load Shedding will be split into discrete MW blocks to be actuated by Under Frequency Relays.

6.3 TECHNICAL REQUIREMENTS FOR SYNCHRONOUS GENERATING PLANTS

The *Generating Plants* connected to the *Distribution System*:

(a) Shall be capable of supplying its Reactive Power outputs, as specified in the *Generation Plant*'s declared data, within the Voltage Variation specified in this *KNDGC*, during Normal Conditions.

(b) Shall meet the requirements for Voltage Unbalance as specified in this *KNDGC*.

(c) With a size of 500 kW or larger shall also be required to withstand without tripping, the unbalance loading during clearance by the Backup Protection of a close-up phase-to-phase fault on the *Distribution System*.

(d) Shall meet the requirements for preventing Unintended Islanding Operation in KS IEC 62116-2008 and any other applicable international standards approved by Kenya Bureau of Standards

6.3.1. Embedded Generator

Generating Plants connected to the *Distribution System* (*Embedded Generators*) shall be connected at the voltage level agreed to by the *DNSP*, based on the *Distribution System* Impact Studies and in accordance with the *KNDGC* Performance Standards. The *Connection Point* shall be controlled by a Circuit Breaker that is capable of interrupting the maximum short circuit current at the *Connection Point*. Means shall also be provided for Circuit Breaker isolation for maintenance purposes.

6.3.2. System Frequency

The *Generating Plant* connected to the *Distribution System* shall be capable of continuously supplying its Active Power output, as specified in the *Generating Plant's* declared data, within the System Frequency range specified in the *KNDGC*. Any decrease of power output occurring in the Frequency range of 48.75 to 51.25 Hz shall not be more than the required proportionate value of the System Frequency decay.

In situations in which the System frequency momentarily rises up to the value of 51.5 Hz or drops to the value to 48.5 Hz, *Generating Plant*s connected to the *Distribution System* shall remain synchronized with the *Distribution System*, unless something different has been agreed in the *Connection Agreement*.

The *Generation Licensee* shall be responsible for protecting its *Generating Plant* connected to the *Distribution System* against damage for frequency excursions outside the range of 51.5 Hz and 48.5 Hz. Outside this range, the *Distribution Network User* shall decide whether or not to disconnect its *Generating Plant* from the *Distribution System*.

6.3.3. Protection System Coordination

The Protection of *Generating Plant*s connected to the *Distribution System* and associated equipment shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity in fault clearing and to minimise the impact of faults on the *Distribution System*. The *DNSP* and the *Generation Licensee* shall be solely responsible for the Protection System of the electrical Equipment and facilities at their respective sides of the *Connection Point*. Tables 6-6 and 6-7 summarise typical protection requirements of *Generating Plant*s of different types

and sizes. As protection requirements could widely vary depending on the *Generating Plant* and *Distribution System* characteristics, the information on the tables shall be used only as a guide. Detailed protection schemes should be arranged between the *DNSP* and the *Generation Licensee*, and stated in the *Connection Agreement*.

Table 6-6: Protection for Single Phase Generating Plants

Interconnection Control, Protection and Safety Equipment[1] **YES denotes a requirement for this *Guideline***	
Generation Size	
50kW or less[3]	
Interconnection Disconnection Device	YES
Generator Disconnect Device	YES
Under-voltage Trip	YES
Over-voltage Trip	YES
Over & Under Frequency Trip	YES
Over-current Trip	YES
Synchronising Control[2]	Manual or Automatic
Synch-Check[2](At the Connection Point)	YES
Prevention of Unintended Islanding Operation (Loss of mains) in KS IEC 62116-2008	YES

Notes:

[1]. Exporting power to the Distribution System may require additional operational/protection devices and will require coordination of operations with the Distribution Network Service Provider.

[2]. For synchronous and other types of Generators with standalone capability.

[3]. For single-phase Generators larger than 50 kW, consult with Distribution Network Service Provider on the required interconnection control, Protection and safety equipment. Requirements for systems larger than 50 kW will include the requirements in this table and others as specified by the Distribution Network Service Provider.

Table 6-7 Protection for Three-Phase Generating Plants

Interconnection Control, Protection and Safety Equipment[8] **YES denotes a requirement for this *Guideline* - All devices are three-phase unless otherwise specified.**					
Generator Size Classifications	**Small**	**Medium**			**Large**
Device	<50 kW	50 - 499 kW	500 - 2000 kW	2001 - 10000 kW	>10000 Kw
Interconnect Disconnect Device	YES	YES	YES	YES	YES

Interconnection Control, Protection and Safety Equipment[8]

YES denotes a requirement for this *Guideline* - All devices are three-phase unless otherwise specified.

Generator Size Classifications	**Small**	**Medium**			**Large**
Device	<50 kW	50 - 499 kW	500 - 2000 kW	2001 - 10000 kW	>10000 Kw
Generator Disconnect Device	YES	YES	YES	YES	YES
Synchronising Control[1] Manual (M) or Automatic (A)	M or A	M or A	A	A	A
Synch-Check(at the Connection Point)	YES	YES	YES	YES	YES
Automatic Voltage Regulation (AVR)[1]	NO	NO	NO	YES	YES
Undervoltage	YES	YES	YES	YES	YES
Overvoltage	YES	YES	YES	YES	YES
Neutral Overvoltage[2]	YES[3]	YES	YES	YES	YES
Instantaneous/Timed Over current	YES[4]	YES[4]	YES[4]	YES[4]	YES[4]
Instantaneous/Timed Neutral Over current	YES[3]	YES	YES	YES	YES
Over and Under Frequency	YES	YES	YES	YES	YES
Directional Power	YES[5]	YES[5]	YES[5]	YES[5]	YES[5]
Inter-trip or Equivalent Relay	NO	YES[6]	YES[6]	YES[6]	YES[6]
Telemetry Data Communication	NO	NO	YES[7]	YES[7]	YES
Prevention of Unintended Islanding Operation(Loss of mains)	YES	YES	YES	YES	YES

Notes:

1. For synchronous and other types of Generators with standalone capability.
2. Only required for Generators that have their interconnection transformer's primary winding ungrounded. Used in conjunction with 3 PT's in broken delta configuration rated for line-to-line voltage for detecting earth faults on the Distribution System.
3. May not be required if the Generator is an inverter type voltage-following system of less than 50 kW aggregate. In this case, the Distribution Network Service Provider will inform the Generator if this Protection is required.
4. A timed over current relay with voltage restraint may also be required to prevent nuisance trips.
5. Only required for non-exporting or export limited Generators.
6. Transfer trip or equivalent protective relay function required for all synchronous Generators rated 500 kW and larger with export capability. May also be required for exporting synchronous Generators under 500 kW, depending upon characteristics of the distribution circuit.
7. System Controller requirement for all Generators 5 MW and larger. The Distribution Network Service Provider may also require telemetry for smaller Generators depending upon location and distribution circuit characteristics.
8. Exporting to Distribution System may require additional operational/protection devices and will require coordination of operations with the Distribution Network Service Provider.

A fault or maintenance outage could result in the disconnection of the *Generating Plant* connected to the *Distribution System* together with an associated section of the *Distribution System,* from the remainder of the total system. Unless explicitly arranged with the *DNSP*, and clearly stated on the *Connection Agreement* or amended *Connection Agreement*, the *Generating Plant* connected to the *Distribution System* should never supply load and/or maintain voltage in any part of the *Distribution System* if this part is isolated from the Transmission System, and if the *Generating Plant* is capable of maintaining both voltage and frequency within acceptable limits because it is equipped with synchronous or self-excited asynchronous *Generating Plant*s, the *Generation Licensee* shall install adequate protection devices (that could include inter-tripping schemes) to assure the disconnection either of the *Generating Plant* or the whole *Generation Licensee'*s facilities at the *Connection Point*.

In case the *Distribution Network User* facilities are connected to a feeder of the *DNSP* equipped with auto-reclosing, the protection System and switching arrangements should be designed to separate the *Generating Plant* (or the *Generating Plant* and other *Distribution Network User*'s facilities below the *Connection Point*) following the first *DNSP*'s Main Breaker, Recloser or Sectionaliser opening, and to remain disconnected until the system has completely restored.

6.3.4. Reactive Power

*Generating Plant*s connected to the *Distribution System* shall be capable of supplying Reactive Power outputs, as specified in the *Generating Plant*'s declared data, within the voltage variation specified in the *KNDGC*, during normal conditions.

*Generating Plant*s connected to the *Distribution System* that are providing *Ancillary Services* for Reactive Power supply, as specified in their Connection Agreement, shall be capable of contributing to Voltage Control by continuous regulation of the Reactive Power supplied to the *Distribution System*. These Generating Plants shall be fitted with a continuously acting automatic *Excitation Control System* to control the terminal voltage without instability over the entire operating range of the *Generating Plant*s connected to the *Distribution System.* The performance requirements for excitation control facilities, including *Power System Stabilisers,* where necessary for System operations shall be specified in the Distribution *Connection Agreement* or Amended *Connection Agreement.* The Reactive Power capability shall be available within the parameters presented in Table 6-9

Table xxx Reactive power capability

Voltage, p.u.	Reactive Power Range (p.u. of full output)	Equivalent Full Load Power Factor
0.20 to 0.80	-0.33 to 0.33	-0.95 to 0.95
0.80 to 1.10	-0.228 to 0.228	-0.975 to 0.975

6.3.5. Black Start

Generation Licensees with a *Generating Plant* connected to the *Distribution System* shall specify in the application for a connection or modification if it has a *Black Start* capability. In the case the *Generation Licensee* wishes to provide *Ancillary Services* for Black Start to the *System Operator*, it shall develop and sign the necessary agreements with System Operator and comply with the *KNDGC.*

6.3.6. Islanding

Intentional islanding of the *Generating Plant* shall be permitted wherever possible to provide uninterrupted service to local *Customers* during an outage. Protection system must be capable of providing protection in normal as well as islanding mode.

6.3.7. Active Power Control

The control system of a Synchronous Generator shall be capable of operating the Synchronous Generator at a reduced level if the Active Power output has been restricted by the *System Operator*. The Synchronous Generator control system shall be capable of receiving an on-line Active Power Control Set-point sent by the *System Operator* and shall commence implementation of the set-point within 10 seconds of receipt of the signal from the *System Operator*. The rate of change of output to achieve the Active Power Control Set-point should be no less than the maximum ramp rate settings of the Synchronous Generator control system, as advised by the *System Operator*.

6.3.8. Frequency Response

Frequency response can be achieved through decreasing *Generating Plant* power output when frequency exceeds the upper bound of a specified acceptable frequency range, and by increasing *Generating Plant* power output when frequency falls below the lower bound of the specified range. Thus a Synchronous Generator must operate at a level below its instantaneous available capacity, if it is to provide both upward and downward frequency regulation capability.

The frequency response system of Synchronous Generators shall have the capabilities set out in the power frequency response curve agreed with the *System Operator*.

6.3.9. Rate of Change of Frequency Range

The requirements for remaining connected during a frequency disturbance apply when the rate of change of frequency is within certain limits. Outside these limits, the unit is not obliged to remain connected Synchronous Generators shall remain connected to the *Distribution System* during rate of change of frequency of values up to and including 1.0 Hz per second.

6.3.10. Limited Frequency-Sensitive Mode Overfrequency (LFSM-O)

Limited frequency sensitive mode — overfrequency or LFSM-O means a generating plant operating mode which will result in active power output reduction in response to a change in system frequency above a certain value. The Generating Plant shall comply with the following requirements:

a) the Generating Plant shall be capable of activating the provision of active power frequency response if the grid exceeds a frequency threshold equal to 50.5 Hz;

b) The active power frequency response shall be linear with a droop setting equal to 5%, droop being the percentage increase in the Frequency that would cause the Generating Plant to change its output from actual available Capacity to zero;
c) the Generating Plant shall be capable of activating a power frequency response with an initial delay that is as short as possible, but maximum 2 seconds;
d) upon reaching minimum regulating power level, the Generating Plant shall continue operation at this level;
e) the Generating Plant shall be capable of operating stably during LFSM-O operation. When LFSM-O is active, the LFSM-O setpoint will prevail over any other active power setpoints;
f) the Generating plant shall allow adjustment of the frequency threshold between 50,2 Hz and 51.0 Hz inclusive;
g) the Generating plant shall allow adjustment of the droop between 4% and 12% inclusive;
h) the System Operator may instruct the Generating plant operator to adjust the frequency threshold and the droop from time to time.

6.3.11. Voltage level and quality

The generating plant shall be capable of remaining connected and running for indefinite time and unconstrained as regards to active and reactive power and controllability for any combination of the following:

(i). Voltage at the Connection point between 0.90 and 1.10 pu, and

(ii). Negative sequence voltage levels at the Connection Point up to the level given in Table 6-3 and section 6.2.6, and

(iii). Harmonic voltage distortion levels at the Connection Point up to the level given in Table 6-4 and section 6.2.7.

6.4 TECHNICAL REQUIREMENTS FOR VARIABLE RENEWABLE POWER PLANTS

6.4.1. Embedded Generator

Generating Plants connected to the *Distribution System* (*Embedded Generators*) shall be connected at the voltage level agreed to by the *DNSP*, based on the *Distribution System* Impact Studies and in accordance with the *KNDGC* Performance Standards. The *Connection Point* shall be controlled by a Circuit Breaker that is capable of interrupting the maximum short circuit current at the *Connection Point*. Means shall also be provided for Circuit Breaker isolation for maintenance purposes.

6.4.2. System Frequency

The *Generating Plant* connected to the *Distribution System* shall be capable of continuously supplying its Active Power output, as specified in the *Generating Plant's* declared data, within the System Frequency range specified in the *KNDGC*. Any decrease of power output occurring in the

Frequency range of 48.75 to 51.25 Hz shall not be more than the required proportionate value of the System Frequency decay.

In situations in which the System frequency momentarily rises up to the value of 51.5 Hz or drops to the value to 48.5 Hz, *Generating Plant*s connected to the *Distribution System* shall remain synchronized with the *Distribution System*, unless something different has been agreed in the *Connection Agreement*.

The *Generation Licensee* shall be responsible for protecting its *Generating Plant* connected to the *Distribution System* against damage for frequency excursions outside the range of 51.5 Hz and 48.5 Hz. Outside this range, the *Distribution Network User* shall decide whether or not to disconnect its *Generating Plant* from the *Distribution System*.

6.4.3. Protection Coordination

The Protection of *Generating Plant*s connected to the *Distribution System* and associated equipment shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity in fault clearing and to minimise the impact of faults on the *Distribution System*. The *DNSP* and the *Generation Licensee* shall be solely responsible for the Protection System of the electrical Equipment and facilities at their respective sides of the *Connection Point*. Tables 6-6 and 6-7 summarise typical protection requirements of *Generating Plant*s of different types and sizes. As protection requirements could widely vary depending on the *Generating Plant* and *Distribution System* characteristics, the information on the tables shall be used only as a guide. Detailed protection schemes should be arranged between the *DNSP* and the *Generation Licensee*, and stated in the *Connection Agreement*.

6.4.4. Fault Ride-through Requirements for VRPPs

Fault ride-through refers to the ability of a *Generating Plant* to remain connected during a system voltage disturbance.

Four main characteristics typically provide the requirements for VRPPs in the event of a voltage disturbance:

(a) Conditions for which the VRPP must remain connected

(b) Active Power provision during fault

(c) Voltage support requirements during the disturbance

(d) Restoration of Active Power after the fault has been cleared

Each is discussed in more detail below.

6.4.5. Remain Connected Voltage Condition

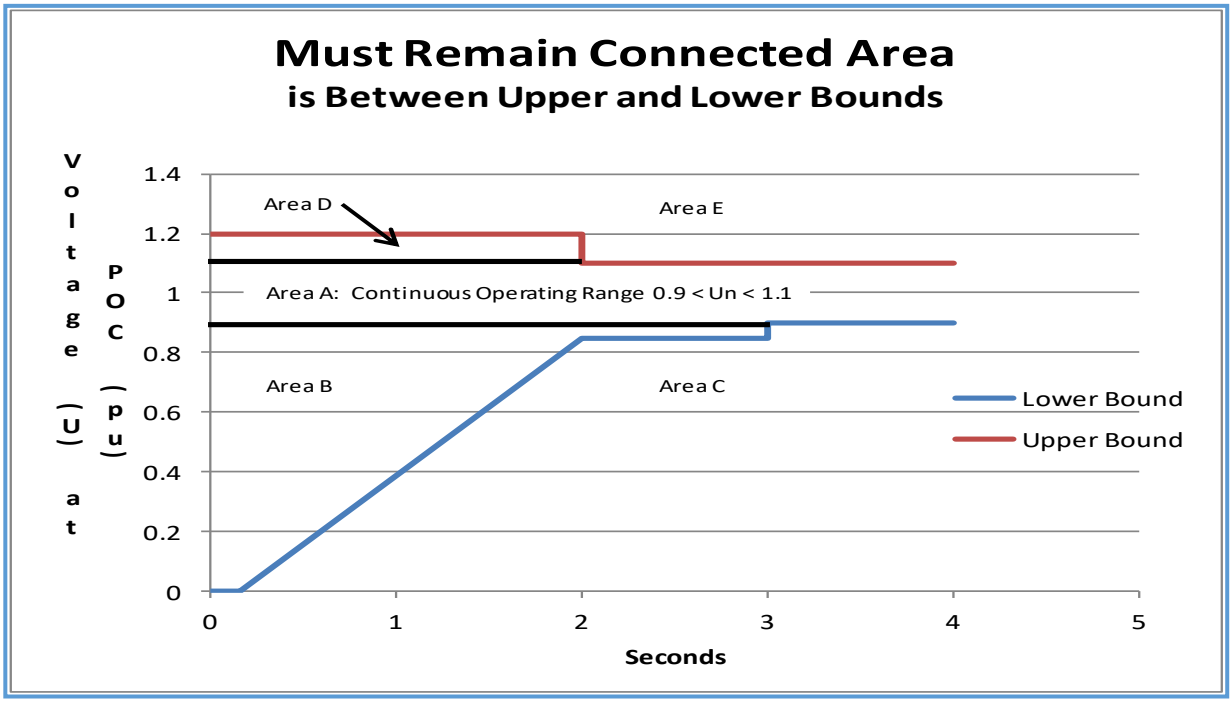
Medium and Large (as defined in Sections 6.1.3.2 and 6.1.3.3) wind or solar photovoltaic V*RPPs* shall remain connected to the *Kenya National Distribution System* for voltage disturbances on any

or all phases, where the system phase voltage measured at the HV terminals of the connection transformer remains above a specified level for a specified length of time.

The "remain connected" requirements takes the form of a voltage vs. time profile which dictates the level of voltage drop or increase that an VRPP must be capable of withstanding along with the time for which the voltage drop or increase should be endured.

Figure 6-1 shows the combinations of voltages and time that the VRPP shall be able to endure.

Figure 6-1: Voltage Must Remain Connected Area



(i) Area A shows that the VRPP shall be able to operate continuously between 0.9 p.u. and 1.1 p.u. In Area A the VRPP shall stay connected to the network and uphold normal production.

