KENYA NATIONAL

TRANSMISSION GRID CODE

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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 system in a manner that will ensure reliable, efficient and safe operation.

This Preamble provides the rationale for the development of the Kenya National Transmission Grid Code (KNTGC) and summarises the provisions of the KNTGC. The KNTGC underwent a rigorous approval process involving the Regulatory Authority, the Ministry of Energy and Petroleum, the Attorney General, and Parliament.

The objective of the KNTGC 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, while multiple independent parties use the power system. The KNTGC provides a framework of rules and regulations under which Users must operate and coordinate with each other and with the operators of the power system. The KNTGC is intended to establish the reciprocal obligations of Users of the Kenya National Transmission System (KNTS) and operation of the East African Power Pool.

The development of the KNTGC took into account the Eastern Africa Power Pool and East African Community Interconnection Code (EAPP IC). The EAPP IC imposes certain minimum requirements on the Member Countries of the EAPP. Thus the EAPP IC plays an important role in the KNTGC. This KNTGC follows to the extent possible the organisation and formatting of the EAPP IC.

Other national grid codes were considered and reviewed in addition to the EAPP IC, including the South African Grid Code (2012), the South African Grid Connection Code for Renewable Power Plants (2012), the Namibian Grid Code (2005), the Indian Electricity Grid Code (2010), the Zambian Grid Code (2006), and the Rwanda Grid Code (2012).

Addressing exclusively wind power, the Australian Energy Market Operator (AEMO) report “Wind Integration: International Experience WP2: Review of Grid Codes 2nd October 2011” provided a review of Grid Codes from the United Kingdom, Germany, Denmark, Spain, Texas, Alberta, Hydro Quebec, Ontario Independent Electricity System Operator (IESO), and the European Network of Transmission System Operators for Electricity (ENTSO-E). This review was helpful in preparing Renewable Power Plant (RPP) Chapter of the KNTGC.

1.2 STRUCTURE OF THE KNTGC

The EAPP IC and the KNTGC each place obligations on the Regulatory Authority, the Kenya National TSO, and Users. In the chapters of the KNTGC, the EAPP requirements are listed first, followed by requirements specific to the KNTS. If in any instance there is a difference in requirements, the more stringent requirement shall hold.
The KNTGC is divided into the following chapters:

1.2.1 Preamble

This Preamble summarises the provisions of the KNTGC.

1.2.2 Glossary and Definitions

The Glossary and Definitions contains a glossary of terms and a list of abbreviations and units used in the KNTGC. Defined terms are italicised and capitalised throughout the KNTGC 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.

1.2.3 General Conditions

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

1.2.4 Governance Chapter

The Governance Chapter summarises the main documents and organisations that provide the authority governing the planning, construction, and operation of the KNTS.

1.2.5 Planning Chapter

The Planning Chapter specifies the minimum technical and design criteria, principles, and procedures:

a. To be used within Kenya in the medium and long term planning and development of the KNTS;

b. To be taken into account by Member Utilities on a coordinated basis, and

c. To specify the planning data required to be exchanged by Member Utilities and the EAPP Subcommittee on Planning to enable the EAPP Interconnected Transmission System to be planned in accordance with planning standards.

1.2.6 Connections Chapter

The Connections Chapter specifies the minimum design, technical, and operational criteria of Plant and Apparatus which must be complied with by both Users and the Kenya National Transmission System Operator (Kenya National TSO) at Connection Points in order to maintain secure and stable operation of the KNTS.
1.2.7 **Renewable Power Plant Chapter**

The *Renewable Power Plant* Chapter sets out the requirements for renewable power plants, especially wind and solar power plants, so that they will be able to contribute to the stability of the *KNTS*.

1.2.8 **Operations Chapters**

The Operations Chapters (OC) set out the data exchange between and responsibilities of the *Kenya National TSO*, the other *TSOs*, and the *EAPP* in operating the *EAPP Interconnected Transmission System*. The six OCs (OC 1 through OC 6, Chapters 8 through 13) deal with the criteria and procedures which will be required to facilitate efficient, safe, reliable and coordinated system operation of the *KNTS*, other *National Systems*, and the *EAPP Interconnected Transmission System*. They include chapters addressing Operational Planning, Operational Security, Emergency Operations, Incident Reporting, Demand Control, and System Tests.

1.2.8.1 **Operational Planning**

Operations Chapter 1 summarises *Outage* requirements for generation and transmission facilities and other factors likely to affect the operation of the *KNTS*, which shall be coordinated between the *Kenya National TSO*, other *TSOs*, and the *EAPP Coordination Centre (EAPP CC)* for a period of three (3) years ahead down to real time. In accordance with the terms of Chapter 5 (Planning), OC 1 also requires the *Kenya National TSO*, other *TSOs*, and the *EAPP Sub-Committee on Planning* to produce a *Power Balance Statement* and a *Transmission System Capability Statement* on an annual basis for the succeeding ten (10) years. It also sets out refinements of the planning process to account for nearer-term characteristics.

1.2.8.2 **Operational Security**

Operations Chapter 2 specifies the technical requirements and standards for the operational security of the *KNTS*, the *National Systems* of other *Member Countries*, and the *EAPP Interconnected Transmission System* as they relate to the following issues:

a. N-1 Contingency criterion;
b. Interchange scheduling;
c. Operating reserves for control of system frequency and interchange with other *Control Areas* or *External Systems*;
d. Voltage control;
e. Fault level control;
f. Protection coordination, and
g. *Remedial Action Schemes (RAS).*

1.2.8.3 **Emergency Operations**

Operations Chapter 3 sets requirements to ensure that the *Kenya National TSO*, other *TSOs*, and the *EAPP CC*:
a. Are able to identify insecure operating conditions on the EAPP Interconnected Transmission System;

b. Have procedures and plans in place to manage emergency conditions;

c. Have comprehensive Contingency plans in place for the restoration of supplies in the shortest possible time using the most effective means.

1.2.8.4 Incident Reporting

Operations Chapter 4 sets out the requirements for reporting significant incidents that have caused, or could have caused, damage to system equipment or operation of the KNTS, other National Systems, and or the EAPP Interconnected Transmission System outside the Operational Security Standards.

This chapter also sets out the procedures for the joint investigation of significant incidents and for the technical audit of the Kenya National TSO and other TSOs procedures and Plant and Apparatus connected to, or forming part of, the EAPP Interconnected Transmission System.

1.2.8.5 Demand Control

Operations Chapter 5 sets out the provisions to be made by the Kenya National TSO, in cooperation with the EAPP CC, to permit reductions in demand in the event of insufficient generation capacity being available to meet demand or in the event of breakdown or thermal overloading of any part of the KNTS or the EAPP Interconnected Transmission System leading to the possibility of unacceptable frequency or voltage conditions.

1.2.8.6 System Tests

Operations Chapter 6 sets out the arrangements, data exchange, and procedures across the EAPP Interconnected Transmission System for System Tests or operational tests including Black Start tests and Power Island tests. System Tests are those tests, which involve either a simulated or a controlled application of irregular, unusual, or extreme conditions on the EAPP Interconnected Transmission System. In addition, they include commissioning and or acceptance tests on Plant and Apparatus to be carried out by a User and which may have a significant impact upon the EAPP Interconnected Transmission System.

1.2.9 Interchange Scheduling and Balancing Chapters

The Interchange Scheduling and Balancing Chapters (ISBC) set out the procedures for the scheduling, coordination and balancing of power transfers across the EAPP Interconnected Transmission System. The ISBC is divided into Chapters 14, 15, and 16 of the KNTGC: ISBC 1 Interchange Scheduling, ISBC 2 Balancing and Frequency Control, and ISBC 3 Ancillary Services.

1.2.9.1 Interchange Scheduling

ISBC 1 Interchange Scheduling deals with the following aspects of the scheduling process:
a. Determination of the Net Transmission Capability (NTC) between Neighbouring Control Areas and or External Systems over the Operational Planning timescales;

b. Publication of NTC values to enable the Kenya National TSO, other TSOs, and Users to evaluate possible energy interchanges;

c. Allocation of NTC to the Kenya National TSO, other TSOs, and or External Systems in accordance with pre-determined rules and the issue of Interchange Schedules.

1.2.9.2 Balancing and Frequency Control

ISBC 2 Balancing and Frequency Control sets out the procedure that the Kenya National TSO and other TSOs will use to direct frequency control. The frequency of the EAPP Interconnected Transmission System will be controlled by:

a. Automatic response from synchronised Generating Plants;

b. The dispatch of Generating Plants including Automatic Generation Control (AGC);

c. Response from interconnections with External Systems, and

d. Demand control.

1.2.9.3 Ancillary Services

ISBC Chapter 3 Ancillary Services sets requirements for the provision of Ancillary Services to ensure that the Kenya National TSO and other TSOs meet the obligations and responsibilities under the EAPP IC for a safe, secure, and reliable operation of the EAPP Interconnected Transmission System.

The operation of the KNTS, other National Systems, and the EAPP Interconnected Transmission System requires the provision by the Kenya National TSO and other TSOs of the following Ancillary Services grouped into three major categories:

a. Frequency Control;

b. Network Control, and

c. System Restart Capability.

The above Ancillary Services are the traditional mechanisms to provide the required capability in relation to:

a. Operating Reserves;

b. Demand Control;

c. Voltage Control;

d. Power flow control;

e. Stability control, and

f. Black-Start.
1.2.10 **Kenya Metering Chapter**

The Kenya Metering Chapter (KMC) specifies the minimum technical, design, and operational criteria to be complied with for the metering of each Connection Point of a User with the KNTS. The KMC also specifies the associated data collection equipment and the related metering procedures required for the operation of the KNTS.

1.2.11 **Interconnection Metering Chapter**

The Interconnection Metering Chapter (IMC) specifies the minimum technical, design, and operational criteria to be complied with for the metering of each point of interchange of energy between Control Areas. The IMC also specifies the associated Data Collection and the related metering procedures required for the operation of the EAPP Interconnected Transmission System.

1.2.12 **Data Exchange Chapter**

The Data Exchange Chapter defines the data to be exchanged between the **Kenya National TSO**, other TSOs, and the **EAPP Sub-Committees on Planning and Operations** for the purpose of the modelling and analysis of steady-state and dynamic conditions for the **EAPP Interconnected Transmission System**. The DEC sets out the information flows required between the **Kenya National TSO**, other TSOs, and the **EAPP Sub-Committees on Planning and Operations** to produce EAPP system models for the various processes that require system studies to be undertaken. These processes include those associated with System Planning as set out in the Planning Chapter, including the preparation of the **Transmission System Capability Statement**, and with **Operational Planning** as set out in Operations Chapter 1.

1.2.13 **Information Exchange Chapter**

The Information Exchange Chapter defines the reciprocal obligations of parties with regard to the provision of information for the implementation of the KNTGC. The information requirements, as defined for the **Transmission Network Service Provider (TNSP)**, the **Kenya National TSO**, the **Regulatory Authority**, and **Users**, are necessary to ensure non-discriminatory access to the **Kenya National Transmission System (KNTS)** and the safe, reliable provision of transmission services. The information requirements are divided into planning information, operational information and post-dispatch information.

1.2.14 **Cyber Security Chapter**

Cyber Security can be defined as the protection required to ensure confidentiality, integrity, and availability of the electronic communication system. With the two-way flow of electricity and information, the management and protection of the electrical communication system that includes information technology and telecommunication infrastructure has become critical. The Cyber Security Chapter sets out requirements in the following areas:

a. Development of information security management controls and procedures;
b. Cyber security systems;

c. Access management for systems; and

d. Building defence against threats through training, awareness and monitoring.

1.2.15 System Operator Training Chapter

The System Operator Training Chapter sets out the responsibilities and the minimum acceptable requirements for the development and implementation of System Operator Training and authorisation programmes. This chapter requires that System Operators within Kenya and throughout EAPP and EAC are provided with continuous and coordinated operational training in order to promote the reliability and security of the EAPP Interconnected Transmission System.

1.3 Scope of the KNTGC

The KNTGC establishes the technical aspects of the planning, connection, operation, and use of the Kenya National Transmission System and the relationships between the Kenya National Transmission System Operator (Kenya National TSO), Transmission Network Service Provider(s) (TNSPs), Generation Licensees, and other Users of the Kenya National Transmission System.

The KNTGC shall be read in conjunction with the relevant legislation, including the Energy Act of 2006, and the Energy (Electricity Licensing) Regulations of 2012 and any applicable amendments related to the administrative authority for the KNTGC. These legislative policies shall be used in conjunction with the Licences issued to Users and the applicable codes and regulations adopted by the Regulatory Authority and the Ministry of Energy and Petroleum. All Licences issued after enactment of the KNTGC shall include the obligation of Parties to comply with the KNTGC requirements.
2.1 **INTRODUCTION**