(ii) Area B is the area between the Lower Bound and the bottom of the continuous operating range, at 0.9 p.u. In Area B the VRPP shall stay connected to the network. Figure 5-1 shows that the VRPP shall be able to withstand voltage drops to zero, measured at the *Connection Point*, for a minimum period of 0.15 seconds without disconnecting. Less severe voltage drops increase the length of time they must be endured. Below 0.85 p.u. the voltage drop shall be endured for nearly two (2) seconds. At 0.85 p.u. the voltage drop shall be endured a minimum of three (3) seconds.

(iii) Area D is the area between the Upper Bound and the top of the continuous operating range, at 1.1 p.u. In Area D the VRPP shall stay connected to the network. Figure 5-1 shows that the VRPP shall be able to withstand voltage increases to 1.2 p.u. for at least two (2) seconds.

(iv) Area C is the area outside the Lower Bound and below the continuous operating range, at 0.9 p.u. In Area C disconnecting the RPP is allowed.

(v) Area E is the area above the Upper Bound and above the continuous operating range, at 1.1 p.u. In Area E disconnecting the RPP is allowed.

6.4.6. Active Power Provision during Fault

During a voltage dip, the controllable VRPP shall provide Active Power in proportion to retained voltage and maximise reactive current to the *Kenya National Distribution System* without exceeding its declared limits.

6.4.7. Reactive Current Flows during Fault

The maximisation of reactive current during a fault shall continue for at least 600 ms or until the voltage recovers to within the normal operational range of the Kenya National Distribution System, whichever is sooner.

6.4.8. Active Power Recovery After Fault

The controllable VRPP shall provide at least 90% of its maximum available Active Power as quickly as possible and in any event within one (1) second of the voltage recovering to the normal operating range.

6.4.9. Power System Remain Connected Frequency Ranges

Frequency is the one parameter common to all members of a synchronous electric power system, and an accepted indicator of that system's ability to balance resources and demand as well as to manage disturbances. This requires that *Generating Plants* remain connected beyond the frequency range associated with normal operation.

Under normal operation, the frequency of the *Distribution System* shall be nominally 50 Hz (± .5%), shall be controlled between 49.50 Hz and 50.50 Hz and shall be capable of continuous operation.

Increasingly, severe system disturbances require progressively wider frequency bands and reduce the time required to operate within the specified frequency range. These figures are summarised in Table 6-8.

Table 6-8: minimum time to remain connected

Frequency Limits	Duration
49.0 Hz to 51.00 Hz	Continuous operation
51.0 Hz to 51.5 Hz	At least 90 minutes
48.50 Hz to 49.0 Hz	At least 90 minutes
47.5 Hz to 48.5 Hz	At least 60 minutes
51.5 Hz to 52.0 Hz	At least 60 minutes
47.0 Hz to 47.5 Hz	At least 20 seconds
<47.0Hz for more than 0.2 sec	May disconnect
>52.0 Hz for more than 4 sec	Must disconnect

6.4.10. Active Power Control

The VRPP control system shall be capable of operating the VRPP at a reduced level if the Active Power output has been restricted by the *System Operator*. The VRPP control system shall be capable of receiving an on-line Active Power Control Set-point sent by the *System Operator* and shall commence implementation of the set-point within 10 seconds of receipt of the signal from the *System Operator*. The rate of change of output to achieve the Active Power Control Set-point should be no less than the maximum ramp rate settings of the VRPP control system, as advised by the *System Operator*.

6.4.11. Frequency Response

Frequency response can be achieved through decreasing *Generating Plant* power output when frequency exceeds the upper bound of a specified acceptable frequency range, and by increasing *Generating Plant* power output when frequency falls below the lower bound of the specified range. Thus a VRPP must operate at a level below its instantaneous available capacity, if it is to provide both upward and downward frequency regulation capability.

The frequency response system of VRPPs shall have the capabilities set out in the power frequency response curve agreed with the *System Operator*.

It is usually economically beneficial for VRPPs to operate at their instantaneous available capacity. If they operate below their instantaneous available capacity, wind and photovoltaic *Generating Plants* lose some of the energy they could have generated. The same is true for other types of VRPP which may lack energy storage facilities. This may be a factor in reaching an agreement with *the Regional Control Centre and System Operator* on the power frequency curve.

6.4.11.1. Limited frequency-sensitive mode over frequency (LFSM-O)

The Generating Plant shall comply with the following requirements:

a) the Generating Plant shall be capable of activating the provision of active power frequency response if the grid exceeds a frequency threshold equal to 50.5 Hz.
b) The active power frequency response shall be linear with a droop setting equal to 5%, droop being the percentage increase in the Frequency that would cause the VRPP to change its output from actual available Capacity to zero.
c) the Generating Plant shall be capable of activating a power frequency response with an initial delay that is as short as possible, but maximum 2 seconds.
d) upon reaching minimum regulating power level, the Generating Plant shall continue operation at this level
e) the Generating Plant, energy system or HVDC station shall be capable of operating stably during LFSM-O operation. When LFSM-O is active, the LFSM-O setpoint will prevail over any other active power setpoints.
f) the Generating plant shall allow adjustment of the frequency threshold between 50,2 Hz and 51.0 Hz inclusive
g) the Generating plant shall allow adjustment of the droop between 4% and 12% inclusive
h) the System Operator may instruct the Generating plant operator to adjust the frequency threshold and the droop from time to time.

6.4.12. Ramp Rates

The VRPP control system shall be capable of controlling the ramp rate of its Active Power output with a maximum MW per minute ramp rate set by the *System Operator*. There shall be two maximum ramp rate settings. The first ramp rate setting shall apply to the MW ramp rate averaged over one (1) minute. The second ramp rate setting shall apply to the MW per minute ramp rate averaged over ten (10) minutes. These ramp rate settings shall be applicable for all ranges of operation including start up, normal operation and shut down. It is recognised that falling wind speed, rapidly changing cloud conditions, or frequency response may cause either of the maximum ramp rate settings to be exceeded.

It shall be possible to vary each of these two maximum ramp rate settings independently over a range between one (1) and thirty (30) MW per minute. The VRPP control system shall have the capability to set the ramp rate in MW per minute averaged over both one (1) and ten (10) minutes.

The VRPP operator and the *System Operator* shall agree on a procedure for setting and changing the ramp rate control.

6.4.13. Reactive Power Capability

The Reactive Power capability of an VRPP shall be available within the parameters presented in Table 6-9

Table 6-9: Reactive Power Capability

Power plant rating and connection voltage	Voltage, pu Power, p.u. of Prated	Active power (MW) output p.u. of nameplate MW rating Prated	Reactive power (Mvar) in p.u. of nameplate MW rating Prated
P_{rated} <1 MW and connection voltage <33 kV	0.90 to 1.10	20-100% P_{rated}	-0.2 P_{rated} to +0.2 P_{rated}
	0.90 to 1.10	0-20% P_{rated}	0.2 P_{rated} to +0.2 P_{rated}
P_{rated} 1 MW or higher or connection voltage 33 kV or above	0.90 to 1.10	20-100% P_{rated}	-0.35 P_{rated} to +0.35 P_{rated}
	0.90 to 1.10	0-20% P_{rated}	-0.2 P_{rated} to +0.2 P_{rated}

If the grid voltage at the point of connection is higher than 1.05 pu, the required range for injection of reactive power shall be reduced linearly with increasing voltage in pu, such that at 1.10 pu the maximum required possible injection shall be zero. If the grid voltage at the point of connection is lower than 0.95 pu, the required range for absorption of reactive power shall be reduced linearly with increasing voltage in pu, such that at 0.90 pu the maximum required possible absorption shall be zero. Reactive power control.

6.4.13.1. Requirements for reactive power and voltage control

The Generating Plant shall be capable of providing reactive power automatically by either voltage control mode, reactive power control mode or power factor control mode as follows:

(a). For the purposes of voltage control mode:

(i).the Generating Plant shall be capable of contributing to voltage control at the connection point by provision of reactive power exchange with the network with a setpoint voltage covering 0,95 to 1,05 pu in steps no greater than 0,01 pu, with a slope (i.e., the ratio of the change in voltage, based on reference 1 pu voltage, to a change in reactive power in-feed from zero to maximum reactive power, based on maximum reactive power) having a range of at least 2 to 7 % in steps no greater than 0,5 %. The reactive power output shall be zero when the grid voltage value at the connection point equals the voltage setpoint

(ii).the setpoint may be operated with or without a deadband selectable in a range from zero to ± 5 % of reference 1 pu network voltage in steps no greater than 0,5 %

(iii).following a step change in voltage, the Generating Plant shall be capable of achieving 90 % of the change in reactive power output within a time t1 to be specified by the system operator in the range of 1 to 5 seconds, and must settle at the value specified by the slope within a time t2 to be specified by the system operator in the range of 5 to 60 seconds, with a steady-state reactive tolerance no greater than 5 % of the maximum reactive power.

(iv). The time t1 shall initially be set at 1 second, t2 at 5 seconds. The System Operator or the DNSP may instruct the generator plant operator to adjust the voltage setpoint, as well as t1 and t2 from time to time

(v). The requirements of voltage control mode only apply to generating plants satisfying one or both of the following conditions:

- rated nameplate power 10 MW or higher
- rated voltage of Connection Point 33 kV or above

(b). For the purpose of reactive power control mode, the Generating Plant shall be capable of setting the reactive power setpoint anywhere in the reactive power range specified above, with setting steps no greater than 5 MVAr or 5 % (whichever is smaller) of full reactive power, controlling the reactive power at the connection point to an accuracy within plus or minus 5 MVAr or plus or minus 5 % (whichever is smaller) of the full reactive power;

The requirements of reactive power control mode only apply to generating plants with a nameplate capacity 200 kW or higher. Generating power plants with a nameplate capacity less than 50 kW do not have to provide reactive power control mode.

(c). For the purpose of power factor control mode, the generating plant shall be capable of controlling the power factor at the connection point within the required reactive power range, specified above, with a target power factor in steps no greater than 0,01. The System Operator or the DNSP shall specify the target power factor value, its tolerance and the period of time to achieve the target power factor following a sudden change of active power output. The tolerance of the target power factor shall be expressed through the tolerance of its corresponding reactive power. This reactive power tolerance shall be expressed by either an absolute value or by a percentage of the maximum reactive power of the power park module

Generating plants with a nameplate capacity less than 50 kW do not have to be capable of adjusting the target power, provided they run at a power factor of 0.99 or higher at the connection point at all times.

(d). The System Operator or the DNSP shall specify which of the above three reactive power control mode options and associated setpoints is to apply, and what further equipment is needed to make the adjustment of the relevant setpoint operable remotely.

6.4.14. Rate of Change of Frequency Range

The requirements for remaining connected during a frequency disturbance apply when the rate of change of frequency is within certain limits. Outside these limits, the unit is not obliged to remain connected. VRPPs shall remain connected to the *Distribution System* during rate of change of frequency of values up to and including 1.0 Hz per second.

6.4.15. Voltage and Frequency for Synchronisation

VRPPs shall only be allowed to connect to the *Distribution System*, at the earliest, 3 seconds after the voltage at the *Connection Point* is within ±5% around the nominal voltage, and the frequency in the *Distribution System* is within the range of 49.0 Hz and 50.2 Hz, or as agreed with the *System Operator*.

6.4.16. Active Power Control for Wind Generating Plants

The wind power *Generating Plant* shall stay connected to the *Kenya National Distribution System* at average wind speeds below a predefined cut-out wind speed. The cut-out wind speed shall as a minimum be 25 m/s, based on the wind speed measured as an average value over a 10-minute period. To prevent instability in the *Distribution System*, the *Wind Turbine Generating Plant* shall be equipped with an automatic downward regulation function making it possible to avoid a temporary interruption of the Active Power production at wind speeds close to the cut-out wind speed.

It shall be possible to continuously downward regulate the *Active Power* supplied by the VRPP to an arbitrary value in the interval from 100% to at least 40% of the rated power. When downward regulation is performed, the shutting-down of individual *Wind Turbine Generating Plant* systems is allowed so that the load characteristic is followed as well as possible.

Downward regulation shall be performed as continuous or discrete regulation. Discrete regulation shall have a step size of maximum 25%. When downward regulation is being performed, the shutting down of individual *Wind Turbine Generating Plant* systems will be allowed. The downward regulation band shall be agreed with the *DNSP* upon Commissioning of *Wind Turbine Generating Plant*.

6.4.17. Islanding

Intentional islanding of the V*RPP* shall be permitted to provide uninterrupted service to local *Customers* during an outage. Protection system must be capable of providing protection in normal as well as islanding mode.

6.4.18. Voltage level and quality

The generating plant shall be capable of remaining connected and running for indefinite time and unconstrained as regards to active and reactive power and controllability for any combination of the following:

(iv). Voltage at the Connection point between 0.90 and 1.10 pu, and

(v). Negative sequence voltage levels at the Connection Point up to the level given in Table 6-3 and section 6.2.6, and

(vi). Harmonic voltage distortion levels at the Connection Point up to the level given in Table 6-4 and section 6.2.7.

6.5 TECHNICAL REQUIREMENTS FOR AN ENERGY STORAGE SYSTEM

6.5.1. Embedded generator

Energy Storage Systems connected to the *Distribution System* shall be connected at the voltage level agreed to by the *DNSP*, based on the *Distribution System* Impact Studies and in accordance with the *KNDGC* Performance Standards. The *Connection Point* shall be controlled by a Circuit

Breaker that is capable of interrupting the maximum short circuit current at the *Connection Point*. Means shall also be provided for Circuit Breaker isolation for maintenance purposes.

6.5.2. System Frequency

An *Energy Storage System* connected to the *Distribution System* shall be capable of continuously supplying its Active Power output, as specified in the *Energy Storage System's* declared data, within the System Frequency range specified in the *KNDGC*. Any decrease of power output occurring in the Frequency range of 48.75 to 51.25 Hz shall not be more than the required proportionate value of the System Frequency decay.

In situations in which the System frequency momentarily rises up to the value of 51.5 Hz or drops to the value to 48.5 Hz, *Generating Plant*s connected to the *Distribution System* shall remain synchronized with the *Distribution System*, unless something different has been agreed in the *Connection Agreement*.

The *Energy Storage Licensee* shall be responsible for protecting its *Energy Storage System's* connected to the *Distribution System* against damage for frequency excursions outside the range of 51.5 Hz and 48.5 Hz. Outside this range, the *Distribution Network User* shall decide whether or not to disconnect its *Energy Storage System* from the *Distribution System*.

6.5.3. Protection System Coordination

The Protection of *Energy Storage System*s connected to the *Distribution System* and associated equipment shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity in fault clearing and to minimise the impact of faults on the *Distribution System*. The *DNSP* and the *Energy Storage Licensee* shall be solely responsible for the Protection System of the electrical Equipment and facilities at their respective sides of the *Connection Point*. Tables 6-6 and 6-7 summarise typical protection requirements of *Generating Plant*s of different types and sizes. As protection requirements could widely vary depending on the *Generating Plant* and *Distribution System* characteristics, the information on the tables shall be used only as a guide. Detailed protection schemes should be arranged between the *DNSP* and the *Generation Licensee*, and stated in the *Connection Agreement*.

Table 6-6 Protection for Single Phase Energy Storage Storage Systems

Interconnection Control, Protection and Safety Equipment[1] **YES denotes a requirement for this *Guideline***	
Generation Size	
50kW or less[3]	
Interconnection Disconnection Device	YES
Generator Disconnect Device	YES
Under-voltage Trip	YES
Over-voltage Trip	YES
Over & Under Frequency Trip	YES

Over-current Trip	YES
Synchronising Control[2]	Manual or Automatic
Synch-Check[2](At the Connection Point)	YES
Prevention of Unintended Islanding Operation (Loss of mains) in KS IEC 62116-2008	YES

Notes:

[1]. Exporting power to the Distribution System may require additional operational/protection devices and will require coordination of operations with the Distribution Network Service Provider.

[2]. For synchronous and other types of Generators with standalone capability.

[3]. For single-phase Generators larger than 50 kW, consult with Distribution Network Service Provider on the required interconnection control, Protection and safety equipment. Requirements for systems larger than 50 kW will include the requirements in this table and others as specified by the Distribution Network Service Provider.

Table 3 Protection for Three-Phase Generating Plants

Interconnection Control, Protection and Safety Equipment[8] **YES denotes a requirement for this *Guideline* - All devices are three-phase unless otherwise specified.**					
Generator Size Classifications	**Small**	**Medium**			**Large**
Device	<50 kW	50 - 499 kW	500 - 2000 kW	2001 - 10000 kW	>10000 Kw
Interconnect Disconnect Device	YES	YES	YES	YES	YES
Generator Disconnect Device	YES	YES	YES	YES	YES
Synchronising Control[1] Manual (M) or Automatic (A)	M or A	M or A	A	A	A
Synch-Check(at the Connection Point)	YES	YES	YES	YES	YES
Automatic Voltage Regulation (AVR)[1]	NO	NO	NO	YES	YES
Undervoltage	YES	YES	YES	YES	YES
Overvoltage	YES	YES	YES	YES	YES
Neutral Overvoltage[2]	YES[3]	YES	YES	YES	YES
Instantaneous/Timed Over current	YES[4]	YES[4]	YES[4]	YES[4]	YES[4]
Instantaneous/Timed Neutral Over current	YES[3]	YES	YES	YES	YES
Over and Under Frequency	YES	YES	YES	YES	YES
Directional Power	YES[5]	YES[5]	YES[5]	YES[5]	YES[5]
Inter-trip or Equivalent Relay	NO	YES[6]	YES[6]	YES[6]	YES[6]
Telemetry Data Communication	NO	NO	YES[7]	YES[7]	YES
Prevention of Unintended Islanding Operation(Loss of mains)	YES	YES	YES	YES	YES
Notes:					

1. For synchronous and other types of Generators with standalone capability.
2. Only required for Generators that have their interconnection transformer's primary winding ungrounded. Used in conjunction with 3 PT's in broken delta configuration rated for line-to-line voltage for detecting earth faults on the Distribution System.
3. May not be required if the Generator is an inverter type voltage-following system of less than 50 kW aggregate. In this case, the Distribution Network Service Provider will inform the Generator if this Protection is required.
4. A timed over current relay with voltage restraint may also be required to prevent nuisance trips.
5. Only required for non-exporting or export limited Generators.
6. Transfer trip or equivalent protective relay function required for all synchronous Generators rated 500 kW and larger with export capability. May also be required for exporting synchronous Generators under 500 kW, depending upon characteristics of the distribution circuit.
7. System Controller requirement for all Generators 5 MW and larger. The Distribution Network Service Provider may also require telemetry for smaller Generators depending upon location and distribution circuit characteristics.
8. Exporting to Distribution System may require additional operational/protection devices and will require coordination of operations with the Distribution Network Service Provider.

A fault or maintenance outage could result in the disconnection of the *Energy Storage System* connected to the *Distribution System* together with an associated section of the *Distribution System*, from the remainder of the total system. Unless explicitly arranged with the *DNSP*, and clearly stated on the *Connection Agreement* or amended *Connection Agreement*, the *Energy Storage System* connected to the *Distribution System* should never supply load and/or maintain voltage in any part of the *Distribution System* if this part is isolated from the Transmission System, and if the *Energy Storage System* is capable of maintaining both voltage and frequency within acceptable limits because it is equipped with synchronous or self-excited asynchronous *Energy Storage System*s, the *Energy Storage Licensee* shall install adequate protection devices (that could include inter-tripping schemes) to assure the disconnection either of the *Energy Storage System* or the whole *Energy Storage Licensee'*s facilities at the *Connection Point*.