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

2.2 **GLOSSARY**

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

<table>
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<th>Word or Phrase</th>
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<td>Active Energy</td>
<td>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.</td>
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<tr>
<td>Active Power</td>
<td>Instantaneous power derived from the product of voltage and current and the cosine of the voltage phase angle measured in units of Watts and multiples thereof.</td>
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<td>Active Power Control</td>
<td>The automatic change in Active Power output from a Wind Turbine or Solar Power Generating Plant in response to an Active Power Control Set-point received from the Transmission Licensee or Distribution Licensee.</td>
</tr>
<tr>
<td>Active Power Control Set-point</td>
<td>The maximum amount of Active Power in MW, set by the Transmission Licensee or Distribution Licensee, that the Wind Turbine or Solar Power Generating Plant is permitted to export.</td>
</tr>
<tr>
<td>Actual Metering Point (AMP)</td>
<td>The physical point at which the flow of electricity is measured and where the Interchange Metering is installed. The AMP may be different from the Defined Metering Point subject to the approval of the EAPP CC. In these cases, the accuracy requirements in Section 18.1.9 shall apply at the Defined Metering Point.</td>
</tr>
<tr>
<td>Agent</td>
<td>A person appointed by an entity to perform any of its functions or act on its behalf.</td>
</tr>
<tr>
<td>Ancillary Services</td>
<td>Those services necessary to support the transmission of capacity and energy from resources to loads, while maintaining reliable operation of the Kenya National Transmission System in accordance with Prudent Utility Practice. Without limitation, these services may include: (a) the provision of sufficient Secondary Response and Tertiary Reserve to meet fluctuations in load occurring within a scheduling interval; (b) the provision of sufficient Primary Response 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.</td>
</tr>
<tr>
<td>Apparatus</td>
<td>An item of equipment, in which electrical conductors are used, supported...</td>
</tr>
<tr>
<td>Word or Phrase</td>
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<tr>
<td>or of which they form a part and includes meters, lines, cables and appliances used or intended to be used for carrying electricity for the purpose of supplying or using electricity</td>
<td></td>
</tr>
<tr>
<td>Area Control Error (ACE)</td>
<td>The instantaneous difference between net actual and scheduled interchange, taking into account the effects of frequency bias including correction for metering error</td>
</tr>
<tr>
<td>Attorney General</td>
<td>The Attorney General of Kenya</td>
</tr>
<tr>
<td>Automatic Generation Control (AGC)</td>
<td>Equipment that automatically adjusts a Control Area’s generation to maintain its interchange schedule plus its share of frequency regulation</td>
</tr>
<tr>
<td>Automatic Load Shedding Scheme</td>
<td>A load-shedding scheme utilised by the Kenya National TSO or another TSO to prevent frequency collapse and to restore the balance between generation output and demand</td>
</tr>
<tr>
<td>Automatic Voltage Regulator (AVR)</td>
<td>The continuously acting automatic equipment controlling the terminal voltage of a Synchronous Generating Plant by comparing the actual terminal voltage with a reference value and controlling by appropriate means the output of an Exciter (or source of the electrical power providing the field current of a synchronous machine), depending on the deviations</td>
</tr>
<tr>
<td>Black Start</td>
<td>The procedure necessary for recovery of the Kenya National Transmission System from Total Shutdown or Partial Shutdown</td>
</tr>
<tr>
<td>Black Start Capability</td>
<td>Ability in respect of a Generating Plant, for 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</td>
</tr>
<tr>
<td>Chairperson</td>
<td>The person duly appointed by the Regulatory Authority to be Chairperson of the Kenya National Transmission Grid 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 Transmission Grid Code Review Committee the absence of the Chairperson or his alternate.</td>
</tr>
<tr>
<td>Check Meter</td>
<td>A Meter nominated to provide electrical energy measurements at a Defined Metering Point for verification or substitution of the Main Meter.</td>
</tr>
<tr>
<td>Conductor</td>
<td>An electrical conductor connected or arranged to be electrically connected to a system</td>
</tr>
<tr>
<td>Confidential Information</td>
<td>Information which is or has been provided under or, in connection with the Kenya National Transmission Grid Code and which is stated under the Code or by the Regulatory Authority to be Confidential Information.</td>
</tr>
<tr>
<td>Connection</td>
<td>Physical link to or through a transmission/distribution network that will allow the supply of electricity between electrical systems.</td>
</tr>
<tr>
<td>Connection Agreement</td>
<td>A bilateral agreement made between the Kenya National TSO or a TNSP and a User setting out the terms and conditions relating to the use of the Connection Point and other specific provisions in relation to that</td>
</tr>
<tr>
<td><strong>Word or Phrase</strong></td>
<td><strong>Definition</strong></td>
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</tr>
<tr>
<td>connection</td>
<td>The physical point at which a User is connected to the Kenya National Transmission System; the electrical node on a transmission system where a User’s assets are physically connected to the TNSP’s assets.</td>
</tr>
<tr>
<td>Contingency</td>
<td>An unexpected incident, failure or Outage of an interconnected system component, such as a Generating Plant, transmission line, circuit breaker, switch or other electrical element. A Contingency may also include multiple components, which are related by situations leading to simultaneous component Outages.</td>
</tr>
<tr>
<td>Control Area</td>
<td>An area comprised of an electric system or systems, bounded by interconnection metering, capable of regulating its generation in order to maintain its interchange schedule with other electric systems or Control Areas and to contribute its frequency bias obligation to the Kenya National Transmission System.</td>
</tr>
<tr>
<td>Control Area Operator</td>
<td>The Kenya National Transmission System Operator or another TSO responsible for operating, monitoring, and ensuring interchange scheduling of its Control Area.</td>
</tr>
<tr>
<td>Control Centre</td>
<td>A physical location from which a TSO exercises control over its transmission area.</td>
</tr>
<tr>
<td>Current Transformer (CT)</td>
<td>An electric device that produces an alternating current (AC) in its secondary circuit which is proportional to the AC in its primary circuit. When a current is too high to measure directly or the voltage of the circuit is too high, a current transformer can be used to provide an isolated lower current suitable for measuring instruments.</td>
</tr>
<tr>
<td>Customer</td>
<td>A person or entity obtaining electricity services from a Licensee.</td>
</tr>
<tr>
<td>Data Collection System, EAPP (EAPP DCS)</td>
<td>A computer based system that collects or receives data on a routine basis from Metering Equipment.</td>
</tr>
<tr>
<td>Defined Metering Point (DMP)</td>
<td>The DMP is at the Interchange Point within a Control Area and means the physical location at which overall accuracy requirements as defined in the IMC are to be met. The DMP shall be defined in the relevant Connection Agreement. Each single circuit interconnection between Control Areas will have two DMPs, one in each Control Area.</td>
</tr>
<tr>
<td>Derogation</td>
<td>A waiver issued by the Regulatory Authority to suspend a Transmission Licensee, Distribution Licensee’s, or User’s obligations to implement or comply with a provision of the KNTGC.</td>
</tr>
<tr>
<td>Dispatchable Resource</td>
<td>1) A generation plant that can be turned on or off or can adjust power output upon request by the Kenya National TSO; 2) A customer participating as a demand side resource that can comply with Kenya National TSO instructions to reduce electricity usage.</td>
</tr>
<tr>
<td>Dispute</td>
<td>Any difference between the Regulatory Authority and any Transmission Licensee or Distribution Licensee or User in connection with, or arising out of, the interpretation, implementation or breach of any provision of the KNTGC.</td>
</tr>
<tr>
<td>Dispute Notice</td>
<td>A written notice issued by either Party to a Dispute outlining the matter of</td>
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<tr>
<td>such Dispute</td>
<td></td>
</tr>
<tr>
<td>Distribution Licence</td>
<td>A licence granted by the Regulatory Authority to own and / or operate a Distribution System in Kenya</td>
</tr>
<tr>
<td>Distribution Licensee</td>
<td>An entity granted a licence by the Regulatory Authority for the ownership and / or operation and maintenance of a distribution system in Kenya</td>
</tr>
<tr>
<td>Distribution Network</td>
<td>A power delivery system that delivers electric power from electrical substation at sub-transmission level to the end users. Distribution networks consist of: (a) Distribution substation; (b) Primary distribution feeder; (c) Distribution Transformers; (d) Distributors; and (e) Service mains</td>
</tr>
<tr>
<td>Distribution System</td>
<td>A Distribution Network, together with the connection assets associated with the Distribution Network, which is connected to another transmission or Distribution System.</td>
</tr>
<tr>
<td>EAPP Coordination Centre (EAPP CC)</td>
<td>Body established under the guidance of the EAPP Sub-Committee on Operation responsible for the collection of technical and commercial information</td>
</tr>
<tr>
<td>EAPP Independent Regulatory Board</td>
<td>Board consisting of nominees of national regulatory boards in the EAPP countries that is the regulatory body governing the EAPP IC</td>
</tr>
<tr>
<td>EAPP Interconnected Transmission System</td>
<td>The transmission system in Eastern Africa consisting of two or more individual National Systems or Control Areas that normally operate in synchronism and are physically interconnected via transmission facilities</td>
</tr>
<tr>
<td>EAPP Sub-committee on Planning</td>
<td>EAPP body under the direction of EAPP Steering Committee responsible for the coordination of Master Plans and development programs of EAPP Member utilities</td>
</tr>
<tr>
<td>Eastern African Power Pool</td>
<td>Eastern Africa Power Pool (EAPP) is a regional intergovernmental body based in Addis Ababa, Ethiopia. Its mission is the pooling of electrical energy resources in a coordinated and optimized manner to provide an affordable, sustainable and reliable electricity in the region.</td>
</tr>
<tr>
<td>Eastern Africa Power Pool and East African Community Interconnection Code</td>
<td>The Interconnection Code that sets down the technical rules for the coordinated planning and operation of the EAPP</td>
</tr>
<tr>
<td>Electric Supply Line</td>
<td>Any wire, conductor or other means used or intended to be used for the purpose of importing, exporting, generating, transmitting, distributing, supplying or using electrical energy, together with any casing, coating, covering, tube, pipe, insulator or support enclosing, surrounding or supporting the same or any part thereof, or any apparatus (including apparatus for switching, controlling, transforming, converting or otherwise regulating electric energy,) ancillary thereto, but does not include any telegraph or telephone line</td>
</tr>
<tr>
<td>Electrical Energy</td>
<td>Energy involving the use of electric current which may be produced either by mechanical, chemical, photovoltaic or any other means</td>
</tr>
<tr>
<td><strong>Word or Phrase</strong></td>
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<tr>
<td>Electrical Plant</td>
<td>Any plant, equipment, apparatus or appliance used for, or for purposes connected with the importation, exportation, generation, transmission, distribution and supply of electricity, other than: (a) an electric supply line; (b) a meter; or (c) an electrical appliance under the control of a customer</td>
</tr>
<tr>
<td>Environmental, Health and Safety Obligations</td>
<td>Obligations placed on Licensees by the Energy Act and other applicable regulations in Kenya</td>
</tr>
<tr>
<td>Emergency Reserve</td>
<td>Refer to Reserve, Emergency</td>
</tr>
<tr>
<td>End-use User</td>
<td>A Customer of the KTNS that contracts for purchase of electrical energy for his own use, not for delivery or supply to another person</td>
</tr>
<tr>
<td>Energy</td>
<td>Any source of electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, or thermal power for any use; and includes electricity, petroleum and other fossil fuels, geothermal steam, biomass and all its derivatives, municipal waste, solar, wind and tidal wave power</td>
</tr>
<tr>
<td>Energy Act</td>
<td>The Energy Act, No 12, of 2006</td>
</tr>
<tr>
<td>Energy Tribunal</td>
<td>The Energy Tribunal established under the Energy Act</td>
</tr>
<tr>
<td>Ethernet</td>
<td>Communication networks protocols or rules, to exchange information through a single shared connection</td>
</tr>
<tr>
<td>Expected Unserved Energy</td>
<td>A forecast of the aggregate amount by which the demand for electricity exceeds the supply of electricity</td>
</tr>
<tr>
<td>External System</td>
<td>Any electric system outside EAPP that interconnects to the EAPP Interconnected Transmission System</td>
</tr>
<tr>
<td>Financial Year</td>
<td>July 1 – June 30</td>
</tr>
<tr>
<td>Force Majeure</td>
<td>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, wars, sabotage, riots, hurricanes and other actions of the elements, civil disturbances and strikes as set out in Chapter 4 (Governance).</td>
</tr>
<tr>
<td>Gazettement</td>
<td>Publishing of enacted regulations in the Kenya Gazette</td>
</tr>
<tr>
<td>Generating Plant</td>
<td>Any electric power facility or Apparatus delivering electrical energy to the Kenya National Transmission System. Generating Plants shall be understood to be comprised of one or more units which make up the total plant capacity and may be individually controllable</td>
</tr>
<tr>
<td>Generating Unit</td>
<td>As defined in the EAPP IC, any electric power Generating Plant or Apparatus delivering electrical energy to the EAPP Interconnected Transmission System. This is the term used by the EAPP IC for a Generating Plant</td>
</tr>
<tr>
<td>Generation Licence</td>
<td>A licence authorising an entity to generate electrical energy</td>
</tr>
<tr>
<td>Generation Licensee</td>
<td>An entity licensed by the Regulatory Authority to own, operate and maintain generation assets and generate electricity within the Kenya National Transmission System</td>
</tr>
<tr>
<td>Government</td>
<td>The Government of Kenya</td>
</tr>
<tr>
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<td>Definition</td>
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<tr>
<td>Governor</td>
<td>Automatic control system which maintains the desired system frequency by adjusting the mechanical power output of the turbine</td>
</tr>
<tr>
<td>Grid</td>
<td>The network of transmission systems, distribution systems and connection points for the movement and supply of electrical energy from Generating Plants to Customers</td>
</tr>
<tr>
<td>Grid Code Revision Register</td>
<td>A Register of all revisions to the Kenya National Transmission Grid Code as set out in Chapter 4 (Governance)</td>
</tr>
<tr>
<td>Inadvertent Deviation</td>
<td>Difference between net actual energy flow and net scheduled energy flow into or out of the Control Area</td>
</tr>
<tr>
<td>Independent Expert</td>
<td>A well-qualified person with broad proven experience who provides advice to the Kenya National Transmission Grid Code Review Committee on issues concerning the Grid Code</td>
</tr>
<tr>
<td>Independent Regulatory Board</td>
<td>Regulatory body of EAPP which consists of nominees of national regulatory boards of EAPP Member Countries with the responsibilities provided for in the IG-MoU</td>
</tr>
<tr>
<td>Induction Generator</td>
<td>A type of alternating current (AC) electrical generator that uses the principles of induction motors to produce power</td>
</tr>
<tr>
<td>Induction Motor</td>
<td>An AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding</td>
</tr>
<tr>
<td>Installation</td>
<td>Includes all material, wiring or apparatus situated upon any premises for use or intended for use in connection with the supply of electrical energy to such premises</td>
</tr>
<tr>
<td>Instantaneous Reserve</td>
<td>Refer to Reserve, Instantaneous</td>
</tr>
<tr>
<td>Interchange Point (IP)</td>
<td>A location where power flows from one Control Area to another Control Area</td>
</tr>
<tr>
<td>Interchange Metering</td>
<td>Metering Equipment at Interchange Points normally consisting of continuous MW metering for AGC purposes and MWh metering for the accounting of Inadvertent Deviations from Interchange Schedules</td>
</tr>
<tr>
<td>Interconnection Agreement</td>
<td>An agreement made between the Kenya National Transmission System Operator and a Transmission System Operator of another EAPP Member Country, relating to the transfer of power and or Active and or Reactive Energy and or Ancillary Services between their respective electric systems</td>
</tr>
<tr>
<td>Inter-Governmental Memorandum of Understanding (IG-MoU)</td>
<td>A binding agreement that enabled the establishment of EAPP. The document covers issues such as the members, obligations, organisational structure, resources, arbitration, and enforcement of EAPP</td>
</tr>
<tr>
<td>Inter-Utility Memorandum of Understanding (IU-MoU)</td>
<td>A binding agreement between utilities of Member Countries of EAPP which defines the fundamental principles for the management and operation of the EAPP</td>
</tr>
<tr>
<td>Kenya Bureau of Standards (KS IEC)</td>
<td>The set of IEC standards approved and adopted by the Kenya Bureau of Standards</td>
</tr>
<tr>
<td>Kenya Electricity Grid Code (KEGC)</td>
<td>The Grid Code for Kenya that was drafted in 2008 but never officially adopted/gazetted</td>
</tr>
<tr>
<td>Word or Phrase</td>
<td>Definition</td>
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<tr>
<td>Kenya Gazette</td>
<td>An official weekly publication of the Government of the Republic of Kenya, publishing notices of new legislation, notices required to be published by law or policy, and announcements for general public information</td>
</tr>
<tr>
<td>Kenya National Distribution System</td>
<td>The electric distribution system in Kenya</td>
</tr>
<tr>
<td>Kenya National Transmission System (KNTS)</td>
<td>The electricity transmission system of Kenya including all Users connected to that system</td>
</tr>
<tr>
<td>Kenya National Transmission System Grid Code Review Committee</td>
<td>The Committee established in accordance with Chapter 4 (Governance) of the Kenya National Transmission Grid Code and charged with providing recommendations to the Regulatory Authority on the review and revision of the KNTGC. The Kenya National Transmission Grid Code Review Committee shall be governed by the provisions set out in Section 4.5 of the KNTGC</td>
</tr>
<tr>
<td>Kenya National Transmission System Operator (TSO)</td>
<td>The entity responsible for the planning and operation of the Kenya National Transmission System, including the scheduling and dispatch of Generating Plants connected to it</td>
</tr>
<tr>
<td>Licence</td>
<td>Licence as defined in the Energy Act</td>
</tr>
<tr>
<td>Licensee</td>
<td>Holder of a licence under the Energy Act</td>
</tr>
<tr>
<td>Main Meter</td>
<td>The Meter nominated to provide electrical energy measurements at a Defined Metering Point</td>
</tr>
<tr>
<td>Maintenance Plan</td>
<td>Coordinated list of all planned transmission and generation Outages</td>
</tr>
<tr>
<td>Maintenance Outage</td>
<td>Scheduled removal from service, in whole or in part of a Generating Plant or transmission facility in order to perform necessary repairs on specific components of the facility</td>
</tr>
<tr>
<td>Member, Kenya National Transmission Grid Code Review Committee</td>
<td>A person duly appointed to be a Member of or the Chairperson of the Kenya National Transmission Grid Code Review Committee</td>
</tr>
<tr>
<td>Member Country</td>
<td>An eastern Africa country whose government has signed the IG-MoU</td>
</tr>
<tr>
<td>Member Utility</td>
<td>Public or concessionary utility in charge of power generation, transmission, and/or distribution and who has fulfilled membership conditions of the EAPP(which include signing the IU-MoU)</td>
</tr>
<tr>
<td>Meter</td>
<td>A device complying with Kenya Standards which measures and records the production or consumption of electrical energy. Any and every kind of machine, device or instrument used for the measurement of the quantity of electrical energy.</td>
</tr>
<tr>
<td>Meter Information Register (MIR)</td>
<td>A system which uniquely identifies the Meter and Users associated with the Meter and contain pertinent data relating to the Meter</td>
</tr>
<tr>
<td>Metering Equipment</td>
<td>Meters, time-switches, measurement transformers, metering protection and isolation equipment, circuitry and their associated data storage and data communications equipment and wiring which are part of the Active Energy and Reactive Energy measuring equipment at or relating to the Defined Metering Point</td>
</tr>
<tr>
<td>Word or Phrase</td>
<td>Definition</td>
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</tr>
<tr>
<td>Ministry of Energy and Petroleum</td>
<td>Within the Government of Kenya, the Ministry responsible for the power sector</td>
</tr>
<tr>
<td>National System</td>
<td>The electricity transmission system of an EAPP Member Country including all Users connected to that system. For the purposes of the KNTGC, refers to the Kenya National Transmission System</td>
</tr>
<tr>
<td>Neighbouring System</td>
<td>Any system or Control Area either directly interconnected with or electrically close to the EAPP Interconnected Transmission System so as to be significantly affected by it</td>
</tr>
<tr>
<td>Operating Margins</td>
<td>Generating capability in MW above firm System Demand available to provide for regulation, load-forecasting error, equipment forced and scheduled outage</td>
</tr>
<tr>
<td>Operational Effect</td>
<td>An effect which causes the Kenya National Transmission System to operate (or be at a materially increased risk of operating) differently to the way in which it would or may have normally operated in the absence of such effect</td>
</tr>
<tr>
<td>Operational Plan</td>
<td>The plan issued each day containing details of all Outages of Generating Plants and Transmission equipment, details of anticipated transfers, transmission constraints, Contingency plans and any other relevant information</td>
</tr>
<tr>
<td>Outage</td>
<td>Disconnection or separation, planned or unplanned of one or more elements of the Kenya National Transmission System</td>
</tr>
<tr>
<td>Partial Shutdown</td>
<td>The same as a Total Shutdown except that all generation has ceased in a separate part of the Kenya National Transmission System and there is no supply from External Systems or other parts of the Kenya National Transmission System and therefore that part of the interconnected system is Shutdown</td>
</tr>
<tr>
<td>Parliament</td>
<td>The Parliament of Kenya is the bicameral legislature of Kenya, consisting of two houses: the Senate and the National Assembly</td>
</tr>
<tr>
<td>Party</td>
<td>In a general sense refers to any person or entity with the specific meaning ascribed in the related provision of the Kenya National Transmission Grid Code</td>
</tr>
<tr>
<td>Person</td>
<td>Any public or local authority, company, person or body of persons</td>
</tr>
<tr>
<td>Photovoltaic Solar Plant</td>
<td>Generate electricity directly from sunlight via an electronic process that occurs naturally in semiconductors</td>
</tr>
<tr>
<td>Planned Outage</td>
<td>An Outage for which at least ten (10) days notice has been given to allow the Outage to be planned in accordance with the Outage Planning Process as described in Chapter 8 (Operations Code No. 1 - Operations Planning)</td>
</tr>
<tr>
<td><strong>Word or Phrase</strong></td>
<td><strong>Definition</strong></td>
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</tr>
<tr>
<td>Planning and Development Organisations</td>
<td>Those entities that have responsibility for the planning and development of transmission, distribution, and generation in Kenya. These entities include but are not limited to the Kenya National TSO, the Regulatory Authority, Transmission Licensees, Distribution Licensees, and Generation Licensees.</td>
</tr>
<tr>
<td>Plant</td>
<td>Fixed and movable equipment used in the generation and/or supply and/or transmission of electricity other than Apparatus</td>
</tr>
<tr>
<td>Power</td>
<td>Electrical power or the quantity of electrical energy per unit of time</td>
</tr>
<tr>
<td>Power Balance Statement</td>
<td>Forecast produced by TSOs for each National System of their expected demand and generation over the planning horizon as set out in Chapter 5 (Planning)</td>
</tr>
<tr>
<td>Power Island</td>
<td>Has the meaning set out in Chapter 10 (Emergency Operations)</td>
</tr>
<tr>
<td>Power System Security</td>
<td>Safe scheduling, operation and control of the power system on a continuous basis</td>
</tr>
<tr>
<td>Power System Stabiliser (PSS)</td>
<td>Equipment controlling the Exciter output via the voltage regulator in such a way that power oscillations of the synchronous machines are dampened. Input variables may be speed, frequency or power (or a combination of these)</td>
</tr>
<tr>
<td>Power Transfer</td>
<td>Instantaneous rate at which active energy is transferred between connection points</td>
</tr>
<tr>
<td>Power Transfer Capability</td>
<td>Maximum permitted power transfer through a transmission or Distribution Network or part thereof</td>
</tr>
<tr>
<td>Premises</td>
<td>Includes any land, land under water, building or structure</td>
</tr>
<tr>
<td>President</td>
<td>The President of the Republic of Kenya</td>
</tr>
<tr>
<td>Primary Response</td>
<td>The immediate automatic proportional increase or decrease of real power output by synchronised Generating Plants and other devices due to a rise or fall in the Kenya National Transmission System frequency requiring changes in the Generating Plants Active Power output to restore the frequency to within operational limits as defined in Chapter 15 (ISBC 2 Balancing and Frequency Control)</td>
</tr>
<tr>
<td>Prudent Utility Practice</td>
<td>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 experienced operatives engaged in the same type of undertaking under the same or similar conditions</td>
</tr>
<tr>
<td>Ramp Rate</td>
<td>Rate of change of electricity produced from a Generating Plant</td>
</tr>
<tr>
<td>Reactive Energy</td>
<td>A measure, in varhours (varh) of the alternating exchange of stored energy in inductors and capacitors, which is the time-integral of the</td>
</tr>
<tr>
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<td>Definition</td>
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</tr>
<tr>
<td>Reactive Power</td>
<td>Instantaneous power derived from the product of voltage and current and the sine of the voltage-current phase angle, which is measured in units of vars and multiples thereof</td>
</tr>
<tr>
<td>Regional Control Centre (RCC)</td>
<td>A control centre responsible for the operation and maintenance of the Distribution Network in a region of Kenya</td>
</tr>
<tr>
<td>Regulatory Authority</td>
<td>Kenyan energy regulatory body established by the Energy Act</td>
</tr>
<tr>
<td>Remaining Capacity</td>
<td>The difference between available generating capacity and demand at the reference dates and calculated under normal climatic conditions as stated in Chapter 5 (Planning)</td>
</tr>
<tr>
<td>Remedial Action Scheme (RAS)</td>
<td>Also referred to as Special Protection System. RAS means a protection system that automatically initiates one or more control actions following electrical disturbances. Typical examples include tripping Generating Plants or loads and switching of series capacitors, shunt capacitors, or shunt reactors</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>All non-fossil sources including, but not limited to biomass, geothermal, small hydropower, solar, wind, sewage treatment and plant gas</td>
</tr>
<tr>
<td>Renewable Power Plant (RPP)</td>
<td>For the purposes of the KNTGC, a Generating Plant whose primary energy source is from wind or solar energy and whose generation output is variable in nature</td>
</tr>
<tr>
<td>Reserve</td>
<td>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 or less 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</td>
</tr>
<tr>
<td>Reserve, Regulating</td>
<td>Regulating reserve is reserve that is under central AGC and can respond within ten seconds and be fully active within ten (10) minutes of activation. This reserve is used for second-by-second balancing of supply and demand. The reserve is also used to restore instantaneous reserve within ten (10) minutes of the disturbance. The provision of Regulating Reserve is a Secondary Response</td>
</tr>
<tr>
<td>Reserve, Spinning</td>
<td>In Kenya, Spinning Reserve is made available as needed to arrest the frequency at acceptable limits following a Contingency, such as a unit trip or a sudden surge in load. The provision of Spinning Reserve is a Primary Response</td>
</tr>
<tr>
<td>Reserve, Tertiary</td>
<td>Refer to Tertiary Reserve</td>
</tr>
<tr>
<td>Response</td>
<td>The provision of a Reserve</td>
</tr>
<tr>
<td>Response, Primary</td>
<td>Refer to Primary Response</td>
</tr>
<tr>
<td>Response, Secondary</td>
<td>Refer to Secondary Response</td>
</tr>
<tr>
<td>Rota Load Disconnection</td>
<td>A planned temporary disconnection of electricity to customers, for a set</td>
</tr>
<tr>
<td><strong>Word or Phrase</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>duration.</td>
<td></td>
</tr>
<tr>
<td>RSA ID</td>
<td>RSA ID is a two-factor authentication technology that is used to protect network resources. The two factors typically are: (a) a password or PIN; and (b) an authenticator, could be a hardware token (such as a USB token, smart card or key fob). The software token is the RSA Authentication Manager Software that provides the security engine used to verify authentication requests</td>
</tr>
<tr>
<td>SAIDI (System Average Interruption Duration Index)</td>
<td>SAIDI indicates average minutes of service interruption per customer. It is the sum total of customer minutes interrupted divided by the total number of customers served. SAIDI is considered as one of the best indicators of system stress</td>
</tr>
<tr>
<td>SAIFI (System Average Interruption Frequency Index)</td>
<td>SAIFI is the sum total of number of interruptions divided by the total number of customers</td>
</tr>
<tr>
<td>Secondary Response</td>
<td>Secondary Response is the automatic response to a frequency change which is fully available by thirty (30) seconds from the time of frequency change to take over from Primary Response, and which is sustainable for a period of at least thirty (30) minutes. Secondary Response is provided by Generating Plants already synchronised to the KNTS and is normally controlled by the Kenya National TSO by AGC</td>
</tr>
<tr>
<td>Secretary, Kenya National Transmission Grid Code Review Committee</td>
<td>The person appointed by the Regulatory Authority to the Kenya National Grid Code Review Committee and named as such</td>
</tr>
<tr>
<td>Significant Incident</td>
<td>An event which has caused or could have caused injury to persons, damage to system equipment or operation of the Kenya National Transmission System outside the operational security standards</td>
</tr>
<tr>
<td>Solar Power Generating Plant</td>
<td>A Generating Plant deriving its source of energy from the sun and for which its generation is variable in nature</td>
</tr>
<tr>
<td>Special Protection System</td>
<td>Refer to Remedial Action Scheme</td>
</tr>
<tr>
<td>Spinning Reserve</td>
<td>See Reserve, Spinning</td>
</tr>
<tr>
<td>Steering Committee</td>
<td>The body established by EAPP in accordance with the Inter-Government Memorandum of Understanding and responsible for the Governance of EAPP</td>
</tr>
<tr>
<td>Sub-committee on Planning</td>
<td>EAPP body under the direction of EAPP Steering Committee responsible for the coordination of Master Plans and development programs of EAPP Member utilities</td>
</tr>
<tr>
<td>Switchyard</td>
<td>Connection point of a Generating Plant into the network, generally involving the ability to connect the Generating Plant to one or more outgoing network circuits</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>The connecting of a Generating Plant to the power system</td>
</tr>
<tr>
<td>Synchronous Generator</td>
<td>Alternating current Generating Plants of mostly thermal and hydro (water) driven power turbines which operate at the equivalent speed of frequency of the power system in its satisfactory operating state</td>
</tr>
<tr>
<td>Word or Phrase</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>System</td>
<td>An electrical system or grid in which all the conductors and apparatus are electrically connected to a common source of electrical energy</td>
</tr>
<tr>
<td>System Operation</td>
<td>Performance of generation scheduling, commitment and dispatch, scheduling of transmission and ancillary services, and generation outage coordination, transmission congestion management and coordination, and such other activities as may be required for the reliable and efficient operation of the grid</td>
</tr>
<tr>
<td>System Operator</td>
<td>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</td>
</tr>
<tr>
<td>System Tests</td>
<td>Those tests that involve either a simulated or a controlled application of irregular, unusual, or extreme conditions on the Interconnected Transmission System. In addition, they include commissioning and or acceptance tests on Plant and Apparatus to be carried out by a User that may have a significant impact upon the Kenya National Transmission System and or another National System</td>
</tr>
<tr>
<td>Tariff</td>
<td>A set of prices, rates, charges, and any cost associated with capacity, supply and delivery of electrical energy (which may vary by category of customers, service voltage or time of use, and may include any adjustments or formulae therefor), as approved by the Regulatory Authority pursuant to Section 45 of the Energy Act</td>
</tr>
<tr>
<td>Tertiary Reserve</td>
<td>Refers to TSO instructed changes in the dispatching and commitment of Generating Plants. Tertiary Reserve is used to restore both Primary and Secondary Response, to manage constraints on the KNTS and to bring the frequency to target values when the Secondary Response has been depleted. Where Tertiary Reserve is held on Generating Plants not synchronised to the KNTS, the Generating Plants shall be capable of being synchronised within a specified time generally between fifteen (15) minutes and one (1) hour</td>
</tr>
<tr>
<td>Test Proposal</td>
<td>Outline provided in writing of the actions proposed to be carried out as part of tests involving Plant and Apparatus forming part of the EAPP Interconnected Transmission System</td>
</tr>
<tr>
<td>Test Proposer</td>
<td>The Party proposing System Tests</td>
</tr>
<tr>
<td>Total Shutdown</td>
<td>The situation existing when all generation has ceased within the Kenya National Transmission System and there is no supply from External Systems and, therefore, the Kenya National Transmission System has shutdown</td>
</tr>
<tr>
<td>Transmission</td>
<td>The operation, management or control of facilities, consisting of high voltage electric supply lines for movement of electrical energy in bulk between Generating Plants and transmission substations for the purposes of enabling supply to customers</td>
</tr>
<tr>
<td>Transmission Licence</td>
<td>Any document or instrument authorising a person to own transmission infrastructure and transmit electrical energy in the manner described in such document or instrument. Such licence may also entitle the licensee to carry</td>
</tr>
<tr>
<td><strong>Word or Phrase</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Transmission Licensee</td>
<td>An entity that is licensed by the Regulatory Authority to own, operate and maintain transmission assets within the Kenya National Transmission System</td>
</tr>
<tr>
<td>Transmission Metering Administrator</td>
<td>The entity responsible for transmission metering installation, maintenance, and operation</td>
</tr>
<tr>
<td>Transmission Network Service Provider</td>
<td>An entity that operates and maintains a transmission network on the KNTS</td>
</tr>
<tr>
<td>Transmission System Capability Statement</td>
<td>Assessment by EAPP Sub-committee on Planning and TSOs of the capability of the EAPP Interconnected Transmission System to support the required energy flows across both Systems and cross-border connections as set out in Chapter 5 (Planning)</td>
</tr>
<tr>
<td>Tribunal</td>
<td>The Energy Tribunal</td>
</tr>
<tr>
<td>Transmission System Operator (TSO)</td>
<td>The entity responsible for the overall coordination of the planning and operation of the Transmission System, including the scheduling and dispatch of Generating Plants connected to it</td>
</tr>
<tr>
<td>Unplanned Outage</td>
<td>Any Outage which was not planned with at least ten (10) days’ notice</td>
</tr>
<tr>
<td>User</td>
<td>Any person or entity connected to or making use of the Kenya National Transmission System as a Generation Licensee, Transmission Licensee, Distribution Licensee or End-use User</td>
</tr>
<tr>
<td>User System</td>
<td>The system of a Distribution Licensee, a Transmission Licensee, or a system owned or operated by a End-Use Customer comprising Generating Plants Apparatus connecting Generating Plants and/or End-use Users’ equipment to the Kenya National Transmission System</td>
</tr>
<tr>
<td>Vars</td>
<td>Unit of measure of Reactive Power</td>
</tr>
<tr>
<td>Voltage</td>
<td>The effective difference of electrical potential between any two conductors, or between a conductor and the earth, and is said to be: (a) low when it does not exceed 1,000 volts under normal conditions, subject however to the percentage variation allowed by any regulations made under the Energy Act; (b) medium when it exceeds 1,000 volts but does not exceed 33,000 volts under normal conditions, subject however to the percentage variation allowed by any regulations made under the Energy Act; (c) high when it normally exceeds 33,000 volts under normal conditions, subject to the percentage variation allowed by any regulations made under the Energy Act</td>
</tr>
<tr>
<td>Voltage Dip</td>
<td>A voltage reduction with duration of 10 ms to 1 minute and a voltage drop of more than 10% of the existing value</td>
</tr>
<tr>
<td>Voltage Flicker</td>
<td>The impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time caused by an increase or decrease in voltage</td>
</tr>
<tr>
<td>Voltage Transformer (VT)</td>
<td>Voltage Transformers are necessary for isolating the protection, control and measurement equipment from the high voltages of a power system, and for supplying the equipment with the appropriate values voltage</td>
</tr>
</tbody>
</table>
Wind Turbine Generating Plant

A Generating Plant generating electricity from wind, and whose generation is variable in nature

### 2.3 LIST OF ABBREVIATIONS

The table below provides a summary of the abbreviations used in the KNTGC.

**Table 2-2: Abbreviations used in the KNTGC**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>ACE</td>
<td>Area Control Error</td>
</tr>
<tr>
<td>AEMO</td>
<td>Australian Energy Market Operator</td>
</tr>
<tr>
<td>AfDB</td>
<td>African Development Bank</td>
</tr>
<tr>
<td>AGC</td>
<td>Automatic Generation Control</td>
</tr>
<tr>
<td>AMP</td>
<td>Actual Metering Point</td>
</tr>
<tr>
<td>AS</td>
<td>Ancillary Services</td>
</tr>
<tr>
<td>AVR</td>
<td>Automatic Voltage Regulator</td>
</tr>
<tr>
<td>CAIDI</td>
<td>Customer Average Interruption Duration Index</td>
</tr>
<tr>
<td>CC</td>
<td>Connections Chapter</td>
</tr>
<tr>
<td>CDs</td>
<td>Compact Disks</td>
</tr>
<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
</tr>
<tr>
<td>COMESA</td>
<td>Common Market for Eastern and Southern Africa</td>
</tr>
<tr>
<td>COUE</td>
<td>Cost of Unserved Energy</td>
</tr>
<tr>
<td>CT</td>
<td>Current Transformer</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>DCF</td>
<td>Discounted Cash Flow</td>
</tr>
<tr>
<td>DCS</td>
<td>Data Collection System</td>
</tr>
<tr>
<td>DEC</td>
<td>Data Exchange Chapter</td>
</tr>
<tr>
<td>DER</td>
<td>Distributed Energy Resources</td>
</tr>
<tr>
<td>DMP</td>
<td>Defined Metering Point</td>
</tr>
<tr>
<td>DR</td>
<td>Demand Response</td>
</tr>
<tr>
<td>DTE</td>
<td>Data Terminal Equipment</td>
</tr>
<tr>
<td>DVDs</td>
<td>Digital Video Disks</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Meaning</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>EAC</td>
<td>East African Community</td>
</tr>
<tr>
<td>EAPP</td>
<td>Eastern Africa Power Pool</td>
</tr>
<tr>
<td>EAPP CC</td>
<td>Eastern Africa Power Pool Communications Centre</td>
</tr>
<tr>
<td>EAPP DCS</td>
<td>EAPP Data Collection System</td>
</tr>
<tr>
<td>EAPP IC</td>
<td>Eastern Africa Power Pool and East African Community Interconnection Code</td>
</tr>
<tr>
<td>EHV</td>
<td>Extra High Voltage</td>
</tr>
<tr>
<td>EMS</td>
<td>Energy Management System</td>
</tr>
<tr>
<td>ENTSO-E</td>
<td>European Network of Transmission System Operators for Electricity</td>
</tr>
<tr>
<td>EUE</td>
<td>Expected Unserved Energy</td>
</tr>
<tr>
<td>FACTS</td>
<td>Flexible Alternating Current Transmission System</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>GC</td>
<td>General Conditions</td>
</tr>
<tr>
<td>GCR</td>
<td>Generation Plant Connection Requirements, as defined in Section 6.2 of the KNTGC</td>
</tr>
<tr>
<td>GD</td>
<td>Glossary and Definitions</td>
</tr>
<tr>
<td>GoK</td>
<td>Government of Kenya</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Position System</td>
</tr>
<tr>
<td>HV</td>
<td>High Voltage</td>
</tr>
<tr>
<td>HVDC</td>
<td>High Voltage Direct Current</td>
</tr>
<tr>
<td>IC</td>
<td>Interconnected System</td>
</tr>
<tr>
<td>ICCP</td>
<td>Inter-Control Centre Communications Protocol</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electro-technical Commission</td>
</tr>
<tr>
<td>IG-MoU</td>
<td>Inter-Governmental Memorandum of Understanding</td>
</tr>
<tr>
<td>IMC</td>
<td>Interchange Metering Chapter</td>
</tr>
<tr>
<td>IP</td>
<td>Interchange Point</td>
</tr>
<tr>
<td>ISBC 1, ISBC 2, ISBC 3</td>
<td>Interchange Scheduling and Balancing Chapters 14, 15 and 16 of the KNTGC</td>
</tr>
<tr>
<td>ISO</td>
<td>International Standard Organisation</td>
</tr>
<tr>
<td>IU-MoU</td>
<td>Inter-Utility Memorandum of Understanding</td>
</tr>
<tr>
<td>KEGC</td>
<td>Kenya Electricity Grid Code</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Meaning</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>KNDS</td>
<td>Kenya National Distribution System</td>
</tr>
<tr>
<td>KNTS</td>
<td>Kenya National Transmission System</td>
</tr>
<tr>
<td>KMC</td>
<td>Kenya Metering Code</td>
</tr>
<tr>
<td>KNTGC</td>
<td>Kenya National Transmission Grid Code</td>
</tr>
<tr>
<td>KS IEC</td>
<td>Kenya Standard IEC</td>
</tr>
<tr>
<td>LIWL</td>
<td>Lightning Impulse Withstand Level</td>
</tr>
<tr>
<td>LTWP</td>
<td>Lake Turkana Wind Power</td>
</tr>
<tr>
<td>MCR</td>
<td>Maximum Continuous Rating</td>
</tr>
<tr>
<td>MIR</td>
<td>Meter Information Register</td>
</tr>
<tr>
<td>MTBF</td>
<td>Meantime Between Failure</td>
</tr>
<tr>
<td>MTTR</td>
<td>Meantime To Repair</td>
</tr>
<tr>
<td>NERC</td>
<td>North American Electric Reliability Corporation</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>NTC</td>
<td>Net Transmission Capability</td>
</tr>
<tr>
<td>OC 1, OC 2, OC 3, OC 4, OC 5, OC 6</td>
<td>Operations Chapters 8, 9, 10, 11, 12 and 13 of the KNTGC</td>
</tr>
<tr>
<td>PC</td>
<td>Planning Chapter</td>
</tr>
<tr>
<td>PCC</td>
<td>Point of Common Coupling</td>
</tr>
<tr>
<td>PSS</td>
<td>Power System Stabiliser</td>
</tr>
<tr>
<td>PV</td>
<td>Photo Voltaic</td>
</tr>
<tr>
<td>QOS</td>
<td>Quality of Service</td>
</tr>
<tr>
<td>RAS</td>
<td>Remedial Action Scheme</td>
</tr>
<tr>
<td>RCC</td>
<td>Regional Control Centre</td>
</tr>
<tr>
<td>RPP</td>
<td>Renewable Power Plant</td>
</tr>
<tr>
<td>RTU</td>
<td>Remote Terminal Unit</td>
</tr>
<tr>
<td>SAIDI</td>
<td>System Average Interruption Duration Index</td>
</tr>
<tr>
<td>SAIFI</td>
<td>System Average Interruption Frequency Index</td>
</tr>
<tr>
<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
</tr>
<tr>
<td>SIWL</td>
<td>Switching Impulse Withstand Level</td>
</tr>
<tr>
<td>SMTP</td>
<td>Simple Mail Transfer Protocol</td>
</tr>
<tr>
<td>SO</td>
<td>System Operator, in Kenya</td>
</tr>
<tr>
<td>SOTC</td>
<td>System Operator Training Chapter</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Meaning</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>SPS</td>
<td>Special Protection Scheme</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>Transmission Control Protocol/Internet Protocol</td>
</tr>
<tr>
<td>TMA</td>
<td>Transmission Metering Administrator</td>
</tr>
<tr>
<td>TNSP</td>
<td>Transmission Network Service Provider</td>
</tr>
<tr>
<td>TSO</td>
<td>Transmission System Operator</td>
</tr>
<tr>
<td>UM</td>
<td>Voltage Maximum</td>
</tr>
<tr>
<td>UN</td>
<td>Voltage Nominal</td>
</tr>
<tr>
<td>VT</td>
<td>Voltage Transformer</td>
</tr>
<tr>
<td>WAN</td>
<td>Wide Area Network (computer network designed to cover a wide geographic region, usually over telephone lines)</td>
</tr>
</tbody>
</table>

### 2.4 List of Units

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

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

The General Conditions (GC) set out the over-riding principles to be used in the operation of the Kenya National Transmission System (KNTS) 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 KNTGC. The GC also deal with those aspects of the KNTGC not covered in other chapters, including the resolution of disputes, bilateral agreements, confidentiality, non-compliance and the revision of the KNTGC through recommendations of a Kenya National Transmission Grid Code Review Committee.

3.2 SCOPE

These General Conditions apply to the Regulatory Authority, the Kenya National TSO, and Users of the Kenya National Transmission System.

3.3 OBJECTIVE

The Generation Conditions contains provisions, which are of a general nature and apply to all chapters of the KNTGC. The objectives of the GC are to ensure, to the extent possible, that the various chapters of the KNTGC work together and work in practice for the benefit of the Kenya National TSO and Users.

3.4 IMPLEMENTATION AND ENFORCEMENT

The Regulatory Authority is responsible for the implementation and enforcement of the KNTGC.

The Regulatory Authority may, in certain cases, need access to services and facilities of Users, or to issue instructions to Users to implement and enforce the KNTGC. Accordingly, all Users are required not only to abide by the letter and spirit of the KNTGC, but also to provide the Regulatory Authority with such rights of access, services and facilities and to comply with any instructions of the Regulatory Authority.

Each Party shall, at all times, in its dealings with other Parties to the KNTGC act in good faith and in accordance with Prudent Utility Practice.

3.5 SAFETY AND ENVIRONMENT

Nothing in or pursuant to this KNTGC 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.
3.6 **UNFORESEEN CIRCUMSTANCES**

If circumstances arise which are not contemplated by the provisions of the *KNTGC*, the *Regulatory Authority* shall, to the extent reasonably practicable in the circumstances, consult promptly with all affected *Users* in an effort to reach agreement as to what should be done. If agreement between the *Regulatory Authority* and such *Users* cannot be reached in a reasonable time, the *Regulatory Authority* shall determine the best course of action in accordance with *Prudent Utility Practice*.

Each *User* shall comply with all instructions given to it by the *Regulatory Authority* following such a determination provided the instructions are consistent with the then current technical parameters of the *KNTS*. The *Regulatory Authority* shall, as soon as reasonably practicable following the unforeseen circumstances, notify all relevant details to the *Kenya National Transmission Grid Code Review Committee* for consideration and recommendations in accordance with Chapter 4 (Governance).

3.7 **FORCE MAJEURE**

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

Neither *Party* shall be held to have defaulted in respect of any obligation under the *KNTGC* 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 *KNTGC*, that *Party* shall:

a. Promptly notify any other *Party* involved and the *Regulatory 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 *Regulatory Authority* website.

b. Not be entitled to suspend performance of any of its obligations under the *KNTGC* 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 *Regulatory Authority* continually informed of its efforts, and

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

3.8 **COMPLIANCE**

a. All parties shall comply with the *KNTGC* as updated via *Regulatory Authority* decisions from time to time.
b. *Users* shall inform the *Regulatory Authority* of any non-compliance report without delay, but no later than thirty (30) days after becoming aware of the item unless there is significant risk to the *Kenya National Transmission System*, which then must be reported immediately.

c. The *Regulatory Authority* may require a participant to provide the *Regulatory Authority* with information that it deems necessary for the proper administration of the *KNTGC*. This information shall be treated as confidential.

d. Upon a report or suspicion of non-compliance the *Regulatory Authority* may seek to
   1. Resolve the issue through negotiation
   2. Take action in terms of the procedures for handling licensing contraventions
   3. Consider an application for amendment
   4. Consider an application for exemption.

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

### 3.9 Non-Compliance

If a *User* finds that it is, or will be unable to comply with any provision of this *KNTGC*, then that *Party* shall without delay, but not later than thirty (30) days after discovery, report such non-compliance to the *Regulatory Authority*.

#### 3.9.1 Non-Compliance Situations

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

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

a. Failure to provide the *Regulatory Authority*, on time, all required information in the *KNTGC*

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

c. Failure to implement in time the procedures and information systems required in the *KNTGC*

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

#### 3.9.2 Penalties

If the *Regulatory 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 *Regulatory Authority*, or is in violation of the terms of an approved *Derogation*, the *Regulatory Authority* will determine and apply a monetary penalty for the non-compliance situation. The amount of the penalty will be determined by the *Regulatory 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  

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

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

A *Party* seeking derogation from any provision in the *KNTGC* shall make a written request to the *Regulatory Authority* containing the following information. Refer also to the sample Request for *Derogation* form in Appendix A.  

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* sought is permanent exemption or for a delay in achieving compliance, and if a delay in achieving compliance is being sought, the date by which the mitigation plan will be filed and the non-compliance will be remedied;  
d. The specific provision of the *KNTGC* (section title and number) against which the present or predicted non-compliance is identified;  
e. The date of non-compliance discovery and reporting of the non-compliance;  
f. The nature and extent of the non-compliance;  
g. The cause for 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) including details of actions to:  
  1. Mitigate risks to *Customers* or other *Users*
2. 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 User is required to justify the derogation request in terms of both the specific circumstances and the expected duration. Users are advised to give as much notice as possible when making Derogation requests since Derogations will not be granted unless the Regulatory Authority is satisfied that the request is justified.

3.10.1 Derogation Review

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

The Regulatory Authority may initiate at its own initiative a review of any existing Derogations, and any Derogations under consideration where a relevant and material change in circumstance has occurred.

The Regulatory 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.

It may be the case that not all Plant and Apparatus in use as at the date of adoption of this KNTGC will be able to meet the requirements of the KNTGC. In some cases, it may not be economically or technically possible to upgrade such existing Plant and Apparatus to the required standards. Where this is the case the Regulatory Authority will give consideration to a time bound Derogation for all or part of the KNTGC.