In case the *Distribution Network User* facilities are connected to a feeder of the *DNSP* equipped with auto-reclosing, the protection System and switching arrangements should be designed to separate the *Energy Storage System* (or the *Energy Storage System* and other *Distribution Network User*'s facilities below the *Connection Point*) following the first *DNSP*'s Main Breaker, Recloser or Sectionaliser opening, and to remain disconnected until the system has completely restored.

6.5.4. Islanding

Intentional islanding of the *Energy Storage System* shall be permitted wherever possible to provide uninterrupted service to local *Customers* during an outage. Protection system must be capable of providing protection in normal as well as islanding mode

6.5.5. Fault Ride-through Requirements for Energy Storage Systems

Fault ride-through refers to the ability of an *Energy Storage System* to remain connected during a system voltage disturbance.

Four main characteristics typically provide the requirements for *Energy Storage System*s in the event of a voltage disturbance:

(a) Conditions for which the *Energy Storage System*s must remain connected

(b) Active Power provision during fault

(c) Voltage support requirements during the disturbance

(d) Restoration of Active Power after the fault has been cleared

Each is discussed in more detail below.

6.5.6. Remain Connected Voltage Condition

Medium and Large (as defined in Sections 6.1.3.2 and 6.1.3.3) *Energy Storage System*s shall remain connected to the *Kenya National Distribution System* for voltage disturbances on any or all phases, where the system phase voltage measured at the HV terminals of the connection transformer remains above a specified level for a specified length of time.

The "remain connected" requirements takes the form of a voltage vs. time profile which dictates the level of voltage drop or increase that an *Energy Storage System* must be capable of withstanding along with the time for which the voltage drop or increase should be endured.

Figure 6-1 shows the combinations of voltages and time that the *Energy Storage System*s shall be able to endure.

(i) Area A shows that the *Energy Storage System* shall be able to operate continuously between 0.9 p.u. and 1.1 p.u. In Area A the *Energy Storage System* shall stay connected to the network and uphold normal production.

(ii) Area B is the area between the Lower Bound and the bottom of the continuous operating range, at 0.9 p.u. In Area B the *Energy Storage System* shall stay connected to the network. Figure 5-1 shows that the *Energy Storage System* shall be able to withstand voltage drops to zero, measured at the *Connection Point*, for a minimum period of 0.15 seconds without disconnecting. Less severe voltage drops increase the length of time they must be endured. Below 0.85 p.u. the voltage drop shall be endured for nearly two (2) seconds. At 0.85 p.u. the voltage drop shall be endured a minimum of three (3) seconds.

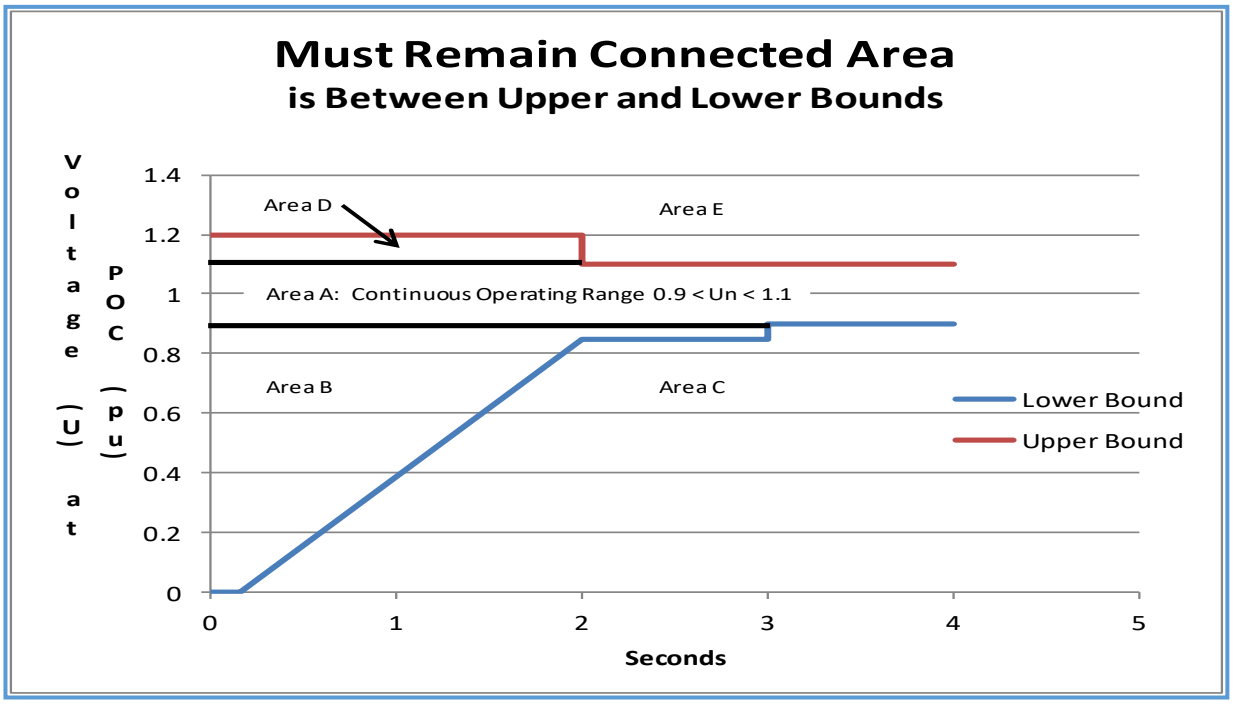
(iii) Area D is the area between the Upper Bound and the top of the continuous operating range, at 1.1 p.u. In Area D the *Energy Storage System* shall stay connected to the network. Figure

5-1 shows that the *Energy Storage System* shall be able to withstand voltage increases to 1.2 p.u. for at least two (2) seconds.

(iv) Area C is the area outside the Lower Bound and below the continuous operating range, at 0.9 p.u. In Area C disconnecting the RPP is allowed.

Area E is the area above the Upper Bound and above the continuous operating range, at 1.1 p.u. In Area E disconnecting the RPP is allowed.

Table 4 Voltage Must Remain Connected Area



6.5.7. Active Power Provision during Fault

During a voltage dip, the controllable *Energy Storage System* shall provide Active Power in proportion to retained voltage and maximise reactive current to the *Kenya National Distribution System* without exceeding its declared limits.

6.5.8. Active Power Control

The *Energy Storage System* control system shall be capable of operating the *Energy Storage System* at a reduced level if the Active Power output has been restricted by the *System Operator*. The *Energy Storage System* control system shall be capable of receiving an on-line Active Power Control Set-point sent by the *System Operator* and shall commence implementation of the set-point within 10 seconds of receipt of the signal from the *System Operator*. The rate of change of output to achieve

the Active Power Control Set-point should be no less than the maximum ramp rate settings of the *Energy Storage System* control system, as advised by the *System Operator*.

6.5.9. Power System Remain Connected Frequency Ranges

Frequency is the one parameter common to all members of a synchronous electric power system, and an accepted indicator of that system's ability to balance resources and demand as well as to manage disturbances. This requires that *Energy Storage Systems* remain connected beyond the frequency range associated with normal operation.

Under normal operation, the frequency of the *Distribution System* shall be nominally 50 Hz (± .5%), shall be controlled between 49.50 Hz and 50.50 Hz and shall be capable of continuous operation.

Increasingly, severe system disturbances require progressively wider frequency bands and reduce the time required to operate within the specified frequency range. These figures are summarised in Table 6-8.

Table 5 : minimum time to remain connected

Frequency Limits	Duration
49.0 Hz to 51.00 Hz	Continuous operation
51.0 Hz to 51.5 Hz	At least 90 minutes
48.50 Hz to 49.0 Hz	At least 90 minutes
47.5 Hz to 48.5 Hz	At least 60 minutes
51.5 Hz to 52.0 Hz	At least 60 minutes
47.0 Hz to 47.5 Hz	At least 20 seconds
<47.0Hz for more than 0.2 sec	May disconnect
>52.0 Hz for more than 4 sec	Must disconnect

6.5.10. Active Power Control

The *Energy Storage System* control system shall be capable of operating the *Energy Storage Systems* at a reduced level if the Active Power output has been restricted by the *System Operator*. The *Energy Storage Systems* control system shall be capable of receiving an on-line Active Power Control Set-point sent by the *System Operator* and shall commence implementation of the set-point within 10 seconds of receipt of the signal from the *System Operator*. The rate of change of output to achieve the Active Power Control Set-point should be no less than the maximum ramp rate settings of the *Energy Storage Systems* control system, as advised by the *System Operator*.

6.5.11. Frequency Response

Frequency response can be achieved through decreasing *Energy Storage System* power output when frequency exceeds the upper bound of a specified acceptable frequency range, and by increasing *Energy Storage System* power output when frequency falls below the lower bound of the specified range. Thus an *Energy Storage System* must operate at a level below its instantaneous available capacity, if it is to provide both upward and downward frequency regulation capability.

The frequency response system of *Energy Storage System*s shall have the capabilities set out in the power frequency response curve agreed with the *System Operator*.

It is usually economically beneficial for *Energy Storage System*s to operate at their instantaneous available capacity. If they operate below their instantaneous available capacity, wind and photovoltaic *Energy Storage Systems* lose some of the energy they could have generated. The same is true for other types of *Energy Storage System* which may lack energy storage facilities. This may be a factor in reaching an agreement with *the Regional Control Centre and System Operator* on the power frequency curve.

6.5.11.1. Limited frequency-sensitive mode over frequency (LFSM-O)

The Generating Plant shall comply with the following requirements:

a) the Generating Plant shall be capable of activating the provision of active power frequency response if the grid exceeds a frequency threshold equal to 50.5 Hz.
b) The active power frequency response shall be linear with a droop setting equal to 5%, droop being the percentage increase in the Frequency that would cause the *Energy Storage System* to change its output from actual available Capacity to zero.
c) the Generating Plant shall be capable of activating a power frequency response with an initial delay that is as short as possible, but maximum 2 seconds.
d) upon reaching minimum regulating power level, the Generating Plant shall continue operation at this level
e) the Generating Plant, energy system or HVDC station shall be capable of operating stably during LFSM-O operation. When LFSM-O is active, the LFSM-O setpoint will prevail over any other active power setpoints.
f) the Generating plant shall allow adjustment of the frequency threshold between 50,2 Hz and 51.0 Hz inclusive
g) the Generating plant shall allow adjustment of the droop between 4% and 12% inclusive
h) the System Operator may instruct the Generating plant operator to adjust the frequency threshold and the droop from time to time.

6.5.12. Voltage level and quality

The Energy Storage System shall be capable of remaining connected and running for indefinite time and unconstrained as regards to active and reactive power and controllability for any combination of the following:

i. Voltage at the Connection point between 0.90 and 1.10 pu, and
ii. Negative sequence voltage levels at the Connection Point up to the level given in Table 6-3 and section 6.2.6, and
iii. Harmonic voltage distortion levels at the Connection Point up to the level given in Table 6-3 and section 6.2.6.

7 OPERATIONS

7.1 PURPOSE AND SCOPE

The purpose of the Operations Chapter of the *KNDGC* is:

(a) To define the operational responsibilities of the *Distribution Network Service Provider* and all *Distribution Network User*s;

(b) To specify the requirements and procedures for Load Forecast;

(c) To specify the maintenance programmes for the Equipment and facilities in the *Distribution System*;

(d) To describe the Demand control strategies used for the control of the Total System frequency and the methods used for voltage control;

(e) To specify the requirements for communication and the notices to be issued by the *DNSP* to *Distribution Network User*s and the notices to be issued by *Distribution Network User*s to the *DNSP* and other *Distribution Network User*s.

(f) To specify the procedures to be followed by the *DNSP* and *Distribution Network User*s during emergency conditions;

(g) To specify the Safety Management System criteria to be applied by the *DNSP*s and *Distribution Network User*s for the co-ordination, establishment and maintenance of necessary safety precautions when work or testing is to be carried out on Plant and/or Apparatus of a *DNSP* or a *Distribution Network User*

(h) To establish a procedure for the conduct of System Tests which involve the simulation of conditions or the controlled application of unusual or extreme conditions that may have an impact on the *Distribution System* or the *Distribution Network User* System;

(i) To identify the tests and the procedures that needs to be carried out to confirm the compliance of a *Generating Plant connected* to the *Distribution System* with its registered parameters and its ability to provide *Ancillary Services*; and

(j) To specify the requirements for Site and Equipment Identification at the *Connection Point*

7.2 OPERATIONAL RESPONSIBILITIES

This section applies to the following:

(a) The *DNSPs*

(b) *Generating Licensees* with *Generating Plants connected* to the *Distribution System* greater than or equal to 1 MVA output or with a single *Generating Plant* over 500kVA;

(c) Other *Generating Licensees* with *Generating Plants connected* to the *Distribution System* if so instructed in the *Connection Agreement*;

(d) All *Distribution Network User*s with a contracted demand equal to or greater than 4 MVA, unless differently stated in the *Connection Agreement*.

(e) Other Distribution *Network User*s, if so instructed in the *Connection Agreement*.

7.2.1. DNSP

The responsibilities of the *DNSP* shall include the following:

(a) The *DNSP* is responsible for operating and maintaining Supply and Power Quality in the *Distribution System* during Normal Conditions, in accordance with the provisions indicated in the Performance Standards in Chapter 9 of the *KNDGC*, and in proposing solutions to Supply or Power Quality problems.

(b) The *DNSP* is responsible for providing and maintaining all distribution Equipment and facilities within its licensed area.

(c) The *DNSP* is responsible for preparing the Annual Maintenance Plans for the adequate maintenance of its Equipment and facilities, as is described in the *KNDGC*.

(d) The *DNSP* is responsible for designing, installing, and maintaining distribution protection that will ensure selective and timely disconnection of faulted facilities and Equipment.

(e) The *DNSP* has a responsibility for maintaining an Automatic Load Shedding scheme to meet the targets agreed to with the *System Operator* and per the *KNTGC*

7.2.2. Generation Licensees

The *Generation Licensee* with *Generating Plants connected* to the *Distribution System* is responsible for:

(a) Ensuring that its *Generating Plants* can deliver the capabilities declared in its *Connection Agreement*

(b) Providing accurate and timely planning and operations data to the *DNSP*

(c) Executing the instructions of the *DNSP* during emergency conditions

7.2.3. Distribution Network Users

The responsibilities of *Distribution Network Users* shall include the following:

(a) Assisting the *DNSP* in maintaining Power Quality in the *Distribution System* during Normal Conditions by correcting any *Distribution Network User* facility that causes Power Quality problems.

(b) Ensuring that *Distribution Network User's* system will not cause any Degradation of the *Distribution System*.

(c) Undertaking all necessary measures to remedy any degradation that the *Distribution Network User* System has caused to the *Distribution System*.

(d) Executing the instructions of the *DNSP* during emergency conditions.

7.3 OPERATIONAL PLANNING

7.3.1. Load Forecast

In order for the *DNSP* to operate the *Distribution System* efficiently and to ensure maximum System security, there is a need for those *Distribution Network User*s to provide loading and generation output information to the *DNSP*. The information, required to be provided by *Distribution Network User*s, will enable the *DNSP* to comply with these requirements of the *KNDGC.*

This section of the *KNDGC* specifies the information to be provided by *Generation Licensees* and *Distribution Network User*s.

This Demand forecasting information is required to enable the *DNSP* to maintain the integrity of the *Distribution System*. The *DNSP* under its *Distribution Licence* has an obligation under the *KNDGC* to provide Demand forecast information to the *System Operator* in order that generation output can be matched with Demand.

Where Demand data is required from the *Distribution Network User*, this means the MW Demand of electricity at the *Connection Point*. The *DNSP* may, in certain cases, specify that the Demand data shall include the Mvar Demand.

7.3.2. Demand Forecast Information

Information shall be supplied by *Distribution Network User*s to the *DNSP* for the following rolling timescales:

(a) Operational Planning Phase – next year ahead

(b) Programming Phase – twenty-four (24) hours to eight (8) weeks ahead

(c) Control Phase – zero (0) to twenty-four (24) hours ahead

The information supplied will be as specified below:

7.3.2.1. Operational Planning Phase (next year ahead)

The *Distribution Network User* information shall be provided in every calendar year by calendar week thirty-five (35) to the *DNSP* during the Operational Planning Phase.

7.3.2.2. Programming Phase (24 hours to 8 weeks ahead inclusive)

The following information shall be provided to the *DNSP*:

(a) Schedules for the operation of a *Generating Plant* with output greater than 1MW on an hourly basis where the *DNSP* reasonably considers it appropriate;

(b) From the *DNSP*'s supply business, details of their proposed use of Demand Control measures aggregated to [3 MW] or more (averaged over any hour) on an hourly basis for each of the *DNSP*'s *Connection Point*s;

(c) From *Distribution Network User*s and other *DNSP*s connected to the *Distribution System* whose operations are likely to result in an aggregated change in hourly demand at the *Connection Point* of greater than [3 MW];

(d) Any other relevant Demand forecast information reasonably required by the *DNSP*.

7.3.2.3. Control Phase (0 to 24 hours ahead)

The following information shall be supplied to the *DNSP* at reasonable times to be specified by the *DNSP*:

(a) Details of any differences of greater than [2 MW] from the schedules of operation of any Generation connected to the *Distribution System* on an hourly basis.

(b) Details from each *Distribution Network User* connected to the *Distribution System* of any change in aggregated Demand at the *Connection Point* of greater than [3 MW] of the Demand.

7.4 MAINTENANCE PLANS

7.4.1. Maintenance Standards

A *DNSP* shall, in relation to the maintenance of its *Electrical Infrastructure*, adopt quality management and assurance procedures which:

(a) Comply with the laws and other performance obligations which apply to the provision of distribution services, including those contained in the *KNDGC*; and

(b) Minimise the risks associated with the failure or reduced performance of assets; and

(c) Adopt *Prudent Utility Practice*.

7.4.2. Maintenance Plans and Time Scales

The *DNSP* shall prepare the following Distribution Maintenance Programmes:

(a) Long Term Maintenance Plan; 5-Year cycle

(b) Annual Maintenance Plan

(c) Planned Outage Schedule

7.4.3. Annual Maintenance Plan

Each year, the *DNSP* will prepare an Annual Maintenance Plan. All interested *Distribution Network User*s, *Generation Licensee*s, and other *Users* as required by the *DNSP* will provide the *DNSP* with their maintenance and outage plans to include into the Annual Plan.

The Annual Maintenance Plan and its proposed outage programme shall be submitted to the *Authority* and to the *System Operator* on a year-ahead basis by November 1st each year.

The Annual Maintenance Plan shall be developed taking into account the following:

(a) The forecast Demand;

(b) The historical Maintenance Plans actually implemented;

(c) The requests by *Distribution Network User*s for changes in their maintenance schedules;

(d) The requirements for the maintenance of the *Distribution System;*

(e) The need to minimise the total cost of the required maintenance; and

(f) Any other relevant factor.