In the event that Derogation is granted, the User shall take all necessary action to ensure full compliance with the Derogation.

Where a material change in circumstances has occurred, a review of any existing Derogation and any Derogation under consideration may be initiated by the Regulatory Authority.

3.10.2 Derogation Register

The Regulatory Authority shall keep a register of all Derogations which have been granted, identifying the name of the User and Plant and Apparatus in respect of which the Derogation has been granted, the relevant provision of the KNTGC, the period of Derogation and the extent of compliance with the provisions. The register of Derogations shall be published on the Kenya National TSO Website.
Upon request from any User, the Regulatory Authority shall provide a copy of such register of Derogations to such User.

3.10.3 Transitional Provisions

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

Transitional Provisions are provisions of the KNTGC approved by the Regulatory 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 Regulatory Authority can initiate a Transitional Provision
d. Situations which might require the use of Transitional Provisions include (but are not limited to):

1. The effective date of the KNTGC and its impact on requirements, such as multiple old Generating Plants that need equipment upgrade in order to reach compliance
2. 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.
CHAPTER 3

3.11 DISPUTE RESOLUTION

3.11.1 Mutual Discussion

If a Dispute between the Regulatory Authority and any User or between Users in connection with, or arising out of, the interpretation, implementation or breach of any provision in this KNTGC, 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 Regulatory Authority to refer the matter to the Kenya National Transmission Grid Code Review Committee to consider the disputed KNTGC provisions and offer recommendations on resolution of the Dispute.

3.11.2 Determination by the Regulatory 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 Regulatory Authority for resolution. In this case, the procedure will be as follows:

a. The request for referral shall be made in writing to the Regulatory 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 Regulatory Authority shall write to the Parties acknowledging that the Dispute has been referred to the Regulatory Authority for determination;

c. Following receipt of Regulatory 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 Regulatory Authority, and

d. No later than ten (10) business days after the Regulatory Authority has received each Party's reason(s) as to the causes of the Dispute in writing, the Regulatory 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 Regulatory Authority may also seek the views and advice of an Independent Expert on settlement of the Dispute as set out in Section 3.12 of this chapter.

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

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

3.12 INDEPENDENT EXPERT OPINION

If any matter is referred to an Independent Expert in accordance with the description in Chapter 4 (Governance), the Independent Expert shall be appointed by the Regulatory 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 videoconferencing 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 KNTGC 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 pursuant to Section 3.10 in this chapter shall equally divide the entire cost;

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

3.13 KNTGC INTERPRETATION

In the event that any User requires additional interpretation of the wording or application of any provision of the KNTGC, they may make a request to the Regulatory Authority for such interpretation. Provided that the request is reasonable, the Regulatory 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 Regulatory Authority is unreasonable or inappropriate, the matter shall be resolved as provided in Section 3.11 Dispute Resolution of the KNTGC.

3.14 HIERARCHY

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

All data relating to and exchanged among Parties concerning the KNTS shall be considered to be Confidential Information. The Regulatory Authority shall consult with the Kenya National TSO and Users in regard to the publication of any of the data exchanged. Aggregate data may be made available by the Kenya National TSO 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 Kenya National TSO 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

a. 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.

b. A Party:
   1. Shall not disclose confidential information to any person except as permitted by the KNTGC.
   2. Shall only use or reproduce confidential information for the purpose for which it was disclosed or another purpose contemplated by the KNTGC;
   3. Shall not permit unauthorised persons to have access to Confidential Information.

c. Each Party shall use all reasonable endeavours:
   1. To prevent unauthorised access to Confidential Information which is in the possession or control of that Party; and
   2. 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.
   3. 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:
1. 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 Regulatory Authority

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

3.15.4 Indemnity to the Regulatory Authority

Each Party indemnifies the Regulatory Authority against any claim, action, damage, loss, liability, or expense which the Regulatory 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 KNTGC.

3.15.5 Party Information

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

3.15.6 Information on Kenya National Transmission Grid Code Bodies

The Regulatory Authority shall develop and implement policies concerning:

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

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

3.16 Construction of References

3.16.1 Preamble, Table of Contents and Headings

The Preamble, table of contents, and headings are inserted for information and convenience only and shall not be used in construing the provisions of the KNTGC.

3.16.2 Cross References

A cross-reference to another document or part of the KNTGC shall not of itself impose any additional or further or co-existent obligation or confer any additional or further or co-existent right in the part of the text where such cross-reference is contained.
3.16.3 Definitions

a. Terms and expressions printed in italics and beginning with capital letters are listed in the Glossary and Definitions Chapter and shall, unless the context otherwise requires or is not consistent therewith, bear the respective meaning set out therein. However, if there are instances in which the terms are not capitalised or italicised, these meanings still hold.

b. Terms not herein defined shall have the meaning ascribed thereto in the Oxford English Dictionary.

c. Where the Glossary and Definitions refers to any word or term which is more particularly defined in a part of the KNTGC, the definition in that part of the KNTGC will prevail over the definition in the Glossary and Definitions in the event of any inconsistency.

3.16.4 Figures

Figures are provided in some chapters of the KNTGC for convenience and to illustrate a process. In case of any discrepancy between the text and figures regarding any provision of the KNTGC, the text shall prevail.

3.16.5 Gender, Singular and Plural

Unless the context otherwise requires, the singular shall include the plural and vice versa, and references to any gender shall include the other gender.

3.16.6 Include and Including

References to the words "include" or "including" are to be construed without limitation to the generality of the preceding words.

3.16.7 Mandatory Provisions

The word “shall” refers to a rule, procedure, requirement, or any other provision of the KNTGC that requires mandatory compliance.

3.16.8 Person or Entity

References to a person or entity shall include any individual and any other entity, in each case whether or not having a separate legal personality.

3.16.9 References

References to clauses, provisions or to a particular paragraph, sub-paragraph or Appendix are, unless the context otherwise requires, references to that clause, provision, paragraph, sub-paragraph, or Appendix in or to that part of the KNTGC in which the reference is made.
3.16.10 Written and In Writing

Any references to "in writing" or "written" include typewriting, printing, lithography, and other modes of reproducing words in a legible and non-transitory form.

3.17 LANGUAGE

This KNTGC is written in English. In case of any discrepancies between the English version and a version translated into any other language, the English version shall prevail.
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 *KNTGC*. This chapter also summarises the main documents and organisations that provide the authority governing the planning, construction, and operation of the *Kenya National Transmission System*.

This *KNTGC* shall be read in conjunction with the relevant legislation including the *Energy Act* of 2006, the *Energy (Electricity Licensing) Regulations* of 2012 and any applicable amendments related to the administrative authority for the *KNTGC*. The *KNTGC* requirements shall also be applied in conjunction with the licences issued to *Generation Licensees*, Transmission companies and *Transmission Network Service Providers* and regulations that relate to the Electricity Supply Industry adopted by the *Regulatory Authority* and the *Ministry of Energy and Petroleum*. All *Transmission Licences* and agreements concluded after implementation of the *KNDC* shall include the obligation of parties to comply with *KNTGC* requirements.

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

a. To ensure that *Users* are represented in reviewing and making recommendations to the development and revision of the *KNTGC* requirements;

b. Facilitate the monitoring and auditing of compliance with the *KTNGC*;

c. To specify the processes used for the settlement of disputes

4.2 **GOVERNANCE DOCUMENTS**

The primary laws defining governance are Kenya’s *Energy Act No. 12 of 2006* (the Act) and the *Energy (Electricity Licensing) Regulations*, 2012. The *Energy Act* established the *Regulatory Authority*, the *Rural Electrification Authority (REA)*, and the *Energy Tribunal*. The organisations with governance functions include the *Regulatory Authority*, the *Energy Tribunal*, and the *Ministry of Energy and Petroleum (MoEP)*.

4.3 **THE KENYA NATIONAL TRANSMISSION GRID CODE REVIEW COMMITTEE**

The *Regulatory Authority* shall establish and maintain, as a standing committee, the *Kenya National Transmission Grid Code Review Committee*, which shall be governed by the provisions of the *KNTGC* set out in Section 4.3.4 in this chapter. The *Regulatory Authority* is responsible for the review of the operations and revision of the *KNTGC*. The *Kenya National Transmission Grid Code Review*
Committee shall not have decision making authority and the Regulatory Authority shall not be bound by its deliberations or recommendations.

4.3.1 Role of the Kenya National Transmission Grid Code Review Committee

The Kenya National Transmission Grid Code Review Committee shall:

a. Keep the KNTGC and its working under review;

b. Ensure that the KNTGC is consistent in its approach and is developed to reflect changes in Prudent Utility Practice and technology;

c. Review and discuss all proposals for amendments to the KNTGC which the Regulatory Authority, Kenya National TSO, or Users submit to the Kenya National Transmission Grid Code Review Committee for consideration from time to time;

d. Present recommendations to the Regulatory Authority as to amendments to the KNTGC that the Kenya National Transmission Grid Code Review Committee considers warranted and the reason for such changes;

e. Review existing standards relevant to the operation of the Kenya National Transmission System and to make modifications or proposals for new standards in relation to the operation of the Kenya National Transmission System, and


4.3.2 Composition of the Kenya National Transmission Grid Code Review Committee

The Kenya National Transmission Grid Code Review Committee shall consist of the following Members:

a. A Chairperson appointed by the Regulatory Authority;

b. One person representing the Regulatory Authority;

c. One person representing the Kenya National TSO;

d. One person representing public Transmission Licensees and one person representing private Transmission Licensees, other than the Kenya National TSO;

e. One person representing public Distribution Licensees, and one person representing private Distribution Licensees.

f. One person representing public Generation Licensees and one person representing private Generation Licensees.

In the case that any of the above categories include more than one entity, the constituents shall form a caucus and appoint a representative. All appointments are subject to approval by the Regulatory Authority with regard to required minimum qualifications for Members provided in Section 4.3.5.

In the case that any of the above categories contain no entities, the position will remain unfilled.
4.3.3 Conduct of Business

The Kenya National Transmission Grid Code Review Committee shall establish and comply at all times with its own rules and procedures governing the conduct of its business as approved by the Regulatory Authority.

If the Kenya National Transmission Grid Code Review Committee is unable to reach an agreement on any matter before it, it shall set out and report the cause of disagreement and the views held by the respective Members of the Kenya National Transmission Grid Code Review Committee to the Regulatory Authority.

4.3.4 Rules of the Transmission Grid Code Review Committee

4.3.4.1 Committee Name

The Committee charged with making recommendations to the Regulatory Authority on the review of the operation and revision of the KNTGC shall be called the Kenya National Transmission Grid Code Review Committee and shall be governed by provisions set out in this section of the KNTGC.

4.3.5 Kenya National Transmission Grid Code Review Committee Member Qualifications

Due to the technical nature of many of the duties and responsibilities of Committee Members, any person that is being considered as a Committee Member must meet the following minimum experience and qualifications;

4.3.5.1 Chairperson

a. Minimum of 10 years of electric industry experience in a technical capacity
b. Minimum of 7 years of energy sector regulatory compliance oversight experience

4.3.5.2 Committee Member

a. Minimum of 7 years of electric industry experience in a technical capacity;
b. Minimum of 3 years of experience in regulatory compliance responsibilities for an electric utility, regulatory authority or Independent Power Producer

4.3.6 Term of Office

The term of office of a Member shall be three (3) years from the date of his or her appointment. A Member may resign, be reappointed, replaced or removed in accordance with the provisions set forth for the governance of the Kenya National Transmission Grid Code Review Committee.

The Regulatory Authority has the right to modify the term of office during the initial formation of the Kenya National Transmission Grid Code Review Committee to assure that incumbent member’s terms do not expire at the same time. This will assure that the Committee has a consistent mix of incumbents and new Members.
4.3.7 Appointment by the Regulatory Authority

If at any time any entity entitled to appoint a Member has not made an appointment and/or is in disagreement as to whom to appoint and as a result no Member represents that entity, the Chairperson shall notify the Regulatory Authority. The Regulatory Authority shall have the right, until the relevant entity has made an appointment, to appoint a Member on behalf of that entity. The appointed Member must be from an entity from the corresponding category as described in Section 4.3.2. In the event that the Regulatory Authority does not exercise this right the Kenya National Transmission Grid Code Review Committee shall be regarded as complete in the absence of that Member.

4.3.8 Nature of Member

No person other than an individual shall be appointed a Member or his alternate.

4.3.9 Retirement of Members

If a Member chooses to retire before the end of their term, written notification shall immediately be given to the Chairperson. The Chairperson shall notify the Party that appointed the retiring Member, and by notice in writing to the Chairperson, the said Party shall indicate its wish to appoint a new Member. Should the position of a Member become vacant, the Party appointing him must appoint a replacement within twenty-five (25) calendar days.

Such notifications for appointment must be delivered to the Chairperson at least twenty-one (21) days in advance of the meeting of the Kenya National Transmission Grid Code Review Committee from the person or group of persons represented by each Member.

4.3.10 Alternates

The Chairperson and each Member shall have the power to appoint any individual to be his Alternate and may at his discretion remove an alternate Member so appointed. The Chairperson and Members shall not appoint another Member as his Alternate. Any appointment or removal of an alternate Member shall, unless the Chairperson otherwise agrees, be effected by notice in writing executed by the appointer and delivered to the Secretary or tendered at a meeting of the Kenya National Transmission Grid Code Review Committee. If his appointer so requests, an alternate Member shall be entitled to receive notice of all meetings of the Kenya National Transmission Grid Code Review Committee or of sub-committees or working groups of which his appointer is a Member. He shall also be entitled to attend and vote as a Member at any such meeting at which the Member appointing him is not personally present and at the meeting to exercise and discharge all the functions, powers and duties of his appointer as a Member. For the purpose of the proceedings at such meetings, the provisions shall apply as if the alternate appointed were a Member. An alternate shall have all the rights and obligations of a Member including voting rights.
4.3.11  Ceasing to Act

An alternate Member shall cease to be an alternate Member if his appointer ceases for any reason to be a Member.

4.3.12  References Include Alternates

References to a Member shall, unless the context otherwise requires, include his duly appointed alternate.

4.3.13  Representation and Voting

4.3.13.1  Representation

The Chairperson and every other Member shall be entitled to attend and participate at every meeting of the Kenya National Transmission Grid Code Review Committee. One adviser (or such greater number as the Chairperson shall permit) shall be entitled to attend any meeting of the Kenya National Transmission Grid Code Review Committee with each Member.

4.3.13.2  Voting

The Kenya National Transmission Grid Code Review Committee will seek to achieve a unanimous consensus agreement among all voting Members. If the Committee is unable to reach unanimous consensus on an item, a simple majority voting method will be used. If there is a tie after voting, the Chairperson will be allowed to cast a tie-breaking vote. Otherwise, the Chairperson shall not cast a vote.

4.3.14  Removal

Any person or persons entitled to appoint a Member, including the Chairperson, may at any time replace that Member or the Chairperson, as the case may be, from office and appoint another person in his place. A person or persons will only have the right to remove from the committee the person that it or they have appointed, and will have no right to remove from office the Chairperson or any other Member, as the case may be, appointed by another person. In the event of disagreement amongst persons entitled to appoint a Member, the relevant provisions of Section 4.3.7 Appointment by the Regulatory Authority shall apply with any necessary changes. Whenever any individual Member or the Chairperson changes, the person or group of persons entitled to appoint that Member or the Chairperson, shall notify the Secretary in writing within seven (7) days of the change taking effect.

4.4  THE CHAIRPERSON POSITION

4.4.1  Appointment/Removal

The Regulatory Authority may at any time replace the Chairperson. Upon retirement or removal by the Regulatory Authority of the first and each successive Chairperson, the Regulatory Authority shall appoint a person to act as Chairperson.
4.4.2 Alternate Chairperson

The Chairperson shall preside at every meeting of the Kenya National Transmission Grid Code Review Committee at which he is present. If the Chairperson is unable to be present at a meeting but has appointed an alternate, such alternate shall act as Chairperson. If neither the Chairperson nor his alternate is present within half an hour after the time appointed for holding the meeting, the Members present may appoint one of their number to act as Chairperson of the meeting; such appointee shall not be treated as the Chairperson’s alternate and shall not be entitled to cast the Chairperson’s vote.

4.5 The Secretary Position

4.5.1 Appointment

The Regulatory Authority shall have power to appoint and dismiss a Secretary and such other staff for the Kenya National Transmission Grid Code Review Committee as it may deem necessary. The Regulatory Authority shall notify each Member of the identity and address for correspondence of the Secretary as soon as reasonably practicable after the appointment of the first Secretary and, subsequently after the appointment of any new Secretary. The Secretary may, but need not, be a Member but shall not be a Member by virtue only of being Secretary. The Secretary shall have the right to speak at meetings but, unless they are a Member, they have no right to cast a vote at any meeting.

4.5.2 Duties

The Secretary’s duties shall be to attend to the day to day operation of the Kenya National Transmission Grid Code Review Committee and, in particular, to:

a. Attend to the requisition of meetings and to serve all requisite notices;

b. Maintain a register of names and addresses of Members and their alternates as appointed from time to time; and

c. Keep minutes of all meetings.

4.5.3 Registers

The Secretary shall make available the registers of names and addresses and minutes for inspection by the Regulatory Authority and Members.

4.5.4 Group Representative’s Addresses

Each Member shall from time to time communicate all contact information (address, email, office and mobile number) to the Secretary and all notices sent to such address shall be considered as having been duly given.
4.6 **MEETINGS**

4.6.1 Date and Venue

The *Kenya National Transmission Grid Code Review Committee* shall hold meetings quarterly at regular scheduled times as the Committee may decide.

4.6.2 Further Meetings

The *Chairperson* or any other *Member* may request the *Secretary* to requisition meetings by giving a twenty-one (21) day notice to the *Secretary*. The notice shall be in writing and contain a summary of the agenda of the business that it is proposed will be conducted. The *Secretary* shall proceed to convene a meeting of the *Kenya National Transmission Grid Code Review Committee* within seven (7) days of the date of expiry of such notice.

4.6.3 Notice of Meetings

4.6.3.1 Notice by Chairperson

All meetings shall be called by the *Chairperson* on at least fourteen (14) days written notice (exclusive of the day on which it is served and of the day for which it is given), or by shorter notice if so agreed in writing by all *Members*. The *Chairperson* shall provide notice of the meeting to *Consumer* organizations, to allow their representatives to observe the meeting.

4.6.3.2 Details in Notice

The notice of each meeting shall contain the time, date and venue of the meeting, and an agenda.

4.6.3.3 Failure to Give Notice

The accidental omission to give notice of a meeting or the non-receipt of notice of a meeting by a person entitled to receive notice shall not invalidate the proceedings at that meeting.

4.6.3.4 Proposals for Agenda

By notice to the *Secretary*, any *Member* can request additional matters to be considered at the meeting and provided such notice is given at least ten (10) days (exclusive of the day on which it is served and of the day for which it is given) before the date of the meeting, those matters will be included in a revised agenda for the meeting. The *Secretary* shall circulate the revised agenda to each *Member* as soon as practicable.

4.6.4 Proceedings at Meetings

4.6.4.1 Quorum

50% plus one (1) *Member* present in person, or by their alternates, shall constitute a quorum for the conducting of business at any meeting of the committee.
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4.6.4.2 Inquorate Meetings

If, within half an hour from the time appointed for holding any meeting of the *Kenya National Transmission Grid Code Review Committee*, a quorum is not present, the meeting shall be adjourned to such day, time and place as the Secretary may notify to Members within three (3) days of the adjournment.

The adjourned meeting shall not be called to take place within one week of the adjournment but may be called on less than fourteen (14) day notice.

4.6.5 Agenda

Only matters identified in the agenda shall be resolved upon at a meeting. However, this shall not prevent matters raised under the heading “Any Other Business” being discussed and if the Chairperson thinks fit, be resolved.

4.6.6 Validity of Acts

All acts done by any meeting of the *Kenya National Transmission Grid Code Review Committee* or of a sub-committee or working group shall, notwithstanding that it be afterwards discovered that there was some defect in the appointment of a Member, be as valid as if such person had been duly appointed.

4.6.7 Meeting Attendance

*Members* shall attend meetings in person. In special circumstances as approved by the Chairperson, meetings may consist of a conference between Members who are not all in one place but who are able directly or by teleconference to speak to each of the others and to be heard by each of the others simultaneously. The word “meeting” shall be construed accordingly.

4.6.8 Minutes

4.6.8.1 Circulation

The Secretary shall circulate copies of the minutes of each meeting of the *Kenya National Transmission Grid Code Review Committee* to each Member as soon as practicable and in any event within ten (10) business days after the meeting has been held.

4.6.8.2 Approval of Minutes

Each Member shall notify the Secretary of his approval or disapproval of the minutes of each meeting within ten (10) business days of receipt of the minutes. A Member who fails to do so will be deemed to have approved the minutes. The approval or disapproval of the minutes aforesaid will not affect the validity of decisions taken by the *Kenya National Transmission Grid Code Review Committee* at the meeting to which the minutes relate.
4.6.8.3 Amendments

If the Secretary receives any comments on the minutes, he shall then include those aspects of the minutes upon which there is disagreement into the agenda for the next following meeting of the Kenya National Transmission Grid Code Review Committee as the first item for resolution.

4.6.9 Guidance from the Kenya National Transmission Grid Code Review Committee

The Kenya National Transmission Grid Code Review Committee may at any time, and from time to time, issue guidance in relation to the KNTGC and its implementation, performance and interpretation, and it may establish sub-committees and working groups to carry out such work.

4.6.10 Sub-Committees and Working Groups

4.6.10.1 Sub-Committees

The Kenya National Transmission Grid Code Review Committee may establish and may co-opt such sub-committees from time to time consisting of such persons as it considers desirable, whether Members or not. Each sub-committee shall be subject to such written terms of reference and shall be subject to such procedures as the Kenya National Transmission Grid Code Review Committee may determine. The meetings of sub-committees shall so far as possible be arranged so that the minutes of such meetings can be presented to the Members in sufficient time for consideration before the next following meeting of the Kenya National Transmission Grid Code Review Committee.

4.6.10.2 Working Groups

The Kenya National Transmission Grid Code Review Committee may further establish working groups to advise it on any matter from time to time. Such working groups may consist of Members and/or others as the Kenya National Transmission Grid Code Review Committee may determine for the purpose.

4.6.10.3 Resolutions

Resolutions of sub-committees and working groups shall not have binding effect unless approved by resolution of the Kenya National Transmission Grid Code Review Committee.

4.7 VACATION OF OFFICE

The office of a Member shall be vacated if:

a. They resign office by notice delivered to the Secretary; or
b. They become bankrupt or compounds with their creditors generally; or
c. They become of unsound mind or a patient for any purpose of any statute relating to mental health; or
d. They or their alternate fails to attend more than three (3) consecutive meetings of the Kenya National Transmission Grid Code Review Committee without submitting an explanation to the Chairperson which is reasonably acceptable to the Chairperson.

4.8 **MEMBER’S RESPONSIBILITIES AND PROTECTIONS**

4.8.1 Responsibilities

In the exercise of its powers and the performance of its duties and responsibilities, the Kenya National Transmission Grid Code Review Committee shall have due regard for the need to promote the attainment of the principal duties of the Kenya National Transmission Grid Code Review Committee.

4.8.2 Representation

In the exercise of its powers and the performance of its duties and responsibilities as a Member, a Member shall represent the interests of the institution or entity by whom he was appointed, provided that such obligation of representation shall at all times be subordinate to the obligations of the Member as a Member of the Kenya National Transmission Grid Code Review Committee.

4.8.3 Reliance on Documentation

The Kenya National Transmission Grid Code Review Committee, each Member and the Secretary shall be entitled to rely upon any communication or document reasonably believed by it or him to be genuine and correct and to have been communicated or signed by the person by whom it purports to be communicated or signed.

4.9 **REVISENS TO THE KENYA NATIONAL TRANSMISSION GRID CODE**

Any User, Kenya National Transmission Grid Code Review Committee Member, the Kenya National TSO, and the Regulatory Authority may propose revisions to the KNTGC. The Regulatory Authority as the custodian of the Kenya National Transmission Grid Code shall have sole authority to make revisions to the KNTGC. Before approving any proposed revisions to the KNTGC, the Regulatory Authority will be guided by the Kenya National Transmission Grid Code Review Committee recommendations on the matter and any representations made by Parties. In considering the proposed revisions the Regulatory Authority may also seek the opinion of an Independent Expert.

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

4.10.1 **Customer Request**

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

4.10.2 **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**

4.10.3 **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.

4.11 **CONTRACTING**

The *KNTGC* shall comprise one of the standard documents that form part of the contract between *TNSPs* and each of their *Customers*. *TNSPs* shall contract with *Customers* for any services specified in the *KNTGC*.

4.12 **REGISTRATION OF LICENSEES**

4.12.1 **Users**

*Transmission Network Service Providers* shall ensure that transmission agreements between *TNSPs* and *Users* after the implementation of the *KNTGC* shall include an obligation on *Users* to comply with *KNTGC* requirements.

4.12.2 **Licensed Entities**

The *Regulatory Authority* shall ensure that all *Licensees* comply with *KNTGC* requirements.
4.12.3 Registration of Kenya National Transmission Grid Code Licensees

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

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

4.13 Notices

4.13.1 Service of Notices under the Kenya National Transmission Grid Code

A notice is properly given under the KNTGC 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 Energy Act and maintained by the Regulatory Authority or, where the addressee is the Regulatory Authority, the registered office of the Regulatory Authority; or

c. It is sent to the person by facsimile or electronic mail to a number or reference which corresponds with the address referred to in Section 4.13.1(b) or which is supplied by the person to the Regulatory 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.

4.13.2 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 4.13.1(b) to an address in the central business district of Nairobi, on the second business day after the day on which it is posted;

b. Where sent by post in accordance with Section 4.13.1(b) to any other address, on the third business day after the day on which it is posted;

c. Where sent by facsimile in accordance with Section 4.13.1(c) and a complete and correct transmission report is received:

d. Where the notice is of the type in relation to which the addressee is obliged under the KNTGC to monitor the receipt by facsimile outside of, as well as during, business hours, on the day of transmission; and
e. In all other cases, on the day of transmission if a business day or, if the transmission is on a day which is not a business day or is after 400 Hr (addressee's time), at 900 Hr on the following business day;

f. Where sent by electronic mail in accordance with Section 4.13.1(c):

g. Where the notice is of a type in relation to which the addressee is obliged under the KNTGC 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

h. 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 400 Hr (addressee’s time), or the day is not a business day, at 900 Hr on the following business day; or

i. Where published in a newspaper in accordance with Section 4.13.1(d), on the next day after the date of publication of the notice;

j. In any other case, when the person actually receives the notice.

### 4.13.3 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.

### 4.13.4 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.

### 4.14 Enforcement

#### 4.14.1 Investigations

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

b. If a User fails to comply with a request by the Regulatory Authority for information as described in Section 4.14.1(a), the Regulatory Authority may appoint a person to investigate the matter and to prepare a report or such other documentation as the Regulatory 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 4.14.1(a) unless the Regulatory Authority otherwise determines.
d. Any report or other documentation referred to in this Section 4.14.1 may be used in any proceeding involving the Regulatory Authority under the Energy Act or for the purpose of commencing any such proceeding.

e. The Regulatory Authority shall develop and implement guidelines in accordance with the KNTGC consultation procedures governing the exercise of the powers conferred on it by this Section 4.14.1.

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 Regulatory Authority under this Section 4.14.1, including where no breach of the KNTGC by the relevant User has occurred.

4.14.2 Entry and Inspection

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

4.14.3 Functions of the Regulatory Authority

The functions of the Regulatory Authority are set out in the Energy Act.

4.14.4 Alleged Breaches of the Kenya National Transmission Grid Code

a. If a User considers that another User may have breached or may be breaching this KNTGC or any provision in their Connection Agreement, the aggrieved User may, in accordance with this KNTGC or the terms of their Connection Agreement:
   1. Give notice to the person in breach to immediately take steps to remedy and/or stop the breach, as the case may be;
   2. Subject to Section 4.14.4, impose any sanctions on the person in breach as provided in this KNTGC or their Connection Agreement and
   3. Without limitation to his powers, use reasonable endeavours to give effect to any sanctions so imposed.

b. If the Regulatory Authority considers that:
   1. A User may have breached or may be breaching the KNTGC; and
   2. Given the circumstances of the breach it would be appropriate that a sanction or sanctions be imposed on that User, the Regulatory 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 Regulatory Authority receives written information from a User or any other person which alleges a breach of the KNTGC by a User, the Regulatory 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 KNTGC.

d. If the Regulatory Authority considers that a User may be the subject of a disconnection order it shall:
   1. Promptly notify the Users which the Regulatory Authority considers may be affected; and
2. Without limitation to its powers, use reasonable endeavours to give effect to any arrangements notified to the Regulatory Authority by the Users for ensuring the continuation of supply to the relevant purchasers of electricity.

4.14.5 Sanctions

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

4.14.6 Regulatory Authority Action

a. The Regulatory Authority may direct a User or any person to do or refrain from doing anything that the Regulatory 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 4.14.6(a), the Regulatory Authority may direct a Transmission Network Service Provider to disconnect a User from any transmission system or 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 4.14.6(a).

4.14.7 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 KNTGC, such act or omission shall be deemed for the purposes of this Section 4.14.7 to be the act or omission of the User concerned.

4.14.8 Publications

a. The Regulatory Authority shall publish a report at least once every six (6) months setting out a summary for the period covered by the report of:
   1. Matters which have been referred to it;
   2. All its findings during that period; and
   3. Any sanctions it applied under the Energy Act.

b. In considering the circulation of a report under Section 4.14.8(a), the Regulatory Authority shall have regard to KNTGC objectives.

c. In addition to the regular publication described in Section 4.14.8(a), the Regulatory 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 Regulatory Authority to publish a report under this Section 4.14.8(c) is a reviewable decision.

d. No User, or former User is entitled to make any claim against the Regulatory Authority for any loss or damage incurred by the User or former User from the publication of any information pursuant to Section 4.14.8(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 Regulatory Authority or any person publishing or circulating the publication on behalf of the User.
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Regulatory Authority and this section operates as leave for any such publication except where the publication was not done in good faith.

4.14.9 System Security Directions

a. Notwithstanding any other provisions of the KNTGC, a User shall follow any direction issued by or on behalf of the Kenya National TSO, which the Kenya National TSO is entitled to issue in exercising his powers under the Operations Chapters of the KNTGC 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 KNTGC on or by a stipulated day is required by the KNTGC 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 KNTGC.

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 Regulatory Authority in accordance with the procedures contained in Section 4.14.4.

4.15 Monitoring and Reporting

4.15.1 Monitoring Objectives

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

b. The Regulatory Authority shall undertake such monitoring as it considers necessary:
   1. To determine whether Users are complying with the KNTGC;
   2. To assess whether the dispute resolution, KNTGC enforcement, KNTGC change and other mechanisms are working effectively in the manner intended;
   3. To determine whether in its operation, the KNTGC is adequately giving effect to objectives specified in the KNTGC; and
   4. To collect, analyse, and disseminate information relevant and sufficient to enable the Regulatory Authority to comply with its reporting and other obligations and powers under the KNTGC.

c. The Regulatory Authority shall ensure that, to the extent practicable in light of the objectives set out in Section 4.15.1(b), the monitoring processes which it implements under this Section 4.15:
   1. Are consistent over time;
   2. Do not discriminate unnecessarily between Users;
   3. Are cost effective to both the Regulatory Authority and all Users; and
   4. Are publicised or information relating thereto is available to any person, subject to any requirements as a result of the confidentiality obligations.

4.15.2 Reporting Requirements and Monitoring Standards

a. The Regulatory Authority shall establish:
1. Reporting requirements for Users in relation to matters relevant to the KNTGC; and
2. Procedures and standards applicable to the Regulatory Authority and Users relating to information and data received by or from Users in relation to matters relevant to the KNTGC.

b. Prior to establishing requirements or standards and procedures referred to in Section 4.15.2(a), the Regulatory Authority shall consult with such Users as the Regulatory Authority considers appropriate. In formulating requirements or procedures and standards, the Regulatory Authority shall take into consideration the monitoring objectives set out in Section 4.15. The reporting requirements and standards and procedures established by the Regulatory Authority are reviewable decisions.

c. Subject to Section 4.15.2(d), the Regulatory Authority shall notify to all Users particulars of the requirements, procedures, and standards that it establishes under this Section 4.15.2.

d. If the Regulatory Authority establishes additional or more onerous requirements or procedures and standards which do not apply to all Users and the Commission considers that notification of those matters to all Users would contravene the confidentiality provisions in Section 3.15, the Regulatory 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 Regulatory Authority under this Section 4.15.2 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 KNTGC, 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 Regulatory Authority.

g. Any User may ask the Regulatory Authority to impose additional requirements, procedures, or standards under this Section 4.15.2 on another User in order to monitor or assess compliance with the KNTGC by that User. When such a request is made, the Regulatory Authority may but is not required to impose the additional requirements, procedures, or standards. A decision by the Regulatory Authority to impose additional requirement procedures or standards is a reviewable decision. If the Regulatory Authority decides to impose additional requirements, procedures, or standards, the Regulatory 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 Regulatory Authority shall develop and implement guidelines in accordance with the KNTGC consultation procedures governing the exercise of the powers conferred on it by Section 4.15.2(g) which guidelines shall set out the matters to which the Regulatory Authority shall have regard prior to deciding the allocation of costs of any additional requirements, procedures or standards imposed pursuant to Section 4.15.2(g) between the relevant Users.
4.15.3 Use of Information

a. Subject to confidentiality obligations set out in the Confidentiality sections of the KNTGC, the Regulatory Authority is entitled to use any data or information obtained as a result of any monitoring requirements imposed under Section 4.15.2 in pursuance of any of the Regulatory Authority’s powers or functions under the KNTGC. Without limitation, the Regulatory Authority may use any such information in connection with or to initiate:
   1. A process to change or revise the KNTGC; or
   2. An investigation under the KNTGC.

b. A User may claim that the information provided to the Regulatory 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 Regulatory Authority may consider the claim by the User to be reasonable, if the Regulatory Authority considers that its reporting obligations set out in the KNTGC make the disclosure of the information necessary or desirable, the Regulatory Authority may disclose the information. In doing so, the Regulatory 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 Regulatory Authority to be liable for publishing or disclosing any information under this Section 4.15.3.

c. Prior to disclosing in accordance with Section 4.15.3(b) information which a User claims is confidential, the Regulatory Authority shall first notify that User as soon as practicable after the Regulatory Authority has made the decision to disclose the information.

d. Any decision by the Regulatory Authority under Section 4.15.3(b) to disclose information that is claimed by a User to be confidential is a reviewable decision and the Regulatory 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.

4.15.4 Reporting

a. Not later than 31 December in each calendar year, the Regulatory Authority shall prepare and give an annual report for the previous Financial Year to all Users and interested parties. The annual report shall include:
   1. The Regulatory Authority’s assessment of the extent to which the operation of the KNTGC during that period met the KNTGC objectives and of the strategic development of the KNTGC to meet industry objectives;
   2. The Regulatory Authority’s audited accounts for the period covered by the report;
   3. A report on the matters set out in the Operations Chapter concerning the Kenya National TSO use of powers of direction in relation to Power System Security granted to him under the Operations Chapter;
   4. A summary of, and reasons for, any changes to the KNTGC;
   5. A summary of identified material breaches of the KNTGC and the actions taken in response, including particulars of any sanctions imposed;
   6. A summary of any disputes referred to the Regulatory Authority or involving the Regulatory Authority as a Party;
7. A summary of material matters in relation to the dispute resolution under the KNTGC (without identifying the parties); and
8. The Regulatory 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 4.15.4(a), the Regulatory 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.

4.15.5 Recovery of Reporting Costs

Where, under the KNTGC, the Regulatory Authority is entitled or required to publish or give information, notices or reports to any User or any other person, unless the context otherwise requires, the Regulatory Authority (as the case may be) shall charge those persons a fee at cost for providing them with a copy of the information or report.
5.1 EAPP IC REQUIREMENTS

5.1.1 Introduction

The Planning Chapter (PC) specifies the minimum technical and design criteria, principles and procedures:

a. To be used within EAPP in the planning and in the medium and long-term development of the EAPP Interconnected Transmission System;

b. To be taken into account by Member Utilities on a coordinated basis, and

c. To specify the planning data required to be exchanged by Member Utilities and the EAPP Sub-Committee on Planning to enable the EAPP Interconnected Transmission System to be planned in accordance with the planning standards.

The PC specifies the requirements for the interchange of information between EAPP Sub-Committee on Planning and individual TSOs. This information is required to enable EAPP Sub-Committee on Planning and TSOs to take due account of developments, new connection sites or the modification of existing connection sites in a National System or new, or the modification of, connections with External Systems, including changes in factors such as demand, generation, new technology, reliability and environmental requirements that may also have an impact on the planning and operation of the EAPP Interconnected Transmission System.

All parts of the EAPP Interconnected Transmission System shall be designed so that the demand for electricity can be met reliably at the lowest cost. This means that the EAPP Interconnected Transmission System shall be planned, built, and operated so that sufficient transmission capacity will be available to utilise the generation capacity and to meet the needs of Customers in an economic way.

The long-term economic design of the EAPP Interconnected Transmission System aims at a balance between investments and the cost of maintenance, operation, and supply interruptions, taking into account environmental and other limitations. Flexible solutions which take into account future uncertainties, such as generation limitations, new generation technologies, uncertain load development and technical development, should be selected.

5.1.2 Objectives

The objectives of the PC are to provide for:

a. Coordination by the EAPP Sub-Committee on Planning of any proposed development or reinforcement of a National System or construction of new or modification of interconnections with External Systems to ensure that the reliability and security of the EAPP Interconnected Transmission System is not compromised;
b. Cooperation between the TSOs in the planning and procurement of new generation capacity at lowest overall cost, taking into account environmental considerations, and
c. Submission of sufficient information to enable a TSO to optimise the planning and development of its National System including the use of available transmission capacity on the EAPP Interconnected Transmission System.

5.1.3 Scope
The PC applies to the EAPP Sub-committee on Planning and to the TSOs. The TSOs are responsible for the collection of information from Users connected to their National System and for providing any relevant information required by the PC to the EAPP Sub-committee on Planning.

Those TSOs with connections to External Systems shall ensure that the supply of data required under the PC should be contemplated in the Interconnection Agreement with the External System seeking a new or modified interconnection.

5.1.4 Principles of the Planning Chapter
These principles apply to the overall planning of the EAPP Interconnected Transmission System. The planning principles are concerned with planning of the interconnection between National Systems, connections with External Systems and with those facilities within National Systems which have, or could have, an impact on the reliability of the EAPP Interconnected Transmission System.

The principles should also be applied in the planning of National Systems to ensure that the reliability criteria can be met. The principles, however, do not apply to local supply reliability and other local considerations which are the subject of National Grid Codes or equivalent documents.

The reliability level for the EAPP Interconnected Transmission System is defined by a set of minimum criteria in the PC together with the performance characteristics and requirements set out in the Connections Chapter, which must both be met when designing developments, expansions, and reinforcements of both EAPP Interconnected Transmission System and National Systems. The criteria are based on a balance between the probability of contingencies and their consequences.

Reliable transmission capacity can be achieved by specifying standards for primary, protection, and auxiliary equipment as well as by reserve capacity and other operational resources as set out in the Operations Chapters.

5.1.5 Reliability Criteria
All Plant and Apparatus of the EAPP Interconnected Transmission System shall operate within normal capacity ratings, thermal loading and voltage limits under steady-state conditions as set out in the Connections Chapter. The EAPP Interconnected Transmission System shall be able to supply all loads within the emergency limits for bus voltages and Plant and Apparatus loadings during the Outage of any line or transformer (N-1 criteria).
The security and reliability of the *EAPP Interconnected Transmission System* shall not be compromised by the loss of any single power system element such as a *Generating Unit*, transmission circuit, section of busbar, transformer or reactive compensation equipment.

The loss of a single element shall not cause:

a. Any violation of the normal operational limits such as voltage, frequency or *Plant* and *Apparatus* loading which would jeopardise the safety and reliability of the *EAPP Interconnected Transmission System* or would cause overloading of *Plant* or *Apparatus*;
b. Islanding of any part of the *EAPP Interconnected Transmission System*;
c. Loss of stability of the *EAPP Interconnected Transmission System*; or
d. Cascading *Outages* of other elements as a result of exceeding operational security limits as set out Chapter 9 (Operations Code No. 2 – Operational Security)

These criteria are not applicable to areas connected by radial lines to a *National System* where loss of load and any local generation may be acceptable.

The N-1 criterion may be assured in a *National System* with the support of another interconnected *National System*, subject to the prior agreement of the respective TSOs.

The planning criteria for dynamic security are defined such that the *EAPP Interconnected Transmission System* shall remain stable following a single *Contingency*. The *EAPP Interconnected Transmission System* is able to remain stable in some cases following a fault without the *Outage* of any transmission element by a successful auto-reclosing. If the attempt of auto-reclosing fails, the fault shall be cleared by tripping the faulted element.