*Distribution Network User*s and *Generation Licensees* with *Generating Plants connected* to the *Distribution System* shall provide to the *DNSP* information regarding their provisional Maintenance Plan for the next year. The following information shall be included in the *Distribution Network User*'s provisional Maintenance Programme for its System or Equipment:

(a) Identification of the Equipment and the MW capacity involved;

(b) Reasons for the maintenance;

(c) Expected duration of the maintenance work;

(d) Preferred start date for the maintenance work and the date by which the work shall have been completed; and

(e) If there is flexibility in dates, the earliest start date and the latest completion date.

The *DNSP* shall advise *Distribution Network User*s or *Generation Licensees* with *Generating Plants* connected to the *Distribution System* who may be significantly affected by particular outages of Distribution plant or apparatus, of the dates and duration of the outages. If there are objections from *Distribution Network User*s, the *DNSP* and the *Distribution Network User* shall attempt to resolve the problem, as provided in Section 3.11. The *DNSP* shall make all reasonable attempts to revise the Annual Maintenance Plan to address the *Distribution Network User*'s concerns. However, if no reasonable and/or timely alternative exists, then the *DNSP* may take the outage despite the concerns of the Large *Distribution Network User*s or *Generation Licensees.*

7.5 VEGETATION MANAGEMENT

The objective of this Section is to:

(a) Promote public safety in respect of fire hazards;

(b) Establish a standard of care which should be observed when managing vegetation near *Distribution* power lines;

(c) Reduce vegetation related interruptions to electricity supply;

(d) Establish communications protocol with affected persons;

(e) Minimise the impact of vegetation management on the natural environment.

7.5.1. Applicability

This section applies to *DNSP*s and any other party performing tree trimming or other vegetation related tasks on or near electric distribution facilities.

7.5.2. Purpose

The purpose of this section is to establish programme management requirements and prudent work practices and procedures for the pruning and clearing of vegetation in the vicinity of distribution facilities. To that end, this section sets out:

(a) Minimum standards and procedures for clearing vegetation near electric distribution facilities; and

(b) Define the roles and responsibilities for maintaining the *Clearance Space* near power lines.

7.5.3. Alternatives to Vegetation Clearing

There are a number of methods of maintaining the *Clearance Space*. The most common method is pruning and clearing of vegetation. Other methods include:

(a) Undergrounding of electric supply lines;

(b) Installing tree wire or aerial bundled overhead *Conductors*;

(c) Alley arm pole line framing;

(d) Selecting power line routes which avoid vegetation;

(e) Installing taller poles to obtain vertical clearance over vegetation;

(f) Educating developers and the community on selecting low height, slow growth vegetation species for new plantings

Factors that the *DNSP*s shall use in determining the most appropriate options to address the best alternative include:

(a) Public safety;

(b) *Distribution System* reliability;

(c) Capital cost of construction alternatives versus ongoing maintenance;

(d) Community conservation and heritage values and visual impact;

(e) Type of vegetation and its growth characteristics; and

(f) Accessibility to the line/vegetation location for vegetation maintenance crews.

It is for the *DNSP* to determine the most appropriate method of maintaining the *Clearance Space*.

7.5.4. Vegetation Management Programme

The *DNSP* shall have a written Vegetation Management Program that applies prudent power line clearing practices to reduce the risk to the public and maintain the reliability of the *Distribution System*. The components that should be included in the programme are:

(a) Inventory of distribution facilities requiring tree trimming, including the frequency based on species and proximity to the line;

(b) Multi-year maintenance cycles;

(c) Annual maintenance plans; including scope, schedule and budget;

(d) Approved work practices;

(e) Training Programme;

(f) Community Outreach Plan

The *DNSP's* Vegetation Management Program include prudent principles for prevention of soil erosion, and the preservation of water quality, windbreaks and specific wildlife habitat.

7.5.5. Practices and Classifications

To provide a consistent and measurable approach to pruning or clearing vegetation near *Distribution Power lines* and to assist people to understand these concepts, the following practices and classifications apply:

(a) ***Clearance space***: The *Clearance Space* varies with the type of distribution power line installed and the risk of fire at that location. The clearance space is designed to reduce the risk of grassland fires in rural areas and the reliability and continuity of electricity supply.

(b) ***Regrowth Space:*** The *Regrowth Space* required varies with the species of vegetation, the quality of the pruning or clearing, the micro-environment and the pruning and clearing cycle. Determining the regrowth rate is a matter of considering the factors involved. It should be assessed with the support of expert knowledge in vegetation management and following consultation with affected persons.

(c) ***Hazard Space***: The *DNSP* shall take appropriate action in relation to trees and limbs in the hazard space to ensure the safety and reliability of the *Distribution System*. The hazard space will vary with the species of vegetation and the extent of exposure to adverse weather conditions. The hazard space should be determined with reference to these factors and assessed with the support of vegetation management and arboriculture expertise, following consultation with affected persons.

(d) ***Pruning and Clearing Cycle***: The pruning and clearing cycle is based on practical factors which include cost, local growing conditions and the anticipated vigour of the regrowth of species involved, coupled with the use of the land, community values and the utility and

amenity the vegetation provides to the area. The pruning and clearing cycle need not be the same for all areas, but will be determined according to conditions in a particular location.

(e) ***Suitable Vegetation Species***: In some situations, vegetation cannot be pruned to the requirements of the *KNDGC* across successive pruning and clearing cycles without destroying the vegetation's character, amenity and utility value or encouraging vigorous regrowth. In the longer term this could cause the vegetation to become unstable, unhealthy and a hazard to the public and the distribution power line. This vegetation should be removed where judged appropriate following assessment of the vegetation's conservation value and appropriate consultation.Saplings whose mature height will infringe the *Clearance Space* are best removed at an early stage of their growth to minimise cost and disruption to the area in the future. Planting of suitable species by owners and occupiers will remove the potential risk to distribution power lines and the need for costly recurrent pruning or clearing as well as retaining the amenity and utility value of vegetation to the public and environment.

7.5.6. Important Vegetation

Locations recognised by relevant authorities or bodies as containing "important vegetation" require special attention. For the purposes of this chapter, "important vegetation" includes:

(a) Botanical, heritage and cultural sensitive vegetation;

(b) Vegetation of outstanding aesthetic value;

(c) Vegetation of ecological significance; and

(d) Habitat for threatened species.

Before commencement of pruning and clearing, the *DNSP* should identify where the maintenance may be detrimental to important vegetation. The *DNSP* should seek advice from the relevant authorities, for example the Ministry of Environment and Natural Resources, as well as land care and community groups as advised by the relevant authorities, to identify "important vegetation".

Alternative distribution power line routes or construction methods described in Section 7.5.3 may help to preserve "important vegetation". The manner in which this may be done needs to be decided by the *DNSP* with the support of this chapter. This should result in the most practical management arrangements and conditions that may apply.

7.5.7. Important Locations

The *DNSP* should consult with the relevant authorities on the management of "important locations". For the purposes of this section "important locations" contain the following:

(a) Sites of historically or culturally important remnants or artefacts;

(b) Sites of historically or culturally important events;

(c) Sites of outstanding aesthetic value or landscape or streetscape values; or

(d) Sites of ecological significance.

7.5.8. Clearance Space

The principal determinants of the dimensions of the *Clearance Space* are protection of the public from fire start potential and ensuring continuity and reliability of supply. Accordingly, the *Clearance Space* will vary depending on the fire hazard category of the area in which the distribution power line is situated and factors associated with the type of distribution power line installed.

7.5.9. Fire Hazard Categories

The risk of fire starting and spreading varies throughout Kenya. To establish the *Clearance Space* required, Kenya has been divided into two categories in which different *Clearance Space* dimensions apply:

(a) Low to moderate fire risk areas (predominantly urban); and

(b) High to very high fire risk areas (predominantly rural).

The *DNSP* should seek advice from the *Fire Control Authority* as to the *Fire Hazard Rating* of the area within which they propose to undertake vegetation management activity.

7.5.10. Factors Affecting Dimensions of Distribution Power Line Clearance

The dimensions of the *Clearance Space* are also dependent on factors associated with the type of distribution power line installed and include:

(a) ***Line Voltage***: The voltage level of the distribution power line influences the potential for electric discharge. The higher the voltage, the greater the potential hazard, and hence the need for a greater *Clearance Space.*

(b) ***Conductor Type***: Insulated conductors reduce the risk of electric discharge. Using *Aerial Bundled Cable* or other insulated conductors reduces the necessary dimensions of the *Clearance Space*.

(c) ***Span Length***: As the span length increases, the added weight of the line conductors causes an increase in sag. *C*onductors can sway with the wind; therefore, all dimensions of the *Clearance Space* shall be greater as the span length increases.

(d) ***Conductor size***: The size of a *Distribution Power line* conductor affects its weight and therefore the amount that the conductor will sag. *Distribution Power line* conductors can sway with the wind therefore dimensions of the *Clearance Space* need to increase as the size of the conductor increases.

(e) ***Distance along the Distribution Power line conductors from the pole:*** Along the *Distribution Power line conductors*, the greatest sag occurs midway between the supporting

poles. Therefore, the dimensions of the *Clearance Space* should be greater at mid-span than near the pole. Maximum *Clearance Space* dimensions are to apply at the point of maximum sag.

(f) ***Temperature of the Conductors***: Increases in the temperature of *distribution power line* conductors, caused by weather line loading, increases the sag of the conductors. These factors are in a state of continual change, so an allowance is made in the dimensions of the *Clearance Space* for the temperature of distribution power line conductors.

7.5.11. Consumer Responsibilities

The tariff applicable to a *Consumer* or an *Individual Contract* between a *Consumer* and a *DNSP* provides that a *Consumer* shall, at its own expense, maintain safe clearances between vegetation on the *Consumer's* property and *Electrical Infrastructure* providing supply to the *Consumer's Electrical Installation*.

7.5.12. Notification, Consultation and Negotiation

A *Distribution Network Service Provider* shall:

(a) Notify the occupiers of land, giving reasonable notice, before starting programmed pruning or clearing which will not involve changes to established practice. Notices should be informative, explaining why compliance with this section is necessary and stating the proposed time of the pruning and clearing. Where no one is in actual occupation of the land, notices to owners may be published in locally distributed newspapers;

(b) Consult with the owner of land when the proposed pruning or clearing will change from the established practice for that location and notify the occupiers of the land where the owner and the occupiers are not the same person;

(c) When the proposed pruning or clearing will change from the established practice for that location, provide to the owner or, if not practical, the occupiers, a simple written explanation of the proposed method and extent of pruning or clearing which may include details of:

(i) The use of chemicals;

(ii) Disposal of debris resulting from pruning or clearing;

(iii) Avoiding transfer obnoxious weeds and diseases; or

(iv) Implementing measures to prevent bushfires from starting.

7.5.13. Emergency Clearing

In emergency situations, the *DNSP* may remove vegetation which poses an immediate risk in accordance with powers under section 176 of the *Energy Act*, 2019.

Under emergency circumstances, pruning may be undertaken without consultation, but the *DNSP* should notify the owner or occupiers as soon as practicable after the removal of the vegetation

7.5.14. Disputes

Disputes with owners or occupiers or *Distribution Network Users* may arise from decisions made by a *DNSP* in carrying out vegetation management activities. The *DNSP* should endeavour to resolve any dispute in accordance with Section 3.11 of the *KNDGC.*

Notwithstanding the nature of the dispute and the need to resolve the dispute in an amicable manner, the responsibility of the *DNSP* to maintain the *Clearance Space* at all times cannot be compromised.

7.5.15. Training

A *DNSP* should ensure that any of his employees undertaking vegetation management in the vicinity of its *Power lines*, and any contractors engaged to carry out vegetation management, are appropriately trained and competent for that task.

Such training should cover the following areas:

(a) Plant and weed identification;

(b) Management of vegetation waste;

(c) Precautions to avoid spread of weeds and plant diseases; and

(d) Safe working practices near power lines.

A *DNSP* should seek advice from the relevant authorities as to appropriate training for vegetation management.

7.6 DISTRIBUTION ASSET REGISTER

DNSPs shall keep a register of all Electrical Infrastructure and other assets forming part of the *Distribution System*, which shall include:

(a) A physical description of each item of electrical infrastructure or other asset, including its location; and

(b) The value of each item of Electrical Infrastructure and other asset, calculated in accordance with accounting standards generally accepted in Kenya in the electric industry.

7.7 PUBLIC LIGHTING

A *DNSP*, in liaison with the relevant local authority, shall repair or replace an item of public lighting for which it has maintenance responsibility within seven (7) business days of being notified by any person that such repair or replacement is necessary.

7.8 OUTAGE SCHEDULE

Notwithstanding any approved outage plan, the *DNSP* shall not take any circuit/equipment out of service at any *Interconnection* without specific release from the *Regional Control Centre*. This shall however, not apply under the following circumstances:

(a) If the import or export at each *Interconnection* point with the *Transmission Licensee* is not affected.

(b) If removal of any circuit from service becomes necessary under emergency conditions or disconnection for violation of the *Connection Agreement*. In all cases the *System Operator* must be kept fully informed.

Maintenance of the *Distribution System* may require outages that interrupt the supply to a *Distribution Network User* or group of *Distribution Network User*s. In such cases, the *DNSP* shall:

(a) Notify the affected *Distribution Network User*s at least seventy-two (72) hours in advance. Longer notice periods may be agreed between a *Distribution Network User* and a *DNSP*. The notification should contain, as a minimum, a clear indication of the zone affected by the interruption, the interruption starting date, the expected duration, and the reason of the interruption, including the Plant or Equipment to be maintained.

(b) If the above mentioned notification procedures are not fulfilled, the interruption produced to the affected Distribution *Network User*s should be classified and accounted as unscheduled interruption.

7.9 CONTINGENCY PLANNING

7.9.1. Types of Contingencies

A contingency in the *Distribution System* may arise in the event of Total or Partial System Blackout of the *Distribution System*. A Contingency may also affect a part of the *Distribution System* due to local breakdowns in the *Distribution System* itself or in the apparatus of the *TNSP* at the *Interconnection Point.* This section lays down procedures which the *DNSP* shall follow under such contingencies to quickly and efficiently restore and maintain power supply to its *Distribution Network User*s.

These Contingencies are classified as:

(a) System Blackout (Total or Partial).

(b) Failure of equipment at the transmission *Interconnection* points.

(c) *Distribution System* failure.

7.9.2. System Blackout

Total System Blackout is a situation when all generation has ceased with no electricity supply from External *Interconnection*s.

Partial Blackout is a situation where all generation has ceased in a separate part of the *Kenya National Transmission or Kenya National Distribution Systems* and there are no available *Interconnection*s to the other parts of the Total System

In case of Total System Blackout or Partial Blackout at any point of *Interconnection*, the *DNSP* shall abide by the black start procedures framed by the *Transmission Licensee* and incorporated in the *KNDGC.*

The *DNSP* shall be responsible for sectionalising the *Distribution System* into discrete, unconnected blocks of Demand. The *DNSP* shall advise the *System Operator* regarding the amount of MW likely to be picked up when switching on each block of Demand.

The *DNSP* shall prepare a schedule of Essential and non-Essential loads in order of priority at each *Connection Point* to the *KNTS* to be picked up during the restoration process. The schedule is to be approved by the *System Operator* and forwarded to the *Authority*. Such schedule shall be updated continually. The schedule shall conform to provisions of the *KNDGC*.

The DNSP shall maintain direct communications links with the *Regional Control Centre* throughout the restoration process until the system is restored to normal.

To coordinate activities, *Distribution Network User*s and the *DNSP* will ensure that there are suitable communication paths available and that where appropriate senior members of staff are appointed to manage these abnormal situations. The *DNSP* shall furnish to the *Regional Control Centre* the name and designation of person/persons, along with their telephone number/s and location, authorisation to deal with any contingency operations. This list shall always be kept up to date.

7.9.3. System Recovery

The *DNSP*s will segregate its total Demand into suitably sized components to allow progressive re-energisation of the *Distribution System* from black start *Generating Plant*s. The size of the areas of Demand of these will be determined by the *System Operator* and will be commensurate with the size of the *Generating Plant*s being re-started.

The overall strategy of recovery will be to re-establish stable Islands of Supply and Demand and to re-synchronise these islands progressively. *Generating Plant*s connected to the *Distribution System* will be required to operate under the *DNSP* directives, to enable the *DNSP* to comply with its *KNDGC* and/or licence obligations.

Where there are no *Generating Plants* with a Black Start capability within the *Distribution System*, then restoration of supply may be substantially delayed while the *System Operator* re-establishes the *Transmission System* from a restored island or part of the Total System. The *DNSP* will re-appraise its priorities in these situations and restore supplies in accordance with its *KNDGC* and/or licence obligations

7.9.4. Failure of Transmission System or Equipment

In all cases that failures exist on lines or equipment of the *Transmission Licensee* that cause, or may cause, an Incident in the *Distribution System*, the *DNSP* shall immediately contact the *System*

Operator and/or the person authorised for such purpose at the substations of the *Transmission Licensee* and assess the probable time period needed for restoration and/or probable restriction on load draw from the affected substation. The *DNSP* may exercise Demand Control as necessary.

7.9.5. Distribution System Failure

Where a part of the *Distribution System* to which a *Generating Plant* connected to the *Distribution System* is connected becomes isolated from the *Distribution System*, the *DNSP* shall decide if it is desirable for the *Generating Plant* to continue operating.

Where no facilities exist for the subsequent resynchronisation with the rest of the *Distribution System*, the *DNSP* shall issue an instruction to the *Generation Licensee* to disconnect its *Generating Plant* to enable the Island Grid to be reconnected to the rest of the *Distribution System*.

7.10 DEMAND CONTROL

7.10.1. Objective and Scope

The objective of this section is to establish procedures to enable the *DNSP*, following an instruction of the *System Operator*, to achieve a reduction in Demand in order to avoid a Breakdown or Overloading of any part of the *Distribution System* in a manner that does not unduly discriminate against or unduly prefer anyone or group of *Distribution Network User*s.

This section applies to the *DNSP*s and to *Distribution Network User*s, which in this section means *Generation Licensees* with *Generating Plants connected* at Distribution, and *Distribution Network User*s.

7.10.2. Methods of Demand Control

The term "Demand Control" is used to describe any or all of these methods of achieving a Demand Reduction:

(a) Voluntary *Distribution Network User* Demand Management initiated by *DNSP*;

(b) Automatic under frequency load shedding;

(c) *Distribution Network User* Demand reduction including Voltage Reduction;

(d) Emergency manual deep load shedding of *Distribution Network User* Demand

When instructed by the *System Operator*, temporary load shedding shall be carried out to maintain the load generation balance. This may also be necessary due to lack of generation, loss of any circuit, equipment or any other operational contingency.

Distribution Network User Demand may be disconnected automatically at selected locations in accordance with the requirements of the *KNDGC*, in the event of a sudden fall in frequency. Such an arrangement shall be carefully coordinated as part of an overall scheme and may take into account any operational requirements or essential load.

The *DNSP* shall estimate loads that may be shed in discrete blocks at each *Connection Point* to the Transmission System in consultation with the *Distribution Network User*s as required and submit the information to the *System Operator*. The *Distribution Network User*s shall cooperate with the *DNSP*s in this regard.