### 5.1.6 Planning Process

The horizon for the planning of the *EAPP Interconnected Transmission System* extends over ten (10) years. The process has two elements:

a. A forecast, the *Power Balance Statement*, by TSOs for each *National System* of their expected demand and generation over the planning horizon. This forecast will define the requirements for generation support from the *EAPP Interconnected Transmission System* for individual *National Systems*, and
b. An assessment, the *Transmission System Capability Statement* by EAPP Sub-committee on Planning and TSOs of the capability of the *EAPP Interconnected Transmission System* to support the require energy flows across both *National Systems* and cross-border interconnections.

#### 5.1.6.1 Power Balance Statement

*TSOs* will prepare and submit to the *EAPP Sub-committee on Planning* the *Power Balance Statement*. This report will be submitted by 30 September annually showing in respect of the ten (10) succeeding calendar years:
a. The projection of the seasonal maximum and minimum demand for electricity in each National System and the corresponding energy requirements for each year across the study period. These forecasts will correspond to certain reference dates to be defined by the EAPP Sub-committee on Planning;

b. The amount and nature of generation capacity currently available to meet the demand and any anticipated restrictions in the production of energy;

c. The amount of generation capacity it expects will be required to ensure that Operating Margins are achieved;

d. Details of plans for building additional Generating Units including upgrades of existing generation capacity;

e. The amount and nature of demand to be met by other EAPP Member Countries using transmission capacity available on the EAPP Interconnected Transmission System, and

f. The power transfers anticipated with External Systems.

The difference between available generating capacity and demand at the reference dates is called the Remaining Capacity and is calculated under normal climatic conditions. This Remaining Capacity represents the reserves available which can be used to cover demand above forecast or Generating Unit Outages greater than expected. The Remaining Capacity can be positive with export potential or negative where the lack of capacity signals a need for imports.

The EAPP Sub-committee on Planning shall produce a Power Balance Statement for the EAPP Interconnected Transmission System based on the individual TSOs’ Power Balance Statements.

### 5.1.6.2 Transmission System Capability Statement

Once the Power Balance Statement has identified the ability of each TSO to cover its internal demand with the available national generation capacity, a transmission adequacy assessment shall be carried out by each TSO in conjunction with the EAPP Sub-committee on Planning. This assessment will determine the capability of the National System to support the required energy flows across both the National System and cross-border connections.

Based on the transmission adequacy assessment carried out by each TSO, the EAPP Subcommittee on Planning will produce a Transmission System Capability Statement for the EAPP Interconnected Transmission System. This Transmission System Capability Statement is focused on the cross-border connections and those TSO's National Systems which have a direct effect on the cross-border exchanges.

In producing the Transmission System Capability Statement the EAPP Sub-committee on Planning shall consider various scenarios for interchanges, demands and generation. Sensitivity analysis shall be carried out taking into account such parameters as hydrological conditions and fuel price variations.

The EAPP Sub-committee on Planning may also consider the use of Remedial Action Schemes (RAS), in which automatic control equipment disconnects or otherwise controls generation, demand, or network elements other than for faults. Such RAS are used to enhance transmission capacity at the...
expense of reliability and may only be used following specific agreement between the EAPP Steering Committee and the affected TSO.

The EAPP Sub-committee on Planning will determine the form and content of the Transmission System Capability Statement to be issued each year and shall publish it on the EAPP Website.

5.1.7 EAPP Power System Modeling

In order to produce the EAPP Transmission System Capability Statement, it will be necessary to carry out system analysis, including steady-state and dynamic simulations of the EAPP Interconnected Transmission System. This system analysis is required in order to assess the reliability of the EAPP Interconnected Transmission System to meet the forecast demand and determine the need for system enhancements or reinforcements.

These system studies will be carried out by both the EAPP Sub-committee on Planning and the TSOs and shall be performed using a common set of principles and a common database. To achieve this, the EAPP Sub-committee on Planning shall establish a set of common objectives for the development and submission of system data for EAPP power system modelling. The data shall include sufficient detail to ensure that system contingencies, steady-state, transient and dynamic analyses can be simulated. The data required for system studies is set out in the Data Exchange Chapter.

5.1.8 Responsibilities

EAPP Sub-committee on Planning in conjunction with the TSOs shall identify the scope and specify the data required for reliability analyses and the procedures for data reporting. These requirements and procedures should be periodically reviewed, documented, and published for the EAPP Interconnected Transmission System at least every five (5) years.

Each TSO shall provide accurate and appropriate equipment characteristics and power system data for modelling and simulation purposes as required by the EAPP Sub-committee on Planning.

5.1.9 Planning Data Confidentiality

System planning data shall be treated as non-confidential when the EAPP Sub-Committees on Planning and Operations and TSOs use such data:

a. In the preparation of forecasts, Power Balance Statements and Transmission System Capability Statements;

b. For the planning of the EAPP Interconnected Transmission System;

c. To consider a Connection Application or provide advice to a User;

d. Under the terms of an Interconnection Agreement with an External System.
5.2 **Kenya National Transmission Grid Code Requirements**

All the requirements presented in Section 5.1 EAPP IC Requirements shall apply in this Section 5.2 and in all other places in this Planning Chapter.

5.2.1 **Introduction**

Section 5.2 specifies the criteria and procedures to be applied by Kenya’s Planning and Development Organisation(s) in the planning and development of the *Kenya National Transmission System (KNTS)*. It furthermore provides for accountability for KNTS planning and development and sets the required standards and targets. It also specifies the reciprocal obligations and interactions between *Users*.

5.2.2 **Transmission System Planning and Development**

a. The *KNTS* planning and development shall be in accordance with the prevailing *Regulatory Authority* regulatory framework, as being implemented from time to time.

b. The development and update of the *KNTS* planning may occur for a number of reasons, including but not limited to:
   1. Changes to *User* requirements or networks
   2. The introduction of a new transmission substation or *Connection Point* or the modification of an existing connection between a *User* and the *KNTS*
   3. The cumulative effect of a number of developments as referred to above
   4. The need to reconfigure, decommission or optimise parts of the existing network.

c. The development of the *KNTS* may include work involving transformers, breakers, switches, and other equipment connected to the *KNTS*.

d. The time required for the planning and development of the *KNTS* will depend on the type and extent of the necessary reinforcement and/or extension work, the need or otherwise for statutory planning consent, the associated possibility of the need for public participation and the degree of complexity involved in undertaking the new work while maintaining satisfactory security and quality of supply on the existing *KNTS*.

5.2.2.1 **Planning Process**

a. Kenya’s *Planning and Development Organisation(s)* shall follow a planning process divided into major activities as follows:
   1. Identification of the problem
   2. Formulation of alternative options to meet this need
   3. Study of these options to ensure compliance with agreed technical limits and justifiable reliability and quality of supply standards
   4. Costing of these options on the basis of approved procedures
   5. Determination of the preferred option
   6. Building of a business case for the preferred option using the approved justification criteria
   7. Request for approval of the preferred option and initiation of execution.
5.2.2.2 Identification of Need for Transmission System Development
   a. The Kenya National TSO shall review data from all relevant sources, including specific Customer information, system performance statistics, KNTS load forecast, and government and Customer development plans to establish the need for network strengthening.
   b. The needs shall be determined through the modelling of the KNTS over a ten-year term, utilising reasonable load and generation forecasts and equipment performance scenarios. Studies for purposes of determining connection charges payable by Customers may cover a shorter period if appropriate.
   c. The Kenya National TSO shall annually conduct a planning review with parties to co-ordinate KNTS and the Kenya National Distribution System (KNDS).

5.2.3 Demand Forecast
   a. The Kenya National TSO in consultation with the TNSPs and DNSPs shall annually produce a KNTS demand forecast for the next ten years by the end of August of each year.
   b. The KNTS demand forecast shall be determined for each point of supply. Generation and import capacity plans shall be used to obtain the annual generation patterns.
   c. To forecast the maximum demand (MW) for each transmission substation, the Kenya National TSO shall use Distribution Licensee and End-use User load forecasts.
   d. The load forecast shall be adjusted at various levels (making use of diversity factors determined from measurements and calculations) to bring it into line with the higher-level data.
   e. All Distribution Licensees and End-use Users shall supply their ten-year-ahead load forecast data to the Kenya National TSO as detailed in the Information Exchange Chapter annually, by the end of July. All Customers shall inform their TNSP of any changes in excess of 50 MW to this forecast when this information becomes available.

5.2.4 Transmission System Development Plan
   a. The Kenya National TSO shall annually publish a minimum ten-year-ahead KNTS development plan by the end of October, indicating the major capital investments planned (but not yet necessarily approved). The plan shall include at least
      1. The acquisition of servitudes for strategic purposes
      2. A list of planned investments including costs
      3. Diagrams displaying the planned changes to the KNTS
      4. An indication of the impact on Customers in terms of service quality and cost
      5. Any other information as specified by the Regulatory Authority from time to time.
   b. The KNTS development plan shall be based on all Customer requests received at that time, as well as the TNSP initiated projects based on load forecasts and changes in generation.
   c. The Kenya National TSO shall engage in a consultative process with Users and the Regulatory Authority on the KNTS development plan. The consultation process shall include:
      1. An annual public forum to disseminate the intended KNTS development plan
      2. Regular interfacing and joint planning with Users regarding KNTS development.
d. *Disputes* arising from the above process shall be decided in terms of the dispute resolution mechanism in Chapter 4 (Governance).

e. The *Kenya National TSO* shall provide a five (5)-year statement of opportunities to render *Ancillary Services* for the mitigation of network constraints.

### 5.2.4.1 Development Investigation Reports

a. Before any development of the network proceeds, the *Kenya National TSO* shall compile a detailed development investigation report. The report shall be used as the basis for the investment decision and shall as a minimum contain the following elements:

1. A description of the problem/request and the objectives to be achieved
2. Alternatives considered (including non-transmission or capital) and an evaluation of the long-term costs/benefits of each alternative
3. Detailed techno-economic justification of the alternative selected in accordance with the approved investment criteria, with consideration of relevant scenarios and appropriate risk analysis
4. Diagrams, sketches and relevant technical study results
5. Clear statement and analysis of the assumptions used

The report shall be submitted to the *Regulatory Authority*.

### 5.2.5 Technical Limits and Targets for Long Term Planning Purposes

a. The planning limits, targets and criteria form the basis for evaluation of options for the long-term development of the *KNTS*.

b. The limits and targets against which proposed options are checked by the *Kenya National TSO* shall include technical and statutory limits that must be observed and other targets that indicate that the system is reaching a point where power transfer problems may occur. If planning limits are not attained, alternative options shall be evaluated.

#### 5.2.5.1 Voltage Limits and Targets

a. Technical and statutory limits are presented in Table 5-1.

b. Standard voltage levels are given in Table 5-2.

c. Table 5-3 has target voltages for planning purposes at transmission voltages.
### Table 5-1 Voltage Limits for Planning Purposes

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal continuous operating voltage on any bus for which equipment is designed</td>
<td>Un</td>
</tr>
<tr>
<td>Maximum continuous voltage on any bus for which equipment is designed Note: To ensure voltages never exceed $U_m$, the highest voltage used at sending end busbars in planning studies should not exceed 0.98 $U_m$</td>
<td>$U_m$</td>
</tr>
<tr>
<td>Minimum voltage on Point of Common Coupling during motor starting</td>
<td>0.85 $U_n$</td>
</tr>
<tr>
<td>Maximum voltage change when switching, capacitors, reactors, etc. (system healthy)</td>
<td>0.03 $U_n$ (healthy)</td>
</tr>
<tr>
<td>Statutory voltage on bus supplying Customer for any period longer than 10 consecutive minutes (unless otherwise agreed in Supply Agreement)</td>
<td>$U_n$ plus or minus 5%</td>
</tr>
</tbody>
</table>

### Table 5-2 Standard Voltage Levels

<table>
<thead>
<tr>
<th>$U_n$ (kV)</th>
<th>$U_m$ (kV)</th>
<th>$(U_m-U_n)/U_n$, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>525</td>
<td>5.00</td>
</tr>
<tr>
<td>400</td>
<td>420</td>
<td>5.00</td>
</tr>
<tr>
<td>220</td>
<td>245</td>
<td>11.36</td>
</tr>
<tr>
<td>132</td>
<td>145</td>
<td>9.85</td>
</tr>
</tbody>
</table>
### Table 5-3 Target Voltages for Planning Purposes at Transmission Voltages

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum steady state voltage at bus supplying <em>Customer</em> load unless otherwise specified in the <em>Customer</em>’s supply agreement</td>
<td>0.95 Un(^1)</td>
</tr>
<tr>
<td>Minimum and maximum steady state voltage on any controlled bus, unless otherwise specified in the <em>Customer</em> supply agreement:</td>
<td></td>
</tr>
<tr>
<td>System healthy:</td>
<td>0.95 – 1.05 Un(^2)</td>
</tr>
<tr>
<td>After designed contingency (before control actions):</td>
<td>0.90 Un – 0.98 Um(^2)</td>
</tr>
<tr>
<td>After control actions:</td>
<td>0.95 – 1.05 Un(^2)</td>
</tr>
<tr>
<td>Maximum steady state voltage at bus supplying <em>Customer</em> load unless otherwise specified in the <em>Customer</em> supply agreement</td>
<td>1.05 Un</td>
</tr>
<tr>
<td>Maximum harmonic voltage caused by <em>Customer</em> at the PCC:</td>
<td></td>
</tr>
<tr>
<td>Individual harmonic:</td>
<td>0.01 Un</td>
</tr>
<tr>
<td>Total (square root of sum of squares):</td>
<td>0.03 Un</td>
</tr>
<tr>
<td>Maximum negative sequence voltage caused by <em>Customer</em> at PCC:</td>
<td></td>
</tr>
<tr>
<td>Continuous single-phase load connected phase-to-phase:</td>
<td>0.01 Un</td>
</tr>
<tr>
<td>Multiple, continuously varying, single-phase loads:</td>
<td>0.015 Un</td>
</tr>
<tr>
<td>Harmonic voltage limits:</td>
<td>As defined in KS IEC 61000</td>
</tr>
<tr>
<td>Maximum voltage change owing to load varying N times per hour:</td>
<td>(4.5 log(_{10})n)% of Un</td>
</tr>
<tr>
<td>Maximum voltage decrease for a 5% (MW) load increase at receiving end of system (without adjustment):</td>
<td>0.05 Un</td>
</tr>
</tbody>
</table>

\(^1\)Nominal voltage  
\(^2\)Maximum voltage

### 5.2.5.2 Other Targets for Long-term Planning Purposes

#### Transmission Lines

The *Kenya National TSO* shall determine thermal ratings of standard transmission lines and update these from time to time. The thermal ratings shall be used as an initial check of line overloading. If the limits are exceeded, the situation shall be investigated, as it may be possible to defer strengthening depending on the actual line and on local conditions.

#### Transformers

Standard transformer ratings shall be determined by the *Kenya National TSO* and updated from time to time using *International Electro-technical Commission (IEC)* specifications as approved by the *Kenya Bureau of Standards*. The permissible overload of a specific transformer depends on load...
cycle, ambient temperature and other factors. If target loads are exceeded, the specific situation shall be assessed, as it may be possible to defer adding extra transformers.

**Series Capacitors**

The *Kenya National TSO* shall assure the maximum steady state current should not exceed the rated current of the series capacitor. The internationally accepted standard’s cyclic overload capabilities are for operational use only, to allow time to reduce loading to within the rated current without damaging the series capacitor.

**Shunt Reactive Compensation**

The *Kenya National TSO* shall assure that shunt capacitors can operate at 30% above their nominal rated current at Un to allow for harmonics and voltages up to Um.

**Circuit Breakers**

The TNSP shall specify and install circuit breakers as directed by the *Kenya National TSO* that meet system fault levels and other conditions considered important for the safe and secure operation of the KNTS. Ratings are to be according to international circuit breaker standards such as those of the IEC.

**5.2.5.3 Reliability Criteria for Long-term Planning Purposes**

a. The *Kenya National TSO* shall formulate long-term plans for development of the KNTS on the basis of the justifiable redundancy. With one line or transformer or reactive compensation device out of service (N-1), it shall be possible to supply the entire load under all credible system operating conditions. The loss of a single element shall not cause:

   1. Any violation of the normal operational limits such as voltage, frequency or Plant and Apparatus loading which would jeopardise the safety and reliability of the *Kenya National Transmission System* or would cause overloading of Plant or Apparatus;
   2. Islanding of any part of the *Kenya National Transmission System*;
   3. Loss of stability of the *Kenya National Transmission System*; or
   4. Cascading Outages of other elements as a result of exceeding operational security limits as set out in Chapter 9 (Operations Code No. 2 – Operational Security).

b. Investment in the KNTS to satisfy the minimum (N-1) redundancy requirement shall be on a deterministic basis, with no financial justification required.

c. An unfirm transmission infeed to an underlying *Distribution Network* is acceptable, as long as the underlying *Distribution Network* can supply the entire load without load shedding or load curtailment and without violating the technical planning limits on either the Transmission or Distribution systems on loss of the transmission infeed.

d. A system cannot be made 100% reliable, as planned and forced Outages of components will occur and multiple Outages are always possible, despite having a very low probability of occurrence.
e. The Kenya National TSO shall in planning the KNTS minimise as far as practicable the risk of common cause failure of two or more items of plant (e.g. loss of two or more lines in a common servitude or on a double circuit or multi-circuit structure), and insofar as such risk is unavoidable, shall take reasonable measures to mitigate such risk.

f. Additional equipment shall be provided if it can be justified to be included in the rate base in terms of the Least Economic Cost and/or Cost Reduction Investment as defined in this chapter or the cost is recoverable from a Customer or group of Customers in accordance the description under Strategic Investments in this chapter.

### 5.2.5.4 Contingency Criteria for Long-term Planning Purposes

a. A system meeting the N-1 (or N-2) Contingency criterion must comply with all relevant limits outlined in Tables 5-1, 5-2 and 5-3 (voltage limits) and the applicable current limits, under all credible system conditions.

b. For contingencies under various loading conditions it shall be assumed that appropriate, normally used Generating Plants are in service to meet the load and provide spinning reserve. For the more probable N-1 network Contingency, the most unfavourable generation pattern within these limitations shall be assumed, while for the less probable N-2 network Contingency an average pattern shall be used. Refer to the load and generation assumptions for load flow studies in the Transmission System Development section of this chapter.

c. The generation assumptions for the N-1 and N-2 network Contingencies do not affect the final justification to proceed with investments, but merely define what is meant by the statement that the system has been designed to meet an N-1 or N-2 Contingency.

### 5.2.6 Integration of Generating Plants

When the integration of Generating Plants is planned, the following network redundancy criteria shall apply:

a. Generating Plants of less than 100 MW

1. With all connecting lines in service, it shall be possible to transmit the total output of the Generating Plant to the system for any system load condition. If the local area depends on the Generating Plant for voltage support, the connection shall be made with a minimum of two lines.

2. Transient stability shall be maintained following a successfully cleared single-phase fault.

3. If only a single line is used, it shall have the capability of being switched to alternative busbars and be able to go onto bypass at each end of the line.

b. Generating Plants of more than 100 MW

1. With one connecting line out of service (N-1), it shall be possible to transmit the total output of the Generating Plant to the system for any system load condition.

2. With the two most onerous line Outages (N-2), it shall be possible to transmit the total output of the Generating Plant less its smallest unit to the system.
3. Smallest unit installed at the Generating Plant shall only include units that are directly connected to the transmission system and are centrally dispatched.

c. Transient stability shall be retained for the following conditions:
   1. A three-phase line or busbar fault, cleared in normal protection times, with the system healthy and the most onerous Generating Plant loading condition; or
   2. A single-phase fault cleared in “bus strip” times, with the system healthy and the most onerous Generating Plant loading condition; or
   3. A single-phase fault, cleared in normal protection times, with any one line out of service and the Generating Plant loaded to average availability.

d. The cost of ensuring transient stability shall be carried by the Generation Licensee if the optimum solution, as determined by the Kenya National TSO, results in Generating Plant equipment being installed. In other cases, the TNSP shall bear the costs and recover these as per the approved Tariff methodology.

e. Busbar layouts shall allow for selection to alternative busbars. In addition, feeders must have the ability to go onto bypass.

f. The busbar layout shall ensure that not more than 100 MW of generation is lost as a result of a single Contingency.

g. To enable the Kenya National TSO to successfully integrate new Generating Plants, detailed information is required for each Generating Plant, as described in the Information Exchange Chapter.