Automatic disconnection by under voltage relay may be used to discriminately disconnect load in order to maintain voltage within acceptable limits, in order to avoid widespread load shedding. Deliberate reduction of voltage may be used to achieve a temporary reduction in load Demand.

In the event of a sustained period of shortfall due to any constraint in the *Transmission System* and/or *Distribution System*, then planned rotational load shedding may be used to share the available power among affected *Distribution Network User*s.

In addition, *Generation Licensees* with *Generating Plants connected* to the *Distribution System* may wish to disconnect, automatically or manually, their *Generating Plant* from the *Distribution System* to which it is connected at certain frequency levels. Any such disconnection will be agreed with the *DNSP* or the *System Operator*, as required, in accordance with the Distribution Planning and Connection Chapters

7.10.3. Implementation of Demand Control

Deliberate reduction in System frequency may also be used to achieve a temporary reduction in load Demand in accordance with the *KNDGC.* Emergency manual load shedding may be also carried out on the *Distribution System* if so instructed by the *System Operator*.

Where Demand Control is exercised by the *DNSP* on instruction or request from the *System Operator* in order to safeguard the System Security, then the *DNSP* is required to respond to these requests promptly but shall liaise with and inform other *Distribution Network User*s so far as is reasonable practicable.

Where Demand Control is exercised by the *DNSP*, either instructed by the *System Operator* or in order to safeguard the *Distribution System*, the *DNSP* shall liaise with and inform *Distribution Network User*s accordingly as far as is reasonably practicable.

Detailed load shedding procedures shall be established by the *DNSP* and a detailed procedure shall be furnished to the *System Operator* and persons in charge of downstream substations of the *DNSP*, where such load shedding has to be carried out. Where automatic load shedding will be carried out using under frequency relays the circuits involved and the amount of load to be interrupted, complete with corresponding relay settings, shall be submitted to the *System Operator* and persons in charge of downstream substations of the *Licensee* as necessary.

In the event of load shedding under the *DNSP*'s planned load shedding rotations, the public shall be promptly notified of such arrangements through the media or on a website. Large *Distribution Network User*s with contract Demands of [1 MW] and above shall also be notified by telephone.

Essential services such as hospitals, public water works, etc. shall be exempt from being included in the planned load shedding blocks.

Once an automatic or manual disconnection, either due to low frequency or voltage problems, has taken place, it shall not be reconnected until the *DNSP* instructs to do so in accordance with the *KNDGC*. Each *DNSP* shall abide by the instructions of the *System Operator* with regard to reconnection without delay.

All the Standards and Procedures related with the Load Shedding, including automatic load shedding, load shedding exemption policies, rotational load shedding and *Distribution Network User*'s communications should be contained and documented in a Distribution Load Shedding Plan. *DNSP*s shall permanently maintain and update this document, which should be submitted to the *Authority* for revision and approval, if instructed to do so.

7.11 SAFETY COORDINATION

7.11.1. Introduction

This section specifies the Safety Management System criteria to be applied by the *DNSP* and *Distribution Network User*s for the coordination, establishment and maintenance of necessary safety precautions when work or testing is to be carried out on plant and/or apparatus of the *DNSP* or a *Distribution Network User* and where isolation, earthing, and/or some other precautions of the other's System is needed. This section does not apply to the situation where safety precautions need to be agreed solely between *Distribution Network User*s.

This Safety Coordination section does not seek to impose a particular set of safety rules on the *DNSP* and *Distribution Network User*s. The safety rules to be adopted and used by the *DNSP* and each *Distribution Network User* shall be those chosen by each.

7.11.2. Objectives

The objective of the Safety Coordination section is to establish requirements that ensure the safety of facilities and persons working at or across Operational and Ownership Boundaries between the *Distribution System* and *Distribution Network User*s' Systems.

7.11.3. Scope

This section specifies the Safety Management System criteria to be applied by the *DNSP* and all *Distribution Network User*s at or across a *Connection Point*. *Distribution Network User*s for the purposes of requirement shall be:

(a) Medium and High Voltage *Distribution Network User*s.

(b) *Generation Licensees with Generating Plants* connected to the *Distribution System.*

(c) Other *DNSP*s connected to the *Distribution System.*

(d) Any other party reasonably specified by the *DNSP* including *Distribution Network User*s with un-metered supply and those connected at low voltage (LV).

7.11.4. Electric Power Industry Safety Code

A *DNSP* and *Distribution Network User*s shall, in respect of *Electrical Infrastructure* installed into his *Distribution System or* any replacement or modification of existing electrical infrastructure on or after the commencement date, comply with the *Electric Power Industry Safety Code (National Electrical Safety Code – KS 1587:2007)*

If the provisions of this *KNDGC* are inconsistent with a provision of the *Electric Power Industry Safety Code*, the provision of the *Electric Power Industry Safety Code* is to prevail to the extent of the inconsistency.

7.11.5. Operational Safety

7.11.5.1. Approved Safety Management Systems

In order to address the need for a Safety Management System specifying the principles and procedures to be applied at *Operational Boundaries* to ensure the health and safety of all who are liable to be working or testing on the *Distribution System* or on Plant and Apparatus connected to it, a Safety Management System will be established by the *DNSP* and *Distribution Network User*s. For interfaces involving MV and HV systems, this shall include the provision for Control Person(s), a system of documentation and the establishment of Safety Precautions.

The Safety Management System must include the provision for written authorisation of personnel concerned with the control, Operation, work or testing of Plant and Apparatus forming part of, or connected to, the *Distribution System*. Each individual authorisation shall indicate the class of Operation and/or work permitted and the section of the System to which the authorisation applies.

The *DNSP* and every *Distribution Network User* shall at all times have nominated a person or persons to be responsible for the co-ordination of safety pursuant to this *KNDGC*, those persons being referred to in this *KNDGC* as Control Persons. (Under the conditions of the *DNSP*'s Safety Rules a Control Person may either be at the *DNSP*'s *Regional Control Centre* or be a person authorised who is at the site or location of the *Connection Point.*)

7.11.5.2. Procedures

The *DNSP* and a *Distribution Network User* relating to the place where Safety Precautions are required to contact each other to coordinate the Safety Precautions and the persons responsible to assure the precautions are followed and to ensure that only one person is responsible for any item of Plant and Apparatus at any one time. The operational procedures shall be in accordance with the Safety Management System agreed between the *DNSP* and the *Distribution Network User*(s).

7.11.5.3. System of Documentation

A system of documentation shall be maintained by the *DNSP* and the appropriate *Distribution Network User*s which will record the inter-system Safety Precautions taken when:

(a) Work and/or testing is to be carried out on MV Plant and/or Apparatus across the *Connection Point*.

(b) Isolation and/or earthing of the other's System is required.

Where relevant, copies of the Safety Management Systems and related documentation shall be exchanged between the *DNSP* and *Distribution Network User*s prior to performing work at a *Connection Point.*

The *DNSP* and *Distribution Network User*s shall maintain a suitable system of documentation which records all relevant operational events that have taken place on the *Distribution System* or any other System connected to it and the co-ordination of relevant Safety Precautions for work.

All documentation relevant to the Operation of the *Distribution System*, and Safety Precautions taken for work or tests, shall be held by the *DNSP* and the appropriate *Distribution Network User* for a period of not less than one year.

7.11.5.4. Safety Precautions

The establishment of Safety Precautions involves:

(a) The isolation from the remainder of the System of Plant and/or Apparatus, including from Low Voltage back feeds, either by an Isolating Device in the isolating position and immobilised and locked or by other means of rendering the Plant or Apparatus Isolated, and/or;

(b) The earthing by way of providing a connection between a conductor and earth by using an earthing device which is applied and where reasonably practicable, immobilised and locked, the extent of the Safety Precautions required being determined pursuant to this *KNDGC*.

(c) Safety equipment for wind and solar turbines shall include:

(i) Manual disconnect switches

(ii) Earthing systems

(iii) Shutoff devices. IEC 61400-24:2010 shall be followed for earthing of wind turbine generators. IEC 61730 shall be followed for PV modules.

7.11.6. Environmental Safety

Site Safety and Security Arrangements shall be made by the *DNSP* and *Distribution Network User*s to ensure site safety and security.

Suitable arrangements shall be agreed between the *DNSP* and the relevant *Distribution Network User*s to provide free and unrestricted access to the *DNSP*'s Plant and Apparatus at substations or similar by the *DNSP*'s personnel or their designated representatives at all times.

Suitable arrangements shall be made by the *DNSP* and/or the relevant *Distribution Network User*s to ensure that personnel are warned by an appropriate means of hazards specific to any site, before entering any area of the site. This shall include hazards that may be temporary or permanent. Where these risks include contamination or similar, suitable decontamination facilities and procedures shall be provided.

7.12 SECURITY OF DISTRIBUTION SYSTEMS

7.12.1. Energy Act Requirements

Sections 168 and 169 of the *Energy Act*, 2019 impose stiffer penalties to those persons found:

(a) Illegal tapping of distribution power lines

(b) Vandalising, or found to be in possession of vandalised power equipment.

7.12.2. Electric Facility Theft and Vandalism Deterrent Programme

In order to reduce the risk of serious injury, system interruptions and commercial losses that occur on the *Kenya National Distribution System*s, the *DNSP* shall develop and implement an Electric Facility Theft and Vandalism Deterrent Programme that establishes plans and procedures for the ongoing monitoring and enforcement with a goal of reducing the losses suffered by these illegal practices.

7.12.2.1. Performance Measures

The effectiveness of the Deterrent Programme will be measured through the *Distribution System* Losses Performance Indicator described in System Performance Indicators of the *KNDGC*.

7.12.2.2. Reporting Requirements

The *DNSP*s will submit a report to the *Authority* annually describing the plans and procedures implemented in the previous year and the results of those efforts. This will include the following metrics:

(a) Number of Interruptions Caused by Theft or Vandalism of Electric Distribution Facilities;

(b) Percentage of Commercial Losses

7.13 OPERATIONAL LIAISON

7.13.1. Introduction

This section sets out the requirements for the exchange of information in relation to Operations and/or Incidents on the *Distribution System* or the system of any *Distribution Network User* connected to the *Distribution System* which have had or may have an operational effect on the *Distribution System* or the system of any other *Distribution Network User*.

This section applies to the *DNSP and* to the following *Distribution Network Users*:

(a) Any other *DNSP* connected to the *Distribution System*

(b) Medium and High Voltage *Distribution Network User*s

(c) *Generating Plant*s connected to the *Distribution System* at LV and rated above 50kW.

7.13.2. Procedures

The *DNSP* and each Large *Distribution Network User* (greater than 2 MVA) will identify contact individuals in the appropriate organizations and agree on communication channels to make effective the exchange of information required by this section. In order to ensure reliability and safety, the DNSP may request additional *Distribution Network Users*, meeting the criteria listed above (7.13.1), to do the same.

Communication should, as far as practicable, be direct between the *Distribution Network User* and the *DNSP*.

Any communication from the *DNSP* and the *Distribution Network User* utilising the agreed communication channels, including telephone communications, should be considered to be acknowledged by the *Distribution Network User*.

7.13.2.1. Contact List

A list of duly *Authorised Personnel* and their telephone numbers and full contact information shall be exchanged between the *DNSP* and the *Distribution Network User* so that control activities can be efficiently coordinated. The *DNSP* and the *Distribution Network User* shall maintain 24-hour availability for these duly *Authorised Personnel* when necessary.

In the case of an operation on the System of a *Distribution Network User* connected to the *Distribution System*, which will have or may have an operational effect on the *Distribution System*, the *Distribution Network User* will notify the *DNSP* in accordance with the procedures established in this section.

7.13.2.2. Notification

In the case of an operation on the *Distribution System* or on receipt of notification of an operation on the Transmission System which will have, or had, an operational effect on the *Distribution*

Network Users connected to the *Distribution System*, the *DNSP* will notify the affected *Distribution Network User*s.

The following are examples of situations where, in as much as they may have or have had an effect on the Operation of the *Distribution System* or another System, notification will be required:

(a) The implementation of a scheduled outage of lines and/or equipment which has been arranged;

(b) The operation of any Circuit Breaker, Recloser or Sectionaliser or any sequence or combination of the two including any temporary overstressing, system parallels, or *Generating Plant* synchronising; and

(c) Voltage and Demand control.

7.13.3. Form of Notification

The notification will be of sufficient detail to enable the recipient of the notification reasonably to consider and assess the implications and consequences arising from the operation on the *Distribution System* and will include the name of the individual reporting the operation on behalf of the *DNSP*.

7.14 INFORMATION FLOW AND COORDINATION

7.14.1. Responsibility

The *DNSP* and *Distribution Network User*s shall jointly agree in writing, specifying the responsibilities for System Control of Equipment. These shall ensure that only one party is responsible for any item of Plant or Apparatus at any one time.

Pursuant to the Distribution Planning and Connection Chapters, descriptions of site responsibilities specifying the responsibilities for ownership, operation and maintenance shall be jointly agreed by the *DNSP* and the appropriate *Distribution Network User*(s) for each site or location where a *Connection Point* or joint responsibility exists. This will include electrical equipment diagrams illustrating sufficient information for Control Persons to carry out their duties which shall be exchanged by the *DNSP* and the appropriate *Distribution Network User*.

A copy of the descriptions of site responsibilities and electrical equipment diagrams shall be retained as part of the *Connection Agreement* by the *DNSP* and the appropriate *Distribution Network User*(s), and shall be maintained by the *DNSP* and the appropriate *Distribution Network User*(s) and exchanged as necessary to ensure that they reflect the current agreements.

7.14.2. Communications

Where the *DNSP* reasonably specifies the need, suitable communication systems shall be established between the *DNSP* and other *Distribution Network User*s to ensure the control function is carried out in a safe and secure manner. Where the *DNSP* reasonably decides a backup or alternative routing of communication is necessary to provide for the safe and secure operation of the *Distribution System* the means shall be agreed with the appropriate *Distribution Network User*s. Schedules of telephone numbers shall be exchanged by the *DNSP* and appropriate *Distribution Network User* to enable control activities to be efficiently co-ordinated.

The *DNSP* and appropriate *Distribution Network User*s will establish 24-hour availability of *Authorised Personnel* via established communications channels.

7.14.3. Outage Coordination

7.14.3.1. Distribution Network Users Connected at Medium and High Voltage

For those *Distribution Network User*s connected at Medium or High Voltage and where the *Distribution Network User* so requests to the *DNSP*, these schedules shall identify those circuits on which Planned Outages by the *DNSP* shall be notified to the *Distribution Network User*. These specified circuits will be those where the *DNSP* and the *Distribution Network User* have agreed that during outages of the specified circuits the *Distribution Network User* can introduce measures to manage critical processes or safety aspects. These specified circuits will usually have a significant effect on the security level of the *Distribution Network User*'s supply.

7.14.3.2. All other Distribution Network Users

*DNSP*s shall establish a comprehensive programme for the notification and updating of the status of outages affecting *Customers*.

7.14.4. Significant Incident and Accident Reporting

7.14.4.1. Introduction

Where an incident on the *Distribution System* has had a significant effect on the System, the incident shall be reported in writing to the *DNSP* of the affected system. This incident will be termed a "Significant Incident". Information regarding the occurrence of Significant Incidents shall be reported to the *Authority* in writing, in the form and manner prescribed by the *Authority*, of any accident or incident causing loss of life, personal injury, major outages and loss of load, or any other accident or incident causing significant harm or damage to the environment or property.

This section sets out the requirements for reporting in writing those Incidents termed "Significant Incidents" which were initially reported verbally and those specified Incidents to be reported under the request of the *Authority*. It also provides for the joint investigation of Significant Incidents by the *Distribution Network User*s involved.

7.14.4.2. Incident Reporting

When it has been determined that a Significant Incident has occurred, a written report will be given to the *DNSP* by the *Distribution Network User* in accordance with this section. The *DNSP* will not pass this report on to other affected *Distribution Network User*s but may use the information contained therein in preparing a report to a *Distribution Network User* in relation to a Significant Incident on the *Distribution System* which has been caused by (or exacerbated by) the Significant Incident on the *Distribution Network User* System.

A report will be in writing and shall contain written confirmation of the verbal notification given together with more details relating to the Significant Incident. The report should, at a minimum, contain following information, which is not intended to be exhaustive:

(a) Date and time of Significant Incident;

(b) Location;

(c) Apparatus involved;

(d) Brief description of Significant Incident;

(e) Duration of incident;

(f) Estimated date and time of return to normal service, and

(g) Details of any Demand Control undertaken.

7.14.4.3. Joint Investigation of Significant Incidents

Where a Significant Incident has been declared and a report submitted, either party or parties may request in writing that a joint investigation be carried out.

The composition of such an investigation panel will be appropriate to the Incident to be investigated and agreed by all parties involved.

Where there has been a series of Significant Incidents (that is to say, where a Significant Incident has caused or exacerbated another Significant Incident) the parties involved may agree that the joint investigation should include some or all of those Significant Incidents.

A joint investigation will only take place where all parties affected by a Significant Incident agree to it. The form and rules of the procedure for, and all matters relating to, the joint investigation will be agreed at the time of a joint investigation and in the absence of agreement, the joint investigation will take place.

Any joint investigation occurs only when both parties agree. The joint investigation shall form part of any dispute resolution procedure.

7.14.4.4. Report to the Authority

The *DNSP* shall submit a written report to the *Authority* detailing all the information, findings, and recommendations regarding the *Distribution System* Incident. The following minimum information shall be included in the written report following the joint investigation of the Significant Incident:

(a) Time and date of the Significant Incident;

(b) Location of the Significant Incident;

(c) Equipment directly involved and not merely affected by the Event;

(d) Description of the Significant Incident; and

(e) Demand (in MW) and generation (in MW) interrupted and the duration of the Interruption.

The *Authority* shall have the right to request any information and explanations that it reasonably sees fit about any incident, significant incident or event.

7.15 GENERATING PLANTS AND ENERGY STORAGE SYSTEMS CAPABILITY TESTS

7.15.1. Test Requirements

Tests shall be conducted on *Generating Plants and Energy Storage Systems* connected to the *Distribution System,* in accordance with procedures and standards specified by the *DNSP* (or the *Regional Control Centre,* where applicable), to confirm compliance with the *KNDGC* and/or the *KNTGC* for the following:

(a) Capability of *Generating Plants and Energy Storage Systems* to operate within their registered Generation parameters;

(b) Capability of the *Generating Plants and Energy Storage Systems* to meet the applicable requirements of the *KNTGC* and the *KNDGC;*

(c) Capability to deliver any *Ancillary Services* that the *Generation or Energy Storage Systems Licensee* has agreed to provide; and

(d) Availability of *Generating Plants and Energy Storage Systems* in accordance with their capability declaration.

All tests shall be recorded and witnessed by representatives of the *DNSP* and the *Generation or Energy Storage Systems Licensee.*

The *Generation or Energy Storage Systems Licensee* shall demonstrate to the *DNSP* (or the *System Operator* where applicable), the fitness for purpose and accuracy of the test instruments to be used in the test.

The *DNSP* (or the *System Operator*, where applicable) may at any time issue instructions requiring tests to be carried out on any *Generating Plant or Energy Storage System connected* to the *Distribution System*. All tests shall be of sufficient duration and shall be conducted no more than twice a year except when there are reasonable earths to justify further tests.

If a *Generating Plant or Energy Storage System* connected to the *Distribution System* fails the test, the *Generation Licensee* shall correct the deficiency within a period agreed with the *DNSP* (or the *System Operator* where applicable) to attain the relevant registered parameters for that *Generating Plant or Energy Storage System*.

Once the *Generation or Energy Storage System Licensee* achieves the registered parameters of its *Generating Plant* that previously failed the test, it shall immediately notify the *DNSP* (or the *System Operator* where applicable). The *DNSP* (or the *System Operator* where applicable) shall then require the *Generation or Energy Storage System Licensee* to conduct a retest in order to demonstrate that the appropriate parameter has already been restored to its registered value.

If a dispute arises relating to the failure of a *Generating Plant or Energy Storage System* to pass a given test, the *DNSP* (or the *System Operator* where applicable), the *Generation or Energy Storage System Licensee*, and/or *Distribution Network User* shall seek to resolve the dispute according to the provisions in Section 3.11 of the *KNDGC*.

7.15.2. Tests to be Performed

A *Generating Plant*'s or *Energy Storage System* production of Reactive Power shall be subject to the agreement with the *DNSP* and *KNDGC* compliance (where applicable).

The Reactive Power test shall demonstrate that the *Energy Storage System or Generating Plant* meets the registered Reactive Power Capability requirements specified in the *KNDGC*'s Performance Standards. The *Energy Storage System or Generating Plant* shall pass the test if the measured values are within ±5 percent of the capability as registered with the *System Operator* (where applicable) and the *DNSP*.

The Voltage Control test shall verify, for a simulated voltage step, the reactive power response. Reactive power shall settle to the new value within 2% of the rated nameplate MW capacity of the power plant. Both the rise time t1 and the settling time t2 shall be complied with, with no tolerance.

The Black Start test shall demonstrate that the *Energy Storage System or Generating Plant* with Black Start capability can implement a Black Start procedure, as specified in the *Connection Agreement*. To pass the test, the *Energy Storage System or Generating Plant* shall start on its own, synchronise and carry load without the need for external power supply.

The Declared Data capability test shall demonstrate that the *Energy Storage System or Generating Plant* can be scheduled and dispatched in accordance with the Declared Data. To pass the test, the *Energy Storage System or Generating Plant* shall satisfy the ability to achieve the Declared Data.

The Dispatch accuracy test shall demonstrate that the *Energy Storage System or Generating Plant* meets the relevant Generation Scheduling and Dispatch Parameters. The *Energy Storage System or Generating Plant* shall pass the test if:

(a) In the case of synchronisation, the process is achieved within ±5 minutes of the registered synchronisation time;

(b) In the case of synchronising generation (if registered as a Generation Scheduling and Dispatch Parameters), the synchronising generation achieved is within an error level equivalent to 2.5% of Declared Net Capacity;

(c) In the case of meeting ramp rates, the actual ramp rate is within ±10% of the registered ramp rate;

(d) In the case of meeting Load reduction rates, the actual Load reduction rate is within ±10% of the registered Load reduction rate; and

(e) In the case of all other Generation Scheduling and Dispatch Parameters, values are within ±1.5% of the declared values.

The *Frequency Control test* shall verify, for a simulated frequency step, the active power response of the *Energy Storage System or Generating Plant*. Active power shall settle to the new value within 4% of the rated nameplate MW capacity, with rise time less than 2 seconds and settling time less than 5 seconds.

The *Ancillary Services* test, as specified by the *DNSP* or the *System Operator* where applicable, shall demonstrate the services in terms of quantity, quality and operational requirements. *Energy Storage System or Generating Plant*s providing *Ancillary Services* shall conduct the tests and the *DNSP* (or the *System Operator*, where applicable) shall have the right to witness the tests.

7.16 FACILITY AND EQUIPMENT IDENTIFICATION

7.16.1. Site and Equipment Identification Requirements

The *DNSP* shall develop and establish a standard System for Site and Equipment Identification to be used in identifying any Site or Equipment in all Electrical Diagrams, distribution operation instructions, notices, and other documents.

The identification for the Site shall include and be unique for each substation and switchyard where a *Connection Point* is located.

The identification for Equipment shall be unique for each transformer, distribution line, bus, circuit breaker, disconnect switch, earthing switch, *Capacitor Bank*, reactor, lightning arrester, and other MV equipment at the *Connection Point*.

7.16.2. Site and Equipment Identification Label

The *DNSP* shall develop and establish a standard labelling nomenclature, which specifies the dimension, sizes of characters, and colours of labels, to identify the Sites and Equipment.

7.16.3. Signage and Labelling

The *DNSP* and the *Distribution Network User* shall be responsible for the provision and installation of a clear and unambiguous label showing the Site and Equipment Identification for their respective System

8 METERING

8.1 PURPOSE AND SCOPE

8.1.1. Purpose

The purpose of this Distribution Metering Chapter is:

(a) To specify the technical and operational criteria, including the procedures to be complied with by the *Distribution Network Service Provider* in carrying out its obligation to provide metering services to *Distribution Network Users* at each Metering Point.

(b) To specify the ownership of the metering equipment for *Generation Licensees.*

Appendix B provides a complete list of standards that shall apply to *Metering Equipment*.

8.1.2. Applicability

The Distribution Metering Chapter applies to the following:

(a) *DNSP*s

(b) *Distribution Network User*s connected to or seeking connection to, the *Distribution System*.

(c) *Generating Plants connected* to the *Distribution System*.

The DNSP shall:

(a) Own, install, verify, operate, maintain, inspect and replace all Metering Systems at Metering Points on the *Distribution System*, except Metering Systems situated at *Connection Points to* the *Transmission System* and at *Embedded Generators.*

(b) Ensure that each Metering System installed on its *Distribution System* meets the performance, functional and technical requirements set out in this Distribution Metering Code;

(c) Ensure that each Metering System installed on its *Distribution System* is certified where so required by the *Authority*, is in working condition and has been tested for accuracy;

(d) Retrieve data from each Metering System installed on its *Distribution System* for the purposes of billing and settlement;

(e) Process data retrieved from each Metering System installed on its *Distribution System* for the purposes of billing and settlement; and

(f) Shall notify the *Authority* of all Metering Systems where the *DNSP* cannot comply with the Distribution Metering requirements.

(g) Fully implement Net Metering systems, as appropriate.

Generation Licensees shall:

(a) In accordance with *Prudent Utility Practice*, supply and install, test and Commission the *Main Metering* equipment and the *Check Metering*.

(b) Thereafter, the *Generation Licensee* shall transfer to the *DNSP* as beneficial owner (and without any encumbrances) all rights, title and interest in the *Check Metering* equipment (together with all warranties and guarantees applicable thereto) and;

(c) Upon such transfer the *DNSP* shall own and maintain the *Check Metering* equipment while the *Generation Licensee* shall own and maintain the *Main Metering* Equipment.

8.2 OBLIGATIONS

8.2.1. Installation and Replacement of Metering Equipment

The installation of *Metering Equipment* shall be in accordance with the technical requirements of the *DNSP*.

The *DNSP* may replace *Metering Equipment* for which it is responsible at any time after it has been installed, subject to the provisions of this *KNDGC*. The *DNSP* shall notify the *Distribution Network User* in advance of any replacement, unless that replacement is required due to an urgent condition.

The *DNSP* shall:

(a) Assign a unique identifier to the Metering System, cross-referenced to the location of the Metering System;

(b) Record the date of installation of the Metering System;

(c) Record the functionality of the Meter and the unit of measurement used to measure energy flowing through the Metering System or Maximum Load, as it corresponds;

(d) Record the identification of the ancillary equipment;

(e) Record any site-specific loss adjustment factors to be applied;

(f) Record redundancy details and sources of *Check Metering* data and identification of the meters designated as the *Main Meter* and as the *Check Meter*; and

(g) Record the initial Meter register reading;

(h) Ensure that the metering data stored in the Metering System is retrieved and, where a meter is removed, shall ensure that a final Meter reading is obtained.

The *DNSP* shall maintain the following information for each Metering System:

(a) Location of the Metering System;

(b) A record of any malfunction of the Metering System including any test results and of repairs made to the Metering System; and

(c) Documentation of Meter testing prior to installation.

The *DNSP* shall, on request, make the information available for each Metering System to:

(a) The *Distribution Network User*;

(b) The *Authority*.

8.3 STANDARD METERING SYSTEMS

Each Metering Point shall be situated as close as is reasonably practicable to the relevant *Connection Point*.

Prior to the installation of any *Meter* or *Current Transformers* and *Voltage Transformers* that form part of a *Metering System*, such *Metering Equipment* shall be:

(a) Submitted by the *DNSP* to a laboratory for testing and certification; or

(b) Received by the *DNSP* directly from a manufacturer with a test certificate endorsed by an independent laboratory.

Copies of all test certificates shall be retained by the *DNSP* for the Metering Equipment that is in service and for Metering Equipment that is no longer in use for a minimum period of six (6) years. The *DNSP* shall produce these certificates upon notice from the *Authority*.

No Metering equipment shall be certified unless the *DNSP* has received the relevant test certificates from the relevant accredited laboratory or manufacturer.

8.3.1. Standard Medium Voltage Metering Systems

(a) Shall contain a Meter or more than one Meter, each of which complies with the *KNDGC* Metering standards;

(b) Shall record Active Energy (kWh);

(c) Shall record Reactive Energy (kvarh);

(d) Shall record Maximum Load in the cases the applicable tariffs specify that; and

(e) Shall have metering *Current* and *Voltage Transformers* that are tested and certified.

The rated short-duration current rating shall not be less than:

(a) 25kA for 3 seconds for MV Metering Points above 6.6kV; or

(b) 20kA for 3 seconds for MV Metering Points at 6.6kV and below.

For each circuit, metering *Voltage Transformers* of accuracy class 1.0 with 110volts secondary voltage and 100VA burden per phase for star-star connection or 180VA burden per phase for ‘V’ connection shall be provided.

8.3.2. Standard Low Voltage Metering Systems

(a) Shall contain a Meter or more than one Meter, each of which complies with the *KNDGC* Metering standards, being either 1-phase, 2-wire or 3-phase, 4-wire type of accuracy class 2.0 and metering *Current Transformers*, where applicable, of accuracy class 0.5 with 5 amperes secondary current and 5VA burden.;

(b) Shall record Active Energy (kWh);

(c) May record Reactive Energy (kvarh);

(d) Shall record Maximum Load in the cases the applicable tariffs specify that;

(e) Shall contain, where necessary, metering *Current Transformer*(s) provided by the *DNSP* that are tested and certified; and

Shall contain a suitable facility (including all necessary pre-wiring), as specified by the *DNSP* (installed by the *Customer*, or provided and installed by the *DNSP* and costs borne by the *Customer*) in which to house the Metering System.

8.4 ALTERNATIVES TO STANDARD METERING SYSTEMS

Upon the request of a *Distribution Network User*, the *DNSP* may arrange for a Metering System to install a *Check Meter*, or to contain features or equipment in addition to those specified in this Distribution Metering Chapter, provided that:

(a) The *Distribution Network User* agrees to pay the full costs of the additional features or equipment, including the costs of installation, operation, maintenance, repairs and replacement; and

(b) The additional features or equipment are compatible with the rest of the Metering System and do not lead to any degradation of the capability of the Metering System that would cause the Metering System to fail to meet any standards contained in this *KNDGC*.

8.5 FAULTY METERING EQUIPMENT

A Metering System shall be considered faulty if it is determined that any part of that Metering System does not comply with the *KNDGC* Metering standards.

If a Metering System fault occurs, the *DNSP* shall repair or replace the Metering System as soon as is reasonably practicable and in any event within two (2) working days of the *DNSP* discovering that the fault exists.

The *Distribution Network User* shall use Metering Equipment in a safe and prudent manner and shall take due care to avoid damage. The *Distribution Network User* shall notify the *DNSP* of any damage to the Metering Equipment, however caused.

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

The *DNSP* shall record all relevant Meter parameters for a replacement Meter in that Metering System.

8.6 TECHNICAL REQUIREMENTS AND ACCURACY OF METERS

The *DNSP* shall ensure that the accuracy of each Meter in each Metering System is certified by an accredited Meter test laboratory and meets the applicable accuracy limits.

The limits of accuracy for the following classes of Meters shall be:

(a) ± 0.2% for class 0.2 S static watt-hour meters.

(b) ± 0.5% for class 0.5 S static watt-hour meters.

(c) ± 0.5% for class 0.5 watt-hour meters.

(d) ± 1.0% for class 1.0 watt-hour meters.

(e) ± 2.0% for class 2.0 watt-hour meters.

In the event of non-compliance with the required standards, the *DNSP* shall ensure that the accuracy of any Meter in that Metering System is restored to comply with the accuracy standards as soon as is reasonably practicable.

The *DNSP* shall maintain certification records and test results relating to the accuracy class and compliance with the relevant standards for the particular type and model of Meter in that Metering System.

The *DNSP* shall maintain records of the information referred to in this section for each Metering System, either in use or no longer in use, for at least six (6) years and shall produce these records when required by the *Authority*.

8.7 AUDIT AND INSTALLATION TESTS

The *DNSP* shall ensure that each Metering System is inspected according to the minimum frequencies specified:

(a) Medium Voltage: Once every year

(b) Low Voltage, including prepayment: Once every 3 years

The *DNSP* may carry out periodic, random and unannounced inspection and or testing of any Metering System and associated data for the purpose of ascertaining whether the Metering System complies with the requirements of this *KNDGC*. The *Distribution Network User* may request the *DNSP* to carry out such inspection and or testing, provided that the *Distribution Network User* pays the cost, unless an error or malfunction not caused by the *Distribution Network User* is discovered.

In addition, the *Authority* may carry out its own unannounced inspection and or test, in which case the *Distribution Network User* shall grant access to the *Authority*.

The *DNSP* shall, as soon as practicable, make the results of any inspection and or tests conducted pursuant to this section available to the requesting party and to the *Distribution Network User* owning a *Meter* at the *User's Connection Point* that is part of the Metering System.

8.8 ACCESS TO METERING SYSTEMS

The *Distribution Network User* shall grant access to the *DNSP* to enable the *DNSP* to fulfil its obligations. This right of access is conditional upon:

(a) Where practicable, prior notice by the *DNSP*; and

(b) The production of identification by the *DNSP*'s staff or contractor.

Prior arrangement by the *DNSP* shall not be required in respect of routine *Meter* reading or periodic, random and unannounced audits or when the *DNSP* is performing emergency metering repairs.

8.9 SECURITY OF METERING SYSTEMS

8.9.1. Energy Act

Sections 168 and 169 of the Energy Act impose penalties to those persons found;

(a) Illegal tapping of distribution power lines.

(b) Tampering with electric metering systems to illegally divert electric energy.

(c) Vandalising, or in possession of vandalised, power equipment.

8.9.2. Energy Diversion Programme

In order to reduce the risk of serious injury, system interruptions and commercial losses on the *Distribution System*, the *DNSP* shall develop and implement an Energy Diversion Programme that establishes plans for the ongoing monitoring and enforcement procedures.

8.9.2.1. Performance Measures

The effectiveness of the Deterrent Programme will be measured through the *Distribution System* Losses Performance Indicator described in this *KNDGC*.

8.9.2.2. Reporting Requirements

The *DNSP*s will submit a report to the *Authority* annually describing the plans and procedures implemented in the previous year and the results of those efforts. This will include the following metrics:

(a) Number of Energy Diversion Cases Identified and Addressed.

(b) Percentage of Commercial System Losses.

8.9.3. Meter Sealing

Appropriate seals shall be applied to each Metering System. Seals shall be replaced following work requiring the removal of any seals. The *DNSP* shall have procedures for the control of seals and sealing pliers.

The *DNSP* shall, so far as is reasonably practicable, ensure that physical access to each Meter contained in each Metering System is protected by:

(a) Sealing all associated links, circuits, data storage and data processing systems;

(b) Ensuring that the Metering System meets the requirements for the security of Metering Systems;

8.9.4. Meter Data

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

8.10 METER READING

The *DNSP* shall schedule a monthly reading for all manually read meters.

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

The *DNSP* shall record:

(a) The Meter identification number;

(b) The Meter reading and read date at the beginning of the Meter reading period;

(c) The Meter reading and read date at the end of the Meter reading period;

(d) The cumulative Active Energy (kWh) recorded during the Meter reading period;

(e) Where the *Distribution Network User* is billed for Reactive Energy, the cumulative Reactive Energy (kvarh) recorded during the Meter reading period;

(f) Where the *Distribution Network User* is billed for maximum Active Power, the maximum Active Power recorded during the Meter reading period;

(g) Where the *Distribution Network User* is billed for maximum Reactive Power, the maximum Reactive Power recorded during the Meter reading period; and

(h) Details of any Meter alarms that were recorded during the period (e.g., system outages, VT failure).

8.11 REMOTE METERING EQUIPMENT

The *DNSP* shall specify the type of equipment to be used for communication with remote meters.

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

8.12 DATA MANAGEMENT

The *DNSP* shall:

(a) Maintain a metering data registry that contains usage data for each *Distribution Network User* and data required for settlement purposes in respect of each Metering System;

(b) Validate metering data for each Metering System;

(c) Estimate usage when Meter readings are not available, inaccurate, or otherwise not suitable for settlement purposes;

(d) Apply adjustments to metering data to account for system losses and unaccounted for energy;

(e) Aggregate metering data for settlement and loss calculation purposes; and

(f) Use reasonable endeavours to maintain the security and confidentiality of the metering data.

8.13 DATA REGISTRATION

The *DNSP* shall establish and maintain a register that contains the following information for each Metering System:

(a) A unique identifier assigned by the *DNSP* to the Metering System cross-referenced to the location of the Metering System and cross referenced to the *Distribution Network User*'s account;

(b) The date of installation of the Metering System;

(c) The functionality of the Meter and the unit of measurement used to measure Energy flowing through the Metering System (e.g., kWh meter, kvarh meter);

(d) Identification of the ancillary equipment;

(e) Any site-specific adjustment factors to be applied, including a cross reference to the unique identifier specified in (a) above;

(f) The existence of redundancy and sources of *Check Metering* data, where required by this Distribution Metering Code, and identification of the meters designated as the *Main Meter* and as the *Check Meter;*

(g) Data for each Meter following completion of the validation and estimation procedures;

(h) Billing data for each Meter following completion of adjustments for losses and unaccounted for energy; and

(i) The data covering a period of not less than twelve months which shall be immediately accessible in electronic form.

8.14 DATA VALIDATION AND LOSS ADJUSTMENT FACTORS

The *DNSP* shall:

(a) Have in place data validation procedures and loss adjustment calculation methodologies;

(b) Where necessary, determine site-specific loss adjustment factors for each Metering System;

(c) Multiply each valid reading by the appropriate loss adjustment factor to produce loss adjusted production or consumption; and

(d) Shall maintain both unadjusted and loss-adjusted values in the metering data registry in respect of each Metering System.