5.2.7 Criteria for Network Investments

a. The TNSP shall invest in the KNTS when the required development meets the technical and investment criteria specified in this section, or if the investment is in response to a Customer request for transmission service and the cost is recoverable from the Customer or group of Customers concerned in accordance with the Regulatory Authority approved connection charges guidelines.

b. The TNSP shall communicate all impacts timeously such that provision can be made for budgeting and implementation of related changes at the Customer installation.

c. Any one of the investment criteria below, each applicable under different circumstances, can be applied.

d. Calculations will assume a typical project life expectancy of 25 years, except where otherwise dictated by plant life or project life expectancy.

e. The following key economic parameters shall have a Regulatory Authority approved process of establishment:
   1. Discount rate
   2. Cost of unserved energy (COUE)
   3. Other parameters as specified by the Regulatory Authority from time to time.

5.2.7.1 Least Economic Cost Criteria

a. These criteria shall apply under the following circumstances:
1. When new Customers are to be connected
2. When investments are made in terms of improved supply reliability and/or quality to attain the limits or targets determined in the section Technical Limits and Targets for Long Term Planning Purposes in this chapter.
3. To determine and/or verify the desired level of network or equipment redundancy

b. The methodology for determining the value of load or generation in neighbouring countries shall be approved by the Regulatory Authority.

c. The methodology requires the cost of poor service to be determined. These include the cost of:
   1. Interruptions
   2. Load shedding
   3. Network constraints
   4. Voltage dips, surges, flickers, and harmonic distortion.

d. The least-cost investment criterion equation to be satisfied can be expressed as follows: “Value of improved Quality of Service (QOS) to Customers > cost to the TNSP to provide improved QOS”

e. From this equation it is evident that if the value of the improved QOS to the Customer is less than the cost to the TNSP, then the TNSP should not invest in the proposed project(s). The investment decision shall then be delayed such that optimised economic benefit can be derived.

f. This implies that for the criteria to be satisfied: “Cost of Unserved Energy (COUE) annual value (S/kWh) x annual reduction in Expected Unserved Energy (EUE) to Customers (kWh) > annual cost to the TNSP to reduce EUE”

g. The reduction in EUE shall be calculated on a probabilistic basis by a methodology approved by the Regulatory Authority.

h. COUE is a function of the types of loads, the proportion of the total load contributed by each different type of load, the duration and frequency of the interruptions, the time of the day they occur, whether notice is given of the impending interruption, the indirect damage caused, the start-up costs incurred by the Customers, the availability of Customer backup generation and many other factors.

5.2.7.2 Cost Reduction Investments

a. Proposed expenditure that is intended to reduce TNSP’s costs (e.g. shunt capacitor installations, telecommunication projects and equipment replacement that reduce costs, external telephone service expenses and maintenance costs respectively) or the cost of losses or other Ancillary Services should be evaluated in the following manner:
   1. First, it is necessary to calculate the Net Present Value (NPV) of the proposed investment using Discounted Cash Flow (DCF) methods. This shall be done by considering all cost reductions (e.g. savings in system losses) as positive cash flows, off-setting the required capital expenditure. Once again, sensitivity analysis with respect to the amount of capital expenditure (estimated contingency amount), the Annual Average Incremental Cost of Generation (when appropriate) and future load growth scenarios is required. As before, a resulting positive NPV indicates that the investment is justified over the expected life of the proposed new asset.
2. However, a positive NPV does not always indicate the optimal timing for the investment. For this reason, the second portion of the cost reduction analysis is necessary – ascertaining whether the annual extra costs incurred by the TNSP for owning (levelised) and operating the proposed asset is less than all cost reductions resulting from the new asset in the first year that it is in commission.

5.2.7.3 Statutory Investments

a. This category of projects comprises investments that the TNSP is legally required to make, irrespective of whether any economic benefit is likely to accrue, including the following:

1. Investments formally requested in terms of published government policy
2. Projects necessary to meet environmental legislation
3. Expenditure to ensure the safety of operating and maintenance personnel who are exposed to possible danger when busy with activities related to electricity transmission and the safety of the general public
4. Expenditure required to comply with other applicable legislation
5. Expenditure required to comply with court orders
6. Possible compulsory contractual commitments

b. The results of the least economic cost and/or cost reduction analyses should still be documented to demonstrate the financial impact on the business.

5.2.7.4 Strategic Investments

a. This category of investments comprises discretionary investments made by the TNSP to ensure the long-term sustainability of the TNSP, including:

1. Site and servitude acquisition
2. Expenditure, except for network expansion, required to ensure the longer term sustainability of the TNSP which cannot be justified in terms of the Least Economic Cost and Cost Reduction Investment Criteria as defined in this chapter or recovered from a Customer or group of Customers as a connection charge as specified in Strategic Investments in this chapter. In this case, the motivation as to why the investment is genuinely needed to ensure the longer term sustainability of the TNSP must be clearly stated, and the results of the least economic cost and/or cost reduction analyses must be documented, or reasons given why such analysis is not possible or practical. These shall include purchasing of capital spares to minimise Outage duration following major plant failure, purchase of specialised vehicles and equipment to transport transformers and reactors, or implementation of industry restructuring.
3. Asset replacements forming part of an asset lifecycle management plan compiled in accordance with asset management practices approved by the Regulatory Authority.
4. Network expansion projects which cannot be justified in terms of N-1 redundancy or cannot be recovered from a Customer or group of Customers as a connection charge or a Strategic Investment, as defined in this chapter, but will provide flexibility, and avoid network redundancy in the future.
5. Any other investments considered by the TNSP to be justified as strategic on grounds other than those covered in this section are to be submitted to the Regulatory Authority for consideration on a case by case basis prior to commitment to expenditure. The results of the least economic cost and/or cost reduction analyses should still be documented to demonstrate the financial impact on the business.

5.2.8 Mitigation of Network Constraints

a. The TNSP at the direction of the Kenya National TSO has the obligation to resolve network constraints.

b. Network constraints (“congestion”) shall be regularly reviewed by the Kenya National TSO and reported to the Regulatory Authority. Economically optimal plans shall be put in place around each constraint, which may involve investment, the purchase of the constrained generation, ancillary service or other solutions.

5.2.8.1 Special Customer Requirements for Increased Reliability

Where a Customer requires a more reliable or safer connection than the one provided for by the TNSP and the Customer is willing to pay the total cost of providing the increased reliability in the form of an additional connection charge, the TNSP under the direction of the Kenya National TSO shall meet the requirements at the lowest overall cost.
This chapter contains requirements specific to both the EAPP IC and the KNTGC. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

6.1 EAPP IC REQUIREMENTS

6.1.1 Introduction

The Connections Chapter (CC) specifies the minimum technical, design, and operational criteria of Plant and Apparatus, which must be complied with by the TSOs and Users at the Connection Point, in order to maintain secure and stable operation of the EAPP Interconnected Transmission System.

Respective National legislation and codes may lay down local requirements. These local requirements should observe the minimum standards in this CC to avoid adverse effects on the EAPP Interconnected Transmission System, which may affect power interconnection security and quality of supply to other Parties or increase fault levels beyond the capabilities of existing Connection Points.

The provisions of the CC shall apply to all connections to the EAPP Interconnected Transmission System:

a. Existing at the date when this chapter comes into effect, or
b. As established or modified thereafter.

6.1.2 Objective

The CC is designed to ensure:

a. That a new or modified connection shall not impose adverse effects upon the EAPP Interconnected Transmission System nor will it be subject itself to unacceptable effects by its connection to the EAPP Interconnected Transmission System;

b. That the basic rules for connection treat all TSOs and Users in a non-discriminatory manner, and

c. Ongoing compliance with the technical and operational requirements of the Interconnection Code to facilitate operational management of the EAPP Interconnected Transmission System.

6.1.3 Scope

The CC applies to TSOs and to all Users connected or seeking connection to the EAPP Interconnected Transmission System.

6.1.4 Transmission System Performance Characteristics

6.1.4.1 Frequency

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.
Under normal operation, the frequency of the *EAPP Interconnected Transmission System* shall be nominally 50 Hz and shall be controlled between 49.5 Hz and 50.5 Hz (±1%) unless exceptional circumstances prevail. Following a system disturbance such as a load variation, the frequency band is extended to 49.0–51.0 Hz (±2%). If a major *Generating Unit* is tripped, a major transmission element fails or large loads are suddenly disconnected, the maximum frequency band becomes 48.75–51.25 Hz (±2.5%). If several of the contingencies mentioned previously occur simultaneously, the operating condition is labelled as extreme and the frequency can be below 47.5 Hz or above 51.5 Hz (-5%/+3%) for up to 20 seconds, and then extreme measures should be taken to restore the system. These figures are summarised in Table 6-1 and graphically represented in Figure 6-1.

**Table 6-1: Frequency Limits in the EAPP Interconnected Transmission System**

<table>
<thead>
<tr>
<th>Operating Conditions</th>
<th>Frequency Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under Normal Operation</td>
<td>49.50Hz to 50.50Hz</td>
</tr>
<tr>
<td>Under System Disturbance</td>
<td>49.00 Hz to 51.00 Hz</td>
</tr>
<tr>
<td>Maximum band under system fault</td>
<td>48.75 Hz to 51.25 Hz</td>
</tr>
<tr>
<td>Under extreme System operation or fault conditions</td>
<td>f&lt;47.50 Hz or f&gt;51.50 Hz for up to 20 seconds</td>
</tr>
</tbody>
</table>

**Figure 6-1: Frequency Limits in the EAPP Interconnected Transmission System**

- **Normal (49.5 – 50.5) Hz**
- **System Disturbance (49.0 – 51.0) Hz**
- **Maximum band under system fault (48.75 – 51.25) Hz**
- **Extreme System operation or fault conditions (f<47.50 Hz or f>51.50 Hz) for up to 20 seconds**

## 6.1.4.2 Voltage

### Steady State Voltage

Voltage conditions in a high voltage grid are directly related to the *Reactive Power* balance at the system nodes. Unlike *Active Power*, *Reactive Power* cannot be transmitted over long distances, since the transmission of *Reactive Power* generates an additional demand for *Reactive Power* in the system components, thereby causing voltage drops. In order to obtain an acceptable voltage level, *Reactive Power* generation and consumption have to be situated as close to each other as possible to avoid excessive *Reactive Power* transmission.
The voltages on the *EAPP Interconnected Transmission System* shall normally be maintained within the limits set out below:

a. Operating voltage range of 0.95 to 1.05 per unit in steady state normal conditions for nominal voltages used in the *EAPP Interconnected Transmission System* namely 500 kV, 400 kV, 230 kV, 220 kV, 132 kV, 110 kV and 66 kV,

b. Operating voltage range of 0.90 to 1.10 per unit after any single Contingency, and

c. Operating voltage range of 0.85 to 1.20 per unit after any multiple Contingency or severe system stress.

<table>
<thead>
<tr>
<th>Operating Conditions</th>
<th>Voltage Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>0.95 - 1.05</td>
</tr>
<tr>
<td>Contingency (N-1)</td>
<td>0.90 – 1.10</td>
</tr>
<tr>
<td>Multiple Contingency</td>
<td>0.85 – 1.20</td>
</tr>
</tbody>
</table>

TSOs shall endeavour to ensure that Users comply with lagging power factors of 1.0 or less during periods of minimum demand and 0.95 or higher during peak and shoulder hours.

TSOs shall endeavour to ensure that during periods of minimum demand Users comply with a unity or lagging power factor and a power factor of 0.95 or higher during peak and shoulder hours.

**Transient Voltage**

Transient over-voltages can occur on the *EAPP Interconnected Transmission System* as a result of lightning surges or the switching of long transmission lines or cables. The insulation level of all Plant and Apparatus at the Connection Point must be coordinated to take account of these transient over-voltages. The insulation levels for equipment shown in Table 6-3 below are based on IEC 60071-1:

<table>
<thead>
<tr>
<th>Nominal Voltage Or Rated Voltage</th>
<th>Used for Transmission in Countries</th>
<th>Highest Operating Voltage On Equipment</th>
<th>Withstand Voltage for Lightning Surge (LIWL)</th>
<th>Withstand Voltage for Switching Surge (SIWL)</th>
<th>50 Hz, 1 Min Withstand Voltage (kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>66 kV</td>
<td>Ethiopia, Sudan, Tanzania, Kenya</td>
<td>72.5 kV</td>
<td>325</td>
<td>N/A</td>
<td>140</td>
</tr>
<tr>
<td>110 kV</td>
<td>Burundi, DRC, Rwanda, Sudan</td>
<td>123 kV</td>
<td>550</td>
<td>N/A</td>
<td>230</td>
</tr>
<tr>
<td>132 kV</td>
<td>Ethiopia, Kenya, Tanzania</td>
<td>145 kV</td>
<td>650</td>
<td>N/A</td>
<td>275</td>
</tr>
<tr>
<td>220 kV</td>
<td>Egypt, Kenya, Sudan, Tanzania</td>
<td>245 kV</td>
<td>950</td>
<td>N/A</td>
<td>395</td>
</tr>
<tr>
<td>230 kV</td>
<td>Ethiopia</td>
<td>245 kV</td>
<td>1050</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>400 kV</td>
<td>Ethiopia</td>
<td>420 kV</td>
<td>1050 – 1425</td>
<td>850 / 950 / 1050</td>
<td>N/A</td>
</tr>
<tr>
<td>500 kV</td>
<td>Egypt</td>
<td>550 kV</td>
<td>1175 – 1550</td>
<td>950 / 1050 / 1175</td>
<td>N/A</td>
</tr>
</tbody>
</table>
The lowest operating voltages at each voltage level depend on the local conditions. The lowest values are reached during operational disturbances and are usually not lower than 0.9 per unit.

**Voltage Dips**

A voltage reduction with duration of 10 ms to 1 minute and a voltage drop of more than 10% of the existing value is known as a *Voltage Dip*. There are no standard requirements for the severity or extent of *Voltage Dips* since they are highly dependent on the system configuration. The duration of a *Voltage Dip* is highly dependent on the type of fault concerned and on which relay protection methods are used locally.

Most *Voltage Dips* are caused by earth faults. Whether or not such *Voltage Dips* are transferred to lower voltages depends on which earthing methods are used and on the transformer connections. The *Voltage Dips* may often become deeper and may also spread to other parts of the system if faults occur in more than one phase, but this is relatively rare.

**Voltage Flicker**

*Voltage Flicker* is an increase or decrease in voltage over a short period of time, normally associated with a fluctuating load. The characteristics of the particular *Voltage Flicker* problem depend on the characteristics of the load change.

*Voltage Flicker* may arise during the start-up of an *Induction Generator*, motor, energisation of a transformer or other equipment as the large starting or inrush current may cause the voltage to drop considerably.

*TSOs* and *Users* are required to minimise the occurrence of *Voltage Flicker* on the *EAPP Interconnected Transmission System* as measured at the *Connection Point*. The *Voltage Flicker* limits are contained in the following *IEC* standards:


c. In general, the total *Voltage Flicker* at a *Connection Point* shall not exceed:
   1. ± 1% of the steady state voltage level, when these occur repetitively; or
   2. ± 3% of the steady state voltage level, when these occur infrequently.

**6.1.4.3 Harmonics**

Harmonics can cause telecommunication interference and thermal heating in transformers; they can disable solid-state equipment and create resonant over-voltages. In order to protect such equipment harmonics must be managed and mitigated. Harmonics are normally produced by *Plant* and *Apparatus* generating waveforms that distort the fundamental 50 Hz wave.
The following table based on IEEE 519-92 shows the permitted harmonic distortion levels on the 
*EAPP Interconnected Transmission System*.

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>Acceptable Harmonic Distortion Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 kV, 400 kV, 230 kV, 220 kV</td>
<td>Total Harmonic Distortion of 1.5% with no individual harmonic greater than 1%</td>
</tr>
<tr>
<td>132 kV, 110 kV</td>
<td>Total Harmonic Distortion of 2.5% with no individual harmonic greater than 1.5%</td>
</tr>
<tr>
<td>66 kV</td>
<td>Total Harmonic Distortion of 5% with no individual harmonic greater than 3.0%</td>
</tr>
</tbody>
</table>

### 6.1.4.4 Phase Unbalance

Under normal operation, the maximum negative phase sequence component of the phase voltage on the *EAPP Interconnected Transmission System* shall remain below 1%. Under planned *Outage* conditions, infrequent short duration peaks with a maximum value of 2% are permitted for phase unbalance, subject to the prior agreement of the *TSO*.

### 6.1.5 Technical Standards for Plant and Apparatus

All *Plant* and *Apparatus* connected to or proposed for connection to the *EAPP Interconnected Transmission System* shall meet certain minimum technical standards as detailed below, in the following order of preference:

a. Relevant current international and African Standards, such as *IEC, ISO, EN*;

b. Relevant current national standards.

Furthermore, *Plant* and *Apparatus* shall be designed, manufactured and tested in accordance with the quality assurance ISO 9000 family or equivalent.

### 6.1.6 High Voltage Direct Current

Any *HVDC* interconnection shall be designed so that it has no negative effect on existing equipment connected to the *EAPP Interconnected Transmission System*. Each *HVDC* interconnection must ensure that they do not cause any sub-synchronous resonance, undamped oscillations, rapid voltage variations, harmonic voltages and interference with telecommunications.

The conditions specified in this chapter of the CC apply to *HVDC* interconnections connecting to or within the *EAPP Interconnected Transmission System*. Each *HVDC* Interconnection shall have the following minimum capabilities:

a. Operate continuously at its declared MW Output at frequencies in the range 49.5 Hz to 50.5 Hz;

b. Operate and remain connected to the *EAPP Interconnected Transmission System* at frequencies within the range 48.75 Hz to 51.25 Hz;
c. Remain connected to the *EAPP Interconnected Transmission System* at frequencies within the range 47.0 Hz to 47.5 Hz for a duration of 20 seconds on each occasion that the frequency is below 47.5 Hz;

d. Remain synchronised to the *EAPP Interconnected Transmission System* during a rate of change of frequency of values up to and including 1 Hz per second;

e. Remain connected to the *EAPP Interconnected Transmission System* at declared MW Output at voltages within the ranges specified in Section 6.1.4 (Connections - Transmission System Performance Characteristics (Voltage)) for step changes in voltage of up to 10%;

f. Remain connected during and following *Voltage Dips* at the HV terminals of the *HVDC* Interconnection Transformer of 95% of nominal voltage for a duration of 0.2 seconds and *Voltage Dips* of 50% of nominal voltage for a duration of 0.6 seconds. Following fault clearance the *HVDC* Interconnection should return to pre-fault conditions subject to normal frequency control and *Automatic Voltage Regulator* responses;

g. Operate within all normal operating characteristics at a minimum short circuit level at the *Connection Point* of 1000 MVA;

h. Remain connected to the *EAPP Interconnected Transmission System* during a negative phase sequence load unbalance in accordance with IEC 60034-1;

i. In an emergency be capable of reversing the power flow on the *HVDC* Interconnection at a rate which shall be no less than the *HVDC* Interconnection registered capacity within five (5) seconds, up to ten (10) times during the life of the plant and no more than two (2) times in any given twelve (12) months.

### 6.1.7 Protection Criteria

#### 6.1.7.1 General

Protection system design shall be based on simplicity, safety to persons, mitigation, and limitation of equipment damage and control of the spread of any disturbance. The speedy operation of protection systems to clear faults in the *EAPP Interconnected Transmission System* is a pre-requisite to avoid instability and cascade tripping.

The protection systems to be applied to the *User’s Plant and Apparatus* at the *Connection Point* 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 *EAPP Interconnected Transmission System*.

#### 6.1.7.2 Fault Clearance Times

The clearance times for a fault on the *EAPP Interconnected Transmission System* or for a fault on the *User system* at the *Connection Point* shall not be longer than:

a. 80 ms for faults at 400 kV and 500 kV;

b. 100 ms for faults at 230 kV and 220 kV;

c. 120 ms for faults at 132 kV and below.
Nothing shall prevent a TSO or User utilising faster fault clearance times. Total fault clearance time shall be from fault inception until arc extinction, which therefore includes relay operation, circuit breaker operation and telecommunications signalling times.

6.1.7.3 Circuit Breaker Fail Protection

When a circuit breaker is provided at the Connection Point to interrupt fault currents at any side of the Connection Point, a circuit breaker fail protection shall also be provided. The circuit breaker fail protection shall be designed to initiate the tripping of all the necessary electrically-adjacent circuit breakers and to interrupt the fault current within the next 250 ms, in the event that the primary protection system fails to interrupt the fault current within the prescribed Fault Clearance Time as detailed in Section 6.1.7 (Connections – Protection Criteria).

6.1.7.4 Reliability of Protection Systems

The reliability of the protection system to initiate the successful tripping of the circuit breakers that are associated with the faulty Plant and Apparatus shall be not less than 99.5%.