8.15 METERING DISPUTES

If the *DNSP* receives a complaint about the accuracy of metering data or the calculation of any substitute or estimated metering data from a *Distribution Network User*, the *DNSP* shall investigate the complaint. The investigation shall include a review of all available information, including any information supplied by the *Distribution Network User*. If the *DNSP* determines that there is an inaccuracy due to *Meter* error, malfunction or error in the metering data, the *DNSP* shall take appropriate steps to remedy the defect, including repair or replacement of equipment and adjustment of metering data. The owner of the *Meter* is responsible for replacement costs. Appropriate adjustments shall also be made to the *Distribution Network User*'s bill. In the event of a *Dispute*, the *Dispute* shall be settled using the procedure specified in Section 3.11 of the *KNDGC*.

9 PERFORMANCE STANDARDS

9.1 PURPOSE

These Distribution Performance Standards establish the rules, procedures, requirements and indicators for the technical and operational performance of the *Kenya National Distribution System* and for the commercial performance of the retail business.

9.2 APPLICABILITY

The Distribution Performance Standards apply to:

(a) *Distribution Network Service Provider*s;

(b) *Distribution Network Users* including *Customers*

9.3 OBJECTIVES

The objectives of these Distribution Performance Standards are:

(a) To ensure the quality of electric power in the *Distribution System*;

(b) To ensure that the *Distribution System* will be operated in a safe and efficient manner and with a high degree of reliability

(c) To specify *Customer* Services for the protection of the *Customer*; and

(d) To ensure that the voltage at the *Connection Point* of a *Customer* or *Distribution Network User* is adequate for the normal operation of equipment and appliances.

9.4 CONFIDENTIALITY

Unless otherwise specifically stated in these Performance Standards, the *Authority* shall be at liberty to publish the Performance Indicators and performance results of each *DNSP* or *Licensee* to whom this Performance Standards applies.

9.5 SUPPLY QUALITY STANDARDS (RELIABILITY OF SUPPLY)

9.5.1. Rural and Urban Customers

*Customer*s of the *DNSP* shall be classified either as Urban *Customer*s or Rural *Customer*s, according with the definition stated in the *Glossary and Definitions*.

9.5.1.1. Request for Rural Area Designation

When a *DNSP* considers that due to topological reasons and/or scattering of population on a specific town or village although with more than 3,500 *Customer*s, the town or village may be considered to be a rural area. If so proposed, the issue shall be brought to the *Authority*, together

with adequate supporting documentation, including maps or drawings as considered suitable, requesting authorisation to consider these *Customer*s as *Rural Customer*s.

The *Authority* will evaluate the submitted documentation, conduct independent analysis or studies that can include meetings or hearings with the involved *Customer*s and/or representative institutions. Based on these analyses or studies, the *Authority* may grant an authorisation for a specific town or village, or part of a town or village to be considered as rural, and the *Customer*s located in that zone to be considered as Rural *Customer*s.

9.5.2. Types of Interruptions

Supply quality will be expressed as a function of the Interruptions to *Customer*s and will be evaluated using indicators that measure the number of Interruptions and their duration.

Interruptions will be classified according to the affected *Customer* as:

(a) Interruptions to *Rural Customers*; and

(b) Interruptions to *Urban Customers*

For Rural and Urban Customers, Interruptions will be further classified according to type and origin as:

(a) Scheduled Interruptions

(b) Unscheduled Interruptions

(c) External Supply Interruptions, both scheduled and unscheduled; and

(d) Third Party Interruptions

9.5.3. Interruption Register Requirements

Each *DNSP* is obliged to have a detailed chronological register of all Interruptions that impact their *Customer*s, with clear identification of start and end date and time. The information in this register shall be maintained by the *DNSP* for at least a five (5) year calendar cycle.

9.5.3.1. Interruption Start Time

An Interruption start time shall be calculated as:

(a) For a Scheduled Interruption: the time that the first impacted *Customer's* power is interrupted;

(b) For an Unscheduled Interruption, whichever of the following occurs first:

(i) The time the SCADA system detects and reports an operation that drops load; or

(ii) The time when the first *Customer* call was received to report the outage to the *DNSP*; or

(iii) The time the *DNSP* has knowledge of the situation by any other means.

9.5.3.2. Interruption Ending Time

In the register, the ending date and time of an Interruption shall be the time when service was restored to the *Customer*(s).

9.5.3.3. Interruption Time Uniformity

The DNSP shall implement a system and procedures to ensure time uniformity among all the offices and locations that are involved in assigning times to the Interruptions.

9.5.3.4. Customer Outage Notification

To ensure adequate timing of Customer complaints upon an Interruption, the DNSP shall assure the availability of sufficient telephone lines and operators to attend Customers´ incoming calls.

9.5.3.5. Special Cases

The following Interruptions will not be considered for the calculation of *Distribution System* Service Quality indicators:

(a) Momentary Interruptions (less than 3 minutes in duration)

(b) *Force Majeure* Interruptions

(c) Interruptions due to authorised disconnection of a *Customer* due to non-payment

(d) Interruptions due to disconnection for illegal diversion of electricity or meter tampering

9.5.3.6. Performance Indicator Calculation

For the calculation of the supply quality Performance Indicators:

(a) Emergency maintenance Interruptions shall be considered Unscheduled Interruptions;

(b) When, due to protection malfunctioning, a fault in a facility owned by a *DNSP* is not correctly cleared by equipment under the responsibility of the *TNSP* or of another *DNSP*, all Interruptions to *Customer*s of the *DNSP* in excess of those strictly necessary will be classified as External Interruptions.

The Interruptions affecting a *Customer* whose facilities are the source of the event will not be considered for the calculation of supply quality of such *Customer*. When such Interruption also causes an Interruption to another *Customer*, the Interruption to the other *Customer*s will be classified as Unscheduled Interruption for the calculation of Performance Indicators.

9.5.4. Performance Indicators

The same type of Performance Indicators will be applicable to all *DNSP*s.

9.5.5. Supply Quality Performance Indicator Types

Supply quality of each *DNSP* will be assessed through two types of Performance Indicators:

(a) *Customer* Performance Indicators

(b) System Performance Indicators

9.5.5.1. Customer Performance Indicators

The *Customer* Performance Indicators to measure supply quality of individual Customers will be:

(a) Total number of Scheduled Interruptions per calendar year

(b) Total number of Unscheduled Interruptions per calendar year

(c) Total number of External Interruptions per calendar year

(d) Total duration of Scheduled Interruptions per calendar year

(e) Total duration of Unscheduled Interruptions per calendar year

(f) Total duration of External Interruptions per calendar year

9.5.5.2. System Performance Indicators

The Overall Performance Indicators to measure average supply quality of a *DNSP* will be the following, per IEEE Standard 1366.

(a) System Average Interruption Duration Indicator (SAIDI): the total time an average *Customer* has been interrupted during a pre-specified period.

(b) System Average Interruption Frequency Indicator (SAIFI): the number of times an average *Customer* has been out of service during a pre-specified period.

(c) System Average Momentary Interruptions Frequency Indicator (MAIFI): the total number of times an average *Customer* has experienced an Interruption during a pre-specified period.

(d) Customer Average Interruption Duration Index (CAIDI): the average outage duration that any given Customer would experience, measured in units of time.

All Performance Indicators, except for MAIFI, will be calculated and differentiated by:

(a) Scheduled, Unscheduled, External and Third Party interruptions; and

(b) *Rural Customers* and *Urban Customers.*

9.5.5.3. Calculation Intervals

The calculation of the Overall Performance Indicators will be done by all *DNSP*s on a monthly and annual basis. When calculated on an annual basis, the pre-specified period mentioned above shall be considered as a calendar year. When calculated on a monthly basis the pre-specified period shall

be considered from the beginning of the calendar year up to the month the Overall Performance Indicator is calculated.

9.5.6. Tolerance of Performance indicators

The *Authority* will assign the numerical values for the tolerances of each Performance Indicator for each *DNSP* taking into consideration the characteristics of its *Distribution System* and load dispersion in the area of supply.

The tolerances for the Performance Indicators of a *DNSP* shall be approved by the *Authority* in each tariff review period and may be different for each calendar year during such period.

9.5.7. Implementation of Supply Quality Performance Indicators

The implementation of the Supply Quality Performance Indicators and this Distribution Performance Standard shall be done in two consecutive phases:

9.5.7.1. Phase 1

Phase 1 will be a nine (9) month duration:

(a) From the date that the *Authority* publishes the *KNDGC* in the *Kenya Gazette*; or

(b) From the date of the granting of a *Distribution Licence* to a new *DNSP*

During Phase 1, each *DNSP* will have the following obligations:

(a) Develop internal procedures and information systems to properly calculate the SAIDI and SAIFI Performance Indicators;

(b) Calculate and submit to the *Authority* each quarter the previous quarter's monthly SAIDI and SAIFI Performance Indicator measurements. In calculating these indicators:

(i) The Control Area for the statistical measurement will extend from the *Interconnection* with the Transmission system and other *Distribution System*s; *Generating Plants* connected to the *Distribution System* to the low voltage side of distribution transformers and to the *Connection Point* of MV *Customer*s.

(ii) Indicators will be calculated for the whole system without discrimination between Rural and Urban *Customer*s.

9.5.7.2. Final Phase

At the end of the Phase 1 period, the implementation of the Supply Quality Performance Indicator process will be in full effect.

9.5.8. Procedures and Information System

Before the end of Phase 1, the *DNSP* shall prepare and submit a report to the *Authority* for approval, containing adequate documentation regarding internal procedures, databases and information

systems to be implemented in order to control supply quality and calculate Performance Indicators in accordance with this Distribution Performance Standard.

9.5.8.1. Development of Procedures and Information Systems

To comply with this section, the *DNSP* shall implement the necessary procedures and systems, including among others the following:

(a) Procedures and systems to identify and register all of the Interruptions that occur in its Control Area of the *Distribution System*

(b) Procedures and systems to classify the Interruptions according to this Distribution Performance Standard

(c) Procedures and systems to determine the duration of the Interruptions

The *DNSP* shall implement the necessary databases and information systems in order to provide the following information:

(a) *A* Customer *database with the information to identify all the components of the associated supply network chain;*

(i) Consumer identification number

(ii) MV/LV transformer number to which the *Customer* is connected

(iii) Classification of Rural or Urban

(iv) MV circuit which feeds the above mentioned transformer

(v) HV/MV substation that feeds the MV circuit mentioned above

(b) Interruption *databases including information on each Interruption that occurs in the area of supply of the* DNSP*, including the following:*

(i) Date and hour when the Interruption started

(ii) Circuit or sections affected by the Interruption

(iii) Type of Interruption (scheduled, unscheduled or external)

(iv) Cause of Interruption (equipment failure, weather, third party, operating error)

(v) Quantity of *Customer*s affected by the Interruption

(vi) Date and time that the Interruption ended

(c) If the restoration is done in phases, the duration shall be different for each group of *Customer*s restored

9.5.9. Monitoring and Control

9.5.9.1. Audit

At the completion of the phased implementation of the Performance Indicators, the *Authority* will have the right and the *DNSP* shall allow the *Authority* or its authorised representatives to inspect the database and information system in order for the *Authority* to audit the process, data and the accuracy of the information. The *Authority* will have the right to hire qualified companies or persons to perform this activity on its behalf.

9.5.9.2. Routine Reporting

On a semi-annual basis (January and July), the *DNSP* shall submit to the *Authority* in a suitable organised manner, monthly Supply Quality Performance Indicator information and a list of actions to be undertaken by the *DNSP* to improve supply quality to those *Customer*s with quality below the Performance Indicators tolerance.

9.5.9.3. Emergency Reporting

In case of an Emergency Condition in a *Distribution System*, the affected *DNSP* shall:

(a) Within eight (8) hours from the beginning of the emergency, submit to the *Authority* by fax or electronic mail, information with preliminary analysis of the incident;

(b) Following the initial information submitted in (a) and up to the moment all *Customer*s are restored, at least every eight (8) hours, submit to the *Authority* by fax or electronic mail an update regarding the number of MV circuits and *Customer*s restored and remaining interrupted by the emergency;

(c) Within five (5) business days after the end of an emergency, submit a detailed report of the event to the *Authority*, its consequences and any remedial action to avoid or mitigate a similar incident in the future.

The *Authority* shall have the right to request additional information as necessary to perform its monitoring and control role and the *DNSP* shall allow the access to the primary documentation and/or send the necessary data regarding supply quality as requested by the *Authority*. The deadline to submit this additional information shall be not less than seven (7) Business Days from the date of receipt of the request.

9.5.10. Non Compliance with Authorised Tolerances

9.5.10.1. Phase 1

During Phase 1, the *Authority* will not enforce the Performance Indicator tolerance requirements. The *DNSP* shall calculate the System Performance Indicators and submit to the *Authority* the information established in this Distribution Performance Standards in order for the *Authority* to evaluate the performance of the *DNSP*.

9.5.10.2. Final Implementation Phase

During the Final Phase, if the *DNSP* fails to perform in one or more of the System Performance Indicators established in this Performance Standard, not later than ninety (90) calendar days after a System Performance Indicator fails to comply with the authorised tolerance, the *DNSP* shall submit to the *Authority* for approval a detailed report with an action plan to solve or mitigate the deficiency. The report shall include, among others, the following:

(a) Analysis of the causes of the deficiencies in quality

(b) Description of the current situation and the detected deficiency

(c) Description of equipment which contributes in a large extent to the non-compliance

(d) Remedial actions to correct the situation, including immediate and medium term actions and maintenance) and expected improvements

(e) Detailed Mitigation Plan with the proposed actions and required investments

When the *DNSP* submits the report, the *Authority* will review the proposed plan and may request clarifications or modifications prior to approval. Once approved, the plan will be binding to the *DNSP* and the *Authority* shall have the right to monitor and audit its effective execution.

9.6 POWER QUALITY STANDARDS (QUALITY OF SUPPLY)

9.6.1. Definition

A Power Quality problem exists when at least one of the following conditions is present:

(a) The System Frequency has deviated from the nominal value of 50 Hz;

(b) Voltage magnitudes are outside their allowed range of variation;

(c) There are imbalances in the magnitude of the phase voltages;

(d) The phase displacement between the voltages is not equal to 120 degrees;

(e) Voltage fluctuations caused by:

(i) Flicker that is outside the allowed flicker severity limits; or

(ii) Harmonics that are outside the allowed values; or

(iii) High frequency over voltages

9.6.2. Frequency Standards

The nominal fundamental frequency shall be 50 Hz. Although frequency deviations will not be a controlled indicator under this Performance Standard, the *DNSP* shall design and operate its *Distribution System* in order to assist the *System Operator* in maintaining the fundamental frequency within the limits established in the *KNDGC* during normal conditions.

9.6.3. Voltage Standards

The Performance Indicator to control voltage quality will be the voltage level. Deviation of actual voltage level from its Nominal Voltage shall not exceed the tolerance values established in Table 9-1:

Table 9-1: Voltage Standards

Voltage Level	Steady State Change
< 1.0 kV	± 6% to Urban Customers
	± 10% in Rural Customers
1.0 to 33 kV	± 10%

The tolerances for the voltage quality standard may be reviewed by the *Authority* based on technical and economic studies.

9.6.3.1. Voltage Level Deviation

The *DNSP* shall maintain voltage level deviations within the allowed tolerances at least during 97% of the time. During the remaining 3% of the time, voltage deviations shall not exceed 50% of the allowed tolerance values.

9.6.3.2. Audit of Voltage Level Adequacy

Control of the adequacy of voltage level to *Customers* will be assessed through a random/directed measurement at the *Customer's Connection Points*. The *Authority* will define the specification to be used in the measurement and the duration of each measurement shall be not less than seven (7) consecutive days.

During each year, the Distribution and Retail Supply Licensees shall be required to perform a minimum of one voltage measurement for every 100 Medium Voltage Consumers and one Voltage measurement for every 10,000 Low Voltage Consumers. Provided that where the Distribution Licensee is serving less than 200,000 consumers, the Licensee shall perform a minimum of 20 voltage measurements.

In the measurement campaigns, voltage level will be determined as the average RMS voltage during a 15 minutes' period. The *DNSP*, with the approval of the *Authority*, will select the *Customer*s to be measured taking into account:

(a) *Customer*s located in areas where voltage problems have been detected

(b) *Customer*s that have presented voltage complaints to *DNSP*s

Qualified staff of the *DNSP* shall perform the connection and disconnection of the equipment.

9.6.3.3. Remedial Actions

In addition to the remedial actions obligations, when the voltage levels fall out of range, it will be considered as a lack of efficiency of the *DNSP* that will be translated in an economic impact in its allowed revenues.

9.6.4. Perturbations Standards

During Phase 1 and Phase 2, the following perturbation Indicators will be controlled:

(a) *Flicker*

(b) *Harmonic Distortion*

During the Final Phase, in view of the obligations of the *DNSP* stated in the *KNDGC* and due to existing reported problems and based on technical and economic studies, the *Authority* may establish additional perturbation Indicators in order to control other disturbances as necessary.

9.6.4.1. Flicker Disturbance Assessment

The assessment of the disturbance caused by a *Flicker* shall be measured according to the following:

(a) For disturbances caused by a *Flicker* source with a short duty cycle, the Short Term *Flicker* Severity shall be computed over a 10-minute period.

(b) For disturbances caused by *Flicker* sources with a long and variable duty cycle, the Long Term *Flicker* Severity shall be derived from the Short Term *Flicker* Severity levels.

9.6.4.2. Harmonics Distortion Measurements

The Performance Indicators to measure *Harmonic Distortion* will be:

(a) Total *Harmonic Distortion* (THD);

(b) Values of each individual harmonic.

The allowed ranges for *Flicker* and harmonic indicators are established in the *KNDGC*, and shall not be exceeded, at the *Connection Point*, during a time greater than 3% of a measurement period.

9.7 DISTRIBUTION LOSSES

9.7.1. Definitions

For a specified period, Distribution Energy Losses are defined as the difference between the total energy purchased by the *DNSP* during such period from the *System Operator* and from *Generating Plants* connected to the *Distribution System*, and the total energy invoiced to *Customer*s during such period, independently on whether the energy (purchased or sold) has been paid or not.

9.7.2. Losses Categories

Distribution Energy Losses shall be classified in three categories:

(a) Technical Losses: There are distribution losses that occur due to current flowing into the *Distribution System*, including conductor losses and core losses on transformers;

(b) Administrative Losses: This corresponds to the energy used by *DNSP*s for its own consumption in order to carry out distribution retail activities; and

(c) Non-Technical Losses: This is the difference between the Distribution Energy Losses and the sum of Technical Losses and Administrative Losses

9.7.3. Distribution Energy Losses

The *Authority* will determine and approve in each tariff review period, after due notice and consultation with the *DNSP*, a target for the reduction of Technical Losses, a target for the reduction of the Non-Technical Losses and a target for the reduction of the Administrative Losses. The percentage of reduction approved may be different for each calendar year during such review period. The *DNSP* shall be allowed to pass through to tariffs and recover from its *Customers* the reductions to the *Distribution System* Losses approved by the *Authority*.

The targets for *Distribution System* Loss reductions approved by the *Authority* will be used for tariff determination and as Performance Indicators, and each *DNSP* shall endeavour to maintain Distribution Energy Losses below these targets.

9.7.4. Monitoring and Reporting

For the purpose of carrying out suitable monitoring and control of the performance of each *DNSP* regarding Distribution Energy Losses, the *DNSP* shall submit appropriate information to the *Authority*, in a format as may be established by the *Authority*, at the following intervals:

9.7.4.1. Monthly Basis

(a) Total Energy purchased from the *System Operator* and from each *Generating* Plant *connected* to the *Distribution System* selling to the *DNSP*, identifying the *Connection Points* where the energy enters the *Distribution System*.

(b) Total Energy billed to *Customer*s, differentiated by voltage level.

9.7.4.2. Every Six Months

Semi-annual report on Distribution Energy Losses with aggregated information on losses, differentiated by:

(a) Categories of losses (technical, non-technical and administrative)

(b) Voltage level (losses at the medium and low voltage level)

(c) Geographic zones

9.7.5. Implementation of Losses Performance Indicators

Within six (6) months following the adoption of the *KNDGC* or the granting of a distribution and retail supply licence that includes Performance Indicators in accordance with the Distribution Performance Standards of the *KNDGC*, the *DNSP* shall submit to the *Authority* for approval the methodology and assumptions to be used to calculate Distribution Energy Losses, the separation into the different categories of losses, the separation into the different voltage levels and different geographical zones. The proposed methodology shall take full advantage of all the technical data and metering capability the *DNSP* has available at the time the report is submitted, and shall use at least the following information:

(a) Technical data of feeders, transformers and *Generating Plant*s connected to the *Distribution System* within the supply area of the *DNSP*

(b) Energy metered at each transmission *Connection Point*, connection of *Generating Plant*s connected to the *Distribution System and* connection with other *DNSP*s

(c) Energy metered in each HV/MV transformer

(d) Energy metered in each distribution feeder, connected at a HV/33 kV substation

(e) Energy metered in each distribution feeder, connected at a HV/11 kV substation

(f) Energy metered in the distribution feeders, connected at 33/11 kV substations.

9.7.5.1. Transitional Submittal

If at the time of report submission there is a lack of adequate metering capabilities to fulfil the above mentioned requirements, the *DNSP* shall inform the *Authority* the transitional methodology to be used to overcome that situation, and/or the remedial plans to install all the required meters or to obtain the required technical data.

In addition to the information to be provided by the *DNSP* on a monthly and six (6) monthly basis, within the first three (3) months of each year, the *DNSP* shall also submit to the *Authority* an Annual Report on Losses, covering the full previous year performance, including among others the following:

(a) Statistical losses data of the previous year and comparing it with the two (2) previous years.

(b) Main actions undertaken by the *DNSP* in order to reduce technical and non-technical losses, with an identification of the cost of such actions and the achieved or expected results.

(c) Feeders, zones or areas were the annual Energy losses considerably exceed the Performance Indicators, and actions to be undertaken to reduce losses in such feeders, zones or areas.

(d) Any study or analysis carried out by the *DNSP* to reduce losses

(e) Plans for the following twenty-four (24) months associated to loss reduction, together with the corresponding cost – benefit analysis.

9.8 GUARANTEED PERFORMANCE STANDARDS

9.8.1. Guaranteed Performance Standards for the Authority

The Authority shall be subject to the following Guaranteed Performance Standards:

(a) Review the retail tariff every three years.

(b) Set and adjust the electric power tariff.

(c) Approve power purchase and network service contracts.

(d) Collect and maintain energy data.

(e) Issue, renew and modify, suspend, revoke licenses and permits.

(f) Investigate, hear and determine complaints or disputes promptly.

(g) Render decisions within the prescribed timelines.

(h) Put in place documented mechanisms to protect consumer, investor and other stakeholder interests.

9.8.2. Guaranteed Performance Standards for Generation Licensee

(a) The Generation Licensee shall be subject to the following Guaranteed Performance Standards:

(b) For grid stability purposes, the generation licensees for synchronous generators shall ensure that the generating units are designed to provide continuous operation when the Frequency changes within the Frequency Range of 47.50 Hertz and 51.50 Hertz.

(c) For variable renewable power plant, the frequency levels shall be as follows:

Frequency Limits	Duration
49.50 Hz to 50.50 Hz	Continuous operation (normal)
49.00 Hz ≤ f < 49.50 Hz or 50.50 Hz Hz < f ≤ 51.00 Hz	For duration of at least 60 minutes
48.00 Hz ≤ f < 49.50 Hz or 50.50 Hz < f ≤ 51.50 Hz	For duration of at least 30 minutes
47.50 Hz ≤ f < 49.50 Hz or 50.50 Hz < f ≤ 51.50 Hz	For duration of at least 3 minutes
<47.50 Hz or >51.50 Hz	For duration of at least 20 seconds
<47.00 Hz for more than 0.2 sec	May disconnect
>52.00 for more than 4 sec	Must disconnect

(d) The Licensee shall design and operate its generation plant in a manner that enables the System Operator to maintain the system frequency within the limits of 49.50 Hz and 50.50 Hz during normal conditions.

(e) The generation Licensee shall provide constant terminal voltage of the Generating Unit without instability over the entire operating range of the Generating Unit. The Generator automatic voltage regulator shall be capable of maintaining terminal voltage to an accuracy of ±0.50% relative to the constant reference value adjustable over the range of ±5% to ensure adequate steady state stability.

(f) Synchronous Generating Unit shall be capable of supplying rated power output (MW) at any point between the limits 0.85 power factor lagging and 0.95 power factor leading at the *Generating Unit* terminals.

(g) For variable renewable power plant the power factor shall be as follows:

Voltage, p.u.	*Reactive Power* Range (p.u. of full output)	Equivalent Full Load Power Factor
0.20 to 0.80	-0.330 to 0.330	-0.950 to 0.950
0.80 to 1.10	-0.228 to 0.228	-0.975 to 0.975

(h) The Generation Licensee shall comply with the technical requirements stipulated in the Power Purchase Agreement, such as Plant Availability, provision of Ancillary Services and Black Start.

9.8.3. Guaranteed Performance Standards for Distribution and Retail Supply Licensee

The Distribution and Retail Supply Licensee shall be subject to the following Guaranteed Performance Standards:

(a) The Licensee shall operate the distribution and retail supply system in accordance with the contracts for supply of electrical energy and network services and/or Electricity Supply Agreement.

(b) The Distribution Licensee shall design and operate its distribution network in a manner that enables the System Operator to maintain the system frequency within the limits of 49.5Hz and 50.5Hz during normal conditions.

(c) Deviation of actual voltage level from its nominal value shall not exceed the tolerance values prescribed in the Grid Code as illustrated in the table below:

Voltage Level	Steady State Change
Less than 1.0 kV	± 6% for Urban Consumers
	± 10% for Rural Consumers
1.0 to 66 kV	± 10% for all Consumers

(d) The Licensee shall maintain voltage level deviations within the allowed tolerances at least

during 97% of the time. During the remaining 3% of the time, voltage deviations shall not exceed 50% of the allowed tolerance values.

(e) Control of the adequacy of voltage level to Consumers will be assessed through a random/directed measurement at the Consumer's Connection Points.

(f) During each year, the Distribution and Retail Supply Licensee shall be required to perform a minimum of one voltage measurement for every 100 Medium Voltage Consumers and one Voltage measurement for every 10,000 Low Voltage Consumers. Provided that where the Distribution Licensee is serving less than 200,000 consumers, the Licensee shall perform a minimum of 20 voltage measurements.

(g) In the measurement, voltage level will be determined as the average Root Mean Square (RMS) voltage during a fifteen (15) minutes' period.

(h) Distribution Licensee shall ensure that the Total Harmonic Distortion of the voltage at any Connection Point shall not exceed 8% and 5% of the fundamental voltage for the Low Voltage and Medium Voltage systems respectively.

(i) The Voltage Flicker Severity at the Connection Point of any Distribution Network Consumer shall not be above the maximum values stated in KS IEC 61000-3 Standard for more than 3% of the measured period.

(j) The values of the tolerances for forced interruptions targets for the licensees shall be as per the table below

Indicator	Current situation	Target year 1-5	Target year 5 and above
SAIFI	25.6	20	15
SAIDI	115.73	80	45
CAIDI	4.52	4	3
*The Reliability Indicators are calculated using the formulae set out in the **Appendix C***			

(k) The Distribution Licensee shall achieve an efficient level of Distribution Losses (both technical and commercial Losses) on the Licensee system. The standard level of Distribution Losses shall be established by the Authority within the tariff review structure.

9.8.4. Guaranteed Performance Standards for Distribution Licensee

The Distribution Licensee shall be subject to the following Guaranteed Performance Standards:

(a) The Licensee shall operate the distribution system in accordance with the contracts for supply of electrical energy and network services and/or Electricity Supply Agreement.

(b) The Distribution Licensee shall design and operate it distribution network in order to assist the System Operator in maintaining the system frequency within the limits 49.5Hz and 50.5Hz during normal conditions.

(c) Deviation of actual voltage level from its nominal value shall not exceed the tolerance values prescribed below:

Voltage Level	Steady State Change
Less than 1.0 kV	± 6% for Urban Consumers
	± 10% for Rural Consumers
1.0 to 33 kV	± 10% for all Consumers

(d) The Licensee shall maintain voltage level deviations within the allowed tolerances at least during 97% of the time. During the remaining 3% of the time, voltage deviations shall not exceed 50% of the allowed tolerance values -

(e) Control of the adequacy of voltage level to Consumers will be assessed through a random/directed measurement campaign at the Consumer's Connection Points. The Authority will define the specification to be used to perform this campaign.

(f) During each year, the Distribution and/or Retail Supply Licensee shall be required to perform one voltage measurement for every 100 Medium Voltage Consumers and one Voltage measurement for every 1,000 Low Voltage Consumers.

(g) In the measurement campaigns, voltage level will be determined as the average Root Mean Square (RMS) voltage during a fifteen (15) minutes' period.

(h) Distribution Licensee shall ensure that the Total Harmonic Distortion of the voltage at any Connection Point shall not exceed 8% and 5% of the fundamental voltage for the Low Voltage and Medium Voltage systems respectively.

(i) The Voltage Flicker Severity at the Connection Point of any Distribution Network Consumer shall not be above the maximum values stated in KS IEC 61000-3 Standard for more than 3% of the measured period.

(j) The following tolerances for Forced Interruptions shall be achieved by the Licensee.

Indicator	Current situation	Target year 1-5	Target year 5 and above
SAIFI	25.6	20	15
SAIDI	115.73	80	45
CAIDI	4.52	4	3
*The Reliability Indicators are calculated using the formulae set out in the **Appendix C***			

(k) The Distribution Licensee shall achieve an efficient level of Distribution Losses (both technical and commercial Losses) on the Licensee system. The standard level of Distribution Losses shall be established by the Authority.

9.8.5. Guaranteed Performance Standards for Retail Supply Licensee

The Retail Supply Licensee shall be subject to the following Guaranteed Performance Standards:

(a) The Licensee shall operate the retail supply system in accordance with the contracts for supply of electrical energy and network services and/or Electricity Supply Agreement.

(b) Deviation of actual voltage level from its nominal value shall not exceed the tolerance values prescribed in the Grid Code.

(c) The Licensee shall maintain voltage level deviations within the allowed tolerances.

(d) Control of the adequacy of voltage level to Consumers will be assessed through a random/directed measurement campaign at the Consumer's Connection Points. The Authority will define the specification to be used to perform this campaign.

(e) During each year, the Distribution and/or Retail Supply Licensee shall be required to perform one voltage measurement for every 100 Medium Voltage Consumers and one Voltage measurement for every 10,000 Low Voltage Consumers.

(f) In the measurement campaigns, voltage level will be determined as the average Root Mean Square (RMS) voltage during a fifteen (15) minutes' period.

(g) The following tolerances for Forced Interruptions shall be achieved by the Licensee.

Indicator	Current situation	Target year 1-5	Target year 5 and above
SAIFI	25.6	20	15
SAIDI	115.73	80	45
CAIDI	4.52	4	3
*The Reliability Indicators are calculated using the formulae set out in the **Appendix C.***			

APPENDIX A: DEROGATION REQUEST AND MITIGATION PLAN FORMS

A.1 KENYA NATIONAL DISTRIBUTION CODE DEROGATION REQUEST FORM

Name of Entity:		**Date:**
Contact Name (CEO or delegated Officer):	**Contact Phone:**	**Email:**
Signature (CEO or delegated officer):		
Type of Derogation Being Requested (Indicate One): Exemption _____ Mitigation _____ **If Mitigation: Proposed date by which mitigation plan will be filed:** **Date by which the non-compliance will be remedied:**		
Date of Non-Compliance Discovery: **Date Non-Compliance Reported:**		
Code Section Title:	**Code Section Number:**	
Described the nature and extent of the Non-Compliance (Attach)		
Describe the cause of Non-Compliance (Attach)		
Identification and Description of the system, facility, equipment, process, procedures or specific connection point in respect of which the Derogation is sought (Attach)		

A.2 KENYA NATIONAL DISTRIBUTION CODE MITIGATION PLAN FORM

Name of Entity:		**Date:**
Code Section Title:	**Code Section Number:**	
Describe Detailed Plan to Become Compliant, including expected duration of non-compliance (Attach)		
Describe Customer/User Health and Safety Risk Mitigation Plan (Attach)		
Description of reasonable alternative actions that have been considered (Attach)		
Describe Detailed Milestone Schedule to Become Compliant (Attach)		

APPENDIX B METERING STANDARDS

The standards listed in Table C-1 shall apply to all *Metering Equipment* in Kenya.

Table C-1: Metering Standards Applied in Kenya

Standard	Type
KS ISO/IEC 17025	General requirements for the competence to carry out tests and/or calibrations, including sampling (covers testing and calibration performed using standard/non-standard/laboratory-developed methods)
KS IEC 60044 - 2 (replaced by IEC 61869 - 3)	Requirements for voltage transformers to be used with electrical measuring instruments and protective devices at frequencies from 15 Hz to 100 Hz.
KS IEC 60044 - 3 (replaced by IEC 61869 - 4)	Requirements for combined transformers
KS IEC 60044 -5 (replaced by IEC 61869-5)	Requirements for single-phase capacitive voltage transformers connected between line and earth for system voltages Um ≥ 72,5 kV at power frequencies from 15 Hz to 100 Hz. They are intended to supply a low voltage for measurement, control and protective functions
KS IEC 60044 -1 (replaced by IEC 61869-2)	Requirements for current transformers to be used with electrical measuring instruments and protective devices at frequencies from 15 Hz to 100 Hz.
KS IEC 61000 - 3-2: 2014	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
KS IEC 62052-11:2003	Electricity Metering Equipment (a.c.) - General Requirements, Tests and Test Conditions - Part 11: Metering Equipment; Plastic Determination of Temperature Deflection of Load
KS IEC 62053-20:2003	Automatic Meter Reading
KS IEC 62053-21:2003	Electricity Metering Equipment (a.c.) - Particular Requirements - Part 21: Static Meters for Active Energy (class 1.0)
KS IEC 62053-23:2003	Electricity Metering Equipment (a.c.) - Particular Requirements - Part 23: Static Meters for Reactive Energy (classes 2 and 3)
KS IEC 62054 - 21	Accuracy of the Real Time Clock
KS IEC 62056-21:2003	Electricity Metering, Data Exchange for Meter Reading , Tariff, and Load Control - Part 21: Direct Local Data Exchange
KS IEC 62059	Electricity Metering Equipment Dependability

APPENDIX E: FORMULAE FOR CALCULATION OF RELIABILITY INDICATORS

The Authority shall in consultation with the Licensees set the values of SAIFI, SAIDI, CAIDI and ANOFT targets for the licensees annually which shall be used to ensure power system reliability. Forced Interruptions as defined in KS. 2236-3:2010 are the only ones included in the calculation of the reliability indicators. Planned interruptions are excluded. The reliability indicators shall be calculated monthly and annually by the Distribution and Retail Supply Licensees and reported to the Authority.

(a) System Average Interruption Duration Index (SAIDI) is a reliability indicator that measures the average Interruption duration for each Consumer served during the period under review, and is calculated as follows:

$$\textbf{SAIDI} = \frac{\sum (\textbf{R x CI})}{\textbf{CS}} = \frac{\textbf{Sum of All Consumer Interruption Duration}}{\textbf{Total Number of Consumers Served}}$$

Where:

$\sum$ is the summation function
R is the duration of an Interruption or restoration time
CI is the total number of Consumers interrupted (per an interruption)
CS is the total number of Consumers served by the Licensee

(b) System Average Interruption Frequency Index (SAIFI) is a reliability indicator that measures the average number of times that any given Consumer would experience an interruption during the period under review, and is calculated as follows:

$$\textbf{SAIFI} = \frac{\sum \textbf{CI}}{\textbf{CS}} = \frac{\textbf{Sum of All Consumer Interruption Duration}}{\textbf{Total Number of Consumers Served}}$$

Where:

$\sum$ is the summation function
CI is the total number of Consumers interrupted (per an interruption)
CS is the total number of Consumers served by the Licensee

(c) Customer Average Interruption Duration Index (CAIDI) is the average electrical power outage duration that any given Consumer would experience, measured in units of time, and is calculated as follows:

$$\textbf{CAIDI} = \frac{\sum (\textbf{R x CI})}{\sum \textbf{CI}} = \frac{\textbf{SAIDI}}{\textbf{SAIFI}} = = \frac{\textbf{Sum of All Consumer Interruption Durations}}{\textbf{Total Number of Consumers Interrupted}}$$

Where:

$\sum$ is the summation function
R is the duration of an Interruption or restoration time
CI is the total number of Consumers interrupted (per an Interruption)

(d) Average annual number of forced outages for all transmission lines (ANOFT) is equal to the total number of sustained interruptions multiplied by 100km and divided by the total length of the transmission lines owned by licensee in km per voltage level.

(e) Average duration of forced interruption (ADFI) is equal to the total duration of the interruption divided by the number of the interruptions excluding force majeure and third party interferences.

(f) Transmission lines Monthly Availability per voltage shall be equal to

$$100\% - \left(\frac{Hrs\ forced\ outage + Hrs\ of\ planned\ outage}{hours\ for\ the\ month}\ x\ 100\%\right|\ \ )$$

(g) Transmission line Annual Availability per voltage shall be equal to

$$100\% - \left(\frac{Hrs\ forced\ outage + Hrs\ of\ planned\ outage}{hours\ for\ the\ year}\ x\ 100\%\right|\ \ )$$

APPENDIX D REVISION LOG

Chapter	Comments	Page	Action Taken	Date of Action
All	Change of title for consistency	Various	Title changed from Kenya National Distribution Code to Kenya National Distribution Grid Code	21st April 2017
All	Remove ambiguity	Various	Replace Regulatory Authority with Authority as short name for the Energy Regulatory Authority	21st April 2017
All	Align with the Energy Act, 2019	Various	EPT	26th August 2020
All	Align with the Energy Act, 2019	Various	ERC to EPRA	26th August 2020
All	Align with the Energy Act, 2019	Various	Commission to Authority	
All	Align with the Energy Act, 2019	Various	TSO to SO	26th August 2020
All	Align with the Energy Act, 2019	Various	MoEP to MoE	26th August 2020
All	Align with the Energy Act, 2019	Various	Energy Act, 2006 to Energy Act, 2019	26th August 2020