6.1.7.5 Protection of Transmission Facilities

All transmission facilities on the EAPP Interconnected Transmission System shall be provided with two fully redundant main protection systems. The two protection systems shall be supplied from separate secondary windings on one Voltage Transformer or potential device and from separate Current Transformer secondary windings (using two Current Transformers – one Current Transformer for each protection system). Separately fused and monitored DC supplies shall be used with the two protection systems. Each main protection shall be capable of operating in stand-alone mode in parallel with the other main protection in a ‘one out of two’ tripping scheme. To avoid the risk of simultaneous failure of both protection systems due to design deficiencies or equipment problems, the use of two identical protection systems is not appropriate. In addition to the two main protections a separate back-up protection, normally an overcurrent protection, shall be provided.

Transmission Circuit Reclosure

Automatic reclosing is appropriate to support continuity of service and to maintain stability of the EAPP Interconnected Transmission System. All transmission lines shall be equipped with single pole and three pole tripping as well as high speed automatic reclose facilities. The impact on any generating or transmission facility of such automatic reclosure schemes requires careful consideration so that the reliability of the transmission system is not reduced or compromised.

6.1.8 Technical Requirements for Generating Units

6.1.8.1 Performance Requirements

It is necessary to define the performance requirements of Generating Units which have or could have an impact on the reliability, security and adequacy of supply of the EAPP Interconnected Transmission System. In the initial stages of the interconnection only Generating Units directly
connected to the *EAPP Interconnected Transmission System* and with a registered output of greater than thirty (30) MW shall meet the following requirements:

a. Each shall be capable of supplying rated power output \((\text{MW})\) at any point between the limits 0.85 power factor lagging and 0.95 power factor leading at the *Generating Unit* terminals. The short circuit ratio of *Generating Units* shall not be less than 0.5;

b. Each *Generating Unit* must be capable of continuously supplying its registered output within the frequency range given in Section 6.1.4 (Connections – Transmission Performance Characteristics).

c. The output voltage limits of *Generating Units* must not cause voltage variations in excess of ± 10% of nominal. Any necessary voltage regulating equipment shall be installed by the *Generation Licensee* to maintain the output voltage level of its *Generating Units*;

d. The *Active Power* output under steady state conditions of any *Generating Unit* directly connected to the *EAPP Interconnected Transmission System* shall not be affected by voltage changes in the normal operating range;

e. The *Reactive Power* output of a *Generating Unit* under steady state conditions must be fully available within the voltage range of ± 10% of nominal voltage at the *Connection Point*.

### 6.1.8.2 Turbine Control System

The speed governor of each *Generating Unit* must be capable of operating to the standards approved by *EAPP Steering Committee* and the *TSO*. Each *Generating Unit* shall be fitted with a fast acting Turbine Controller to provide power and frequency control under normal operational conditions in accordance with the *Interchange Scheduling and Balancing Chapters*. The turbine speed control principle shall be that the *Generating Unit* output shall vary with rotational speed according to a proportional droop characteristic (*Primary Response*) between 2% and 5%. Superimposed load control loops shall have no negative impact on the steady state and transient performance of the turbine’s rotational speed control.

The Turbine Controller shall be sufficiently damped for both isolated and interconnected operation modes. Under all operating conditions, the damping coefficient of the Turbine Speed Control shall be above 3% for gas turbines and 5% for steam turbines.

Under all system operating conditions, the *Generating Unit* speed shall not exceed 103% corresponding to 51.5 Hz for more than 20 seconds in the *EAPP Interconnected Transmission System* (refer to Frequency Sensitive Relays in this chapter.)

The Turbine Speed Controller and any other superimposed control loop such as load control or gas turbine temperature limiting control shall contribute to the *Primary Response* to maintain the unit within the *Generating Unit* capability limits.

The *Primary Response* characteristics shall be maintained under all operational conditions. Additionally, in the event that a *Generating Unit* becomes isolated from the system but is still supplying demand the *Generating Unit* must be able to provide *Primary Response* to maintain the frequency.
6.1.8.3 Automatic Voltage Regulator

A continuous Automatic Voltage Regulator (AVR) acting on the excitation system is required to provide constant terminal voltage of the Generating Unit without instability over the entire operating range of the Generating Unit. Control performance of the voltage control loop shall be such that under isolated operating conditions the damping coefficient shall be above 0.25 for the entire operating range.

The AVR shall have no negative impact on Generating Unit oscillation damping. If required by the TSO, in consultation with EAPP Sub-Committees on Planning and Operation, a Power System Stabiliser (PSS) shall be provided. Control principle, parameter setting and switch on/off logic shall be coordinated with the TSO and EAPP Sub-Committees on Planning and Operation and specified by the TSO in the Connection Agreement.

6.1.8.4 Frequency Sensitive Relays

The EAPP Interconnected Transmission System frequency could rise to 51.5 Hz or fall to 47.5 Hz and Generating Units must continue to operate within these respective frequency ranges unless EAPP Sub-Committees on Planning and Operation or the TSO has agreed to any frequency-level relays and/or rate-of-change-of-frequency relays which shall trip such Generating Units within this frequency range. Such tripping arrangements shall be set out by the TSO in the Connection Agreement.

6.1.8.5 Protection Arrangements

Protection of Generating Units and their connections to the EAPP Interconnected Transmission System shall meet the minimum requirements given in Section 6.1.4.

Loss of Excitation

The Generation Licensee shall provide the necessary protection device to detect loss of excitation on a Generating Unit and initiate a Generating Unit trip.

Pole Slipping Protection

Where system requirements dictate, the TSO shall specify in the Connection Agreement a requirement for Generation Licensees to fit pole-slipping protection on their Generating Units.

6.1.8.6 Black Start Capability

Some Generating Units shall be designated to have Black Start Capability primarily considering their type and location on the system as set out in Section 10.1.7 (Operations Chapter No. 3 - Emergency Operations). This capability shall enable Generation Licensees to restart their facilities without an incoming supply from the EAPP Interconnected Transmission System. EAPP Sub-Committees on Planning and Operations in consultation with TSOs shall nominate Black Start Generating Units at a number of strategic locations across the Region. The requirement for a Black Start Capability shall be incorporated into the Connection Agreement by the relevant TSO.
*Black Start* facilities shall be routinely tested by the *Generation Licensee* to ensure satisfactory operation. The *TSO* shall have the right to require the *Generation Licensee* to demonstrate the *Black Start Capability*.

### 6.1.9 Technical Requirements for the Interconnected Parties

Protection measures are required to be taken by *EAPP* and *TSOs* to isolate a *National System* or part of such system from the *EAPP Interconnected Transmission System* in case of uncleared faults or the malfunctioning of *Plant* or *Apparatus* which could lead to a System Emergency condition.

Each *TSO* shall make the necessary arrangements to disconnect its *National System* from the *EAPP Interconnected Transmission System* under the circumstances stated below.

#### 6.1.9.1 Area Separation by Frequency Deviation

The cross-border connections to *Neighbouring Systems* shall be tripped when frequency measured at the border falls below 48.75 Hz for more than thirty (30) seconds.

#### 6.1.9.2 Area Separation by Abnormal Transient Conditions

The cross-border connections to *Neighbouring Systems* shall be tripped when an Out of Step pole slipping condition or when sustained inter-area oscillations with amplitudes exceeding an agreed limit are observed.

#### 6.1.9.3 Area Separation by Transmission Line Overloading

The cross-border connections to *Neighbouring Systems* shall be tripped when overloading of the connections occurs. The overload values for the connections shall be agreed between the respective *TSOs* and *EAPP Sub-Committee on Operations*.

### 6.1.10 Ancillary Services

The CC contains requirements for the minimum capability for certain *Ancillary Services* as set out in further detail in Chapter 16 (ISBC No. 3 - Ancillary Services). These *Ancillary Services* are required in order to maintain the *EAPP Interconnected Transmission System* in a safe, secure and reliable operating state.

In the case of *Generating Units* these *Ancillary Services* include *Primary and Secondary Response*, voltage and load flow control and *Black Start Capability*. *TSOs* may enter into *Ancillary Services Agreements* with *Generation Licensees* for the provision of these capabilities. The *Ancillary Services* agreements may also contain commercial arrangements in relation to the provision of these capabilities or of more enhanced capabilities. *Tertiary Reserve* of a *Generating Unit* (fast start hydro and gas turbine *Generating Units* and steam turbine *Generating Units* on hot-standby) is an *Ancillary Service* that is being delivered when a *Generating Unit* is able to start up and synchronise or change its loading within the timescales specified by the *TSO*.

For transmission facilities the *Ancillary Services* provision is related to voltage control equipment such as shunt capacitors, flow control devices such as Phase Shifting Transformers and to special...
control systems such as RAS. The provision of such Ancillary Services would be subject to an agreement between the transmission provider and the TSO.

6.1.11 Technical Criteria for Communications Equipment

6.1.11.1 Criteria

The Control Centre of each TSO shall be equipped with adequate and reliable telecommunication facilities internally and with the Control Centres of other TSOs and the EAPP Coordination Centre to ensure the exchange of information necessary to maintain the security and reliability of the EAPP Interconnected Transmission System. Redundant facilities using alternate routes and different transmission media shall be provided. Each TSO is responsible for building, operating and maintaining that part of the telecommunications network located within its National System and shall bear all costs associated with the investment, operation, maintenance, and improvement.

Each TSO shall take appropriate measures to protect the telecommunications network against risks related to the disruption of operation, data corruption or disclosure of confidential information.

6.1.11.2 Telecommunication System

Dedicated telecommunication channels shall be provided between a Control Centre and the Control Centre of each Neighbouring System. All dedicated telecommunication channels shall not require intermediate switching to establish communication.

Alternate and physically independent telecommunication channels shall be provided for emergency use to back up the circuits used for critical data and voice communications.

Telecommunication Availability

The reliability calculation is based on the Meant Time Between Failure (MTBF) and the Mean Time to Repair (MTTR), as MTBF/(MTBF+MTTR) of each component between two gateways including the backup links. The target availability is 99.8%.

Restoration services on critical telecommunications channels shall be available twenty-four (24) hours per day, every day of the year. Each Control Centre operator should be able to take control of any telecommunication channel for its own use when necessary.

Reliability of Telecommunications Facilities

Vital telecommunications facilities shall be managed tested and actively monitored. Special attention shall be given to back up and emergency telecommunications facilities and equipment not used for routine communications.

Telecommunication Performance

Under normal conditions, the transmission delay, for a given data volume of mutually agreed real-time data exchange, between gateways should not exceed two (2) seconds. The system shall have sufficient bandwidth for a given data volume to meet the required performance. A speed of at least
two (2) Mbps is recommended for the interconnected telecommunication channels and a minimum speed of sixty four (64) kbps is required. A lower speed than two (2) Mbps shall only be used as an interim solution.

**Global Positioning System**

All SCADA systems shall be synchronised to the GPS for accurate time keeping.

**Expansions of Telecommunications Services**

Expansions and modifications to the telecommunications network and minimum technical standard of components shall be agreed by the *EAPP Steering Committee*.

6.1.11.3 Standards

The following Standards shall be used for telecommunications services:

a. The *Wide Area Network (WAN)* shall be based on *TCP/IP* protocol;
b. Communication between *Control Centres* shall be harmonised and based on ICCP protocol or as agreed between TSOs and *EAPP CC*;
c. Tele-control real-time information shall be based on *IEC 870-6 TASE.2* protocol;
d. Non real-time services such as file transfer for exchange of transmission schedules, network model, planning data or statistics shall be based on the *FTP* protocol;
e. E-mail for special applications shall be based on *SMTP*.

6.1.11.4 Voice Recorder

A recording system shall ensure permanent recording of all telephone conversations between the *TSO Control Centres* and the *EAPP Coordination Centre* and shall be located in the *Control Centres* and in the *EAPP Coordination Centre*.

The recording system shall be capable of playing back directly up to one (1) month telephone conversations. Archival storage shall be done on CDs or DVDs or any appropriate medium. Archives shall be stored for at least one (1) year.

6.1.12 Regional System Monitoring

Monitoring equipment shall be provided on the *EAPP Interconnected Transmission System* to enable the *EAPP Coordination Centre* and individual TSOs to monitor the *EAPP Interconnected Transmission System* operation and dynamic performance.

Additionally, the *TSO* shall be required to monitor *Governor* selection mode, and *AVR* selection mode for all power generation plants (with total plant capacity above 30 MW) connected to the national grid as indicated in Table 6-5 below.

Table 6-5 below sets out the minimum telemetered data required by *EAPP CC*. 
Table 6-5: EAPP CC Minimum Requirements for Telemetering

<table>
<thead>
<tr>
<th>Type of Connection</th>
<th>Telemetering Required</th>
<th>Telemetered Status Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interconnected Transmission System Node</td>
<td>MW, Mvar, kV, pf</td>
<td>All circuit breakers on Interconnected Transmission System</td>
</tr>
<tr>
<td></td>
<td>MWh, Mvarh, Amps</td>
<td></td>
</tr>
<tr>
<td>Generating Units connected directly to Interconnected</td>
<td>MW, Mvar, kV, pf</td>
<td>Generating Unit main circuit breakers</td>
</tr>
<tr>
<td>Transmission System</td>
<td>MWh, Mvarh</td>
<td></td>
</tr>
<tr>
<td>Generating Unit &gt; 30 MW not directly connected to</td>
<td>MW, Mvar, kV, pf</td>
<td>Generating Unit main circuit breakers</td>
</tr>
<tr>
<td>Interconnected Transmission System</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The EAPP Coordination Centre shall define any further system parameters it requires to monitor.

6.1.13 Maintenance Standards

All TSO’s and User’s Plant and Apparatus connected to or forming part of the EAPP Interconnected Transmission System shall be maintained adequately for the purpose for which it is intended and to ensure that it does not pose a threat to the safety of any person or other system facilities. The EAPP Independent Regulatory Board through the national Regulatory Body shall have the right to access and inspect the test results and maintenance records relating to such Plant and Apparatus at any time.

TSOs and Users shall ensure that Plant and Apparatus, including protection systems, are tested and maintained and remain rated for the duty required. TSOs shall ensure that a copy of the Annual Transmission System Capability Statement including the update of system fault levels is made available.

6.2 Kenya National Transmission Grid Code Requirements

6.2.1 Connection Conditions

This section defines acceptable requirements for Generating Plant connections. Note that some the sections below refer to the acronym GCR (Generating Plant Connection Requirements) for brevity and later reference.

Compliance with the GCR shall be read in conjunction with the Generating Plant characteristics and sizes as specified in Tables 6-6 and Table 6-7 in Section 6.3 of this chapter, which summarise requirements for Generating Plant connections.
The organisation(s) responsible for the planning and development of the KNTS shall offer to connect and, subject to the signing of the necessary agreements, make available a Connection Point to any requesting Generation Licensee.

For new units special consideration shall be given to the impact of the risks on future operating costs, e.g. for Ancillary Services. The Kenya National TSO is to quantify these expected costs. The special consideration may include obtaining Regulatory Authority approval for including these costs in the Tariff base or obliging the Generation Licensee to purchase reserves.

6.2.2 Protection

A Generating Plant, unit step-up transformer, unit auxiliary transformer, associated busbar ducts and switchgear shall be equipped with well-maintained protection functions, in line with international best practices, to rapidly disconnect appropriate plant sections should a fault occur within the relevant protection zones which fault may reflect into the KNTS.

The following protection functions shall be provided as defined to protect the KNTS.

6.2.2.1 Backup Impedance

An impedance facility with a large reach shall be used. This shall operate for phase faults in the unit, in the HV yard or in the adjacent KNTS lines, with a suitable delay, for cases when the corresponding main protection fails to operate. The impedance facility shall have fuse fail interlocking.

6.2.2.2 Loss of Field

All Generating Plants shall be fitted with a loss of field facility that matches the system requirements. The type of facility to be implemented shall be agreed with the organisation(s) responsible for the planning and development of the KNTS.

6.2.2.3 Trip to House Load

This protection shall operate in the event of a complete loss of load. For example if all the feeder breakers open at a Generating Plant, power flow into the system is cut off and the Generating Plant will accelerate. At 50.5 Hz the over-frequency facility shall pick up to start the house loading process. At this stage the HV breakers will still be closed. There will be power swings between the units and as soon as a unit has a reverse power condition the protection shall open the HV breaker. The units shall island feeding their own auxiliaries. When system conditions have been restored then the islanded units can be resynchronised to the system.

6.2.2.4 Unit Transformer HV Back-up Earth Fault Protection

This is an inverse definite minimum time facility that shall monitor the current in the unit transformer neutral. It can detect faults in the transformer HV side or in the adjacent network. The back-up earth fault facility shall trip the HV circuit-breaker.

6.2.2.5 HV Pole Disagreement Protection

The pole disagreement protection shall cover the cases where one or two poles of a circuit breaker fail to operate after a trip or close signal.
6.2.2.6  Unit Switch onto Standstill Protection

This protection shall be installed in the HV yard substation or in the unit protection panels. If this protection is installed in the unit protection panels then the DC supply for this protection and that used for the circuit-breaker closing circuit shall be the same. This protection safeguards the Generating Plant against an unintended connection to the KNTS (back energisation) when at standstill or at low speed.

6.2.2.7  Protection Setting Management and Additional Requirements

a. In addition, should system conditions dictate, other protection requirements shall be determined by the Kenya National TSO in consultation with the Generation Licensee and these should be provided and maintained by the relevant Generation Licensee at its own cost.

b. Required HV breaker tripping, fault clearance times, including breaker operating times depend on system conditions and shall be defined by the organisation(s) responsible for the planning and development of the KNTS. Guidelines for operating times are:

1. 80 ms where the Connection Point is 330kV or above
2. 80 ms where the Connection Point is 220 kV
3. 100 ms where the Connection Point is 132 kV and below

c. Further downstream breaker tripping (away from the system), fault clearing times, including breaker operating time, shall not exceed the following:

1. 120 ms plus additional 30 ms for DC offset decay or
2. 100 ms plus additional 40 ms for DC offset decay.

d. Where system conditions dictate, these times may be reduced. Where so designed, earth fault clearing times for high resistance earthed systems may exceed the above tripping times.

e. All protection interfaces with the organisation(s) responsible for the planning and development of the KNTS shall be coordinated between the Users.

f. The settings of all the protection tripping functions on the unit protection system of a unit, relevant to KNTS performance and as agreed with each Generation Licensee in writing, shall be co-ordinated with the transmission protection settings. These settings shall be agreed between the organisation(s) responsible for the planning and development of the KNTS and each Generation Licensee, and shall be documented and maintained by the Generation Licensee, with the reference copy, which reflects the actual plant status at all time, held by the organisation(s) responsible for the planning and development of the KNTS. The Generation Licensee shall control all other copies.

g. For system abnormal conditions, a unit is to be disconnected from the KNTS in response to conditions at the Connection Point, only when the system conditions are outside the plant capability where damage will occur. Protection setting documents shall illustrate plant capabilities and the relevant protection operations.

h. Any work on the protection circuits interfacing with transmission protection systems (e.g. bus zone) must be communicated to the Kenya National TSO before commencing with the works. This includes work done during a unit Outage.
6.2.3 Ability of Units to Island

a. Every unit that does not have Black Start capabilities of less than one hour without power from the KNTS shall be capable of unit islanding.

b. Islanding testing shall be contracted as an Ancillary Service.

6.2.4 Multiple Unit Tripping (MUT) Risks

A Generating Plant and its units shall be designed, maintained and operated to minimise the risk of more than one unit being tripped from one common cause within a short time.

6.2.5 Restart after Generating Plant Black-out

6.2.5.1 Thermal Generating Plants other than Gas Turbines

a. A Generating Plant is to be capable of being restarted and synchronised to the KNTS following restoration of external auxiliary AC supply without unreasonable delay resulting directly from the loss of external auxiliary AC supply.

b. For the purposes of this chapter, examples of unreasonable delay in the restart of a Generating Plant are:

1. Restart of the first unit that takes longer than 4 hours after restart initiation

2. Restart of the second unit that takes longer than 2 hours after the synchronising of the first unit.

3. Restarting of all other units that take longer than 1 hour each after the synchronising of the second unit.

4. Delays not inherent in the design of the relevant start up facilities and which could reasonably be minimised by the relevant Generation Licensee

5. The start-up facilities for a new unit not being designed to minimise start up time delays for the unit following loss of external auxiliary AC supplies for two hours or less.

6.2.5.2 Hydro and Gas Turbines

a. A Generating Plant is to be capable of being restarted and synchronised to the KNTS following restoration of external auxiliary AC supply without unreasonable delay resulting directly from the loss of external auxiliary AC supply.

b. For the purposes of this chapter, examples of unreasonable delay in the restart of a Generating Plant are:

1. Restart of the first unit that takes longer than 30 minutes after restart initiation

2. Restarting of all other units that take longer than 30 minutes each after the synchronising of the first unit.

3. Delays not inherent in the design of the relevant start up facilities and which could reasonably be minimised by the relevant Generation Licensee and

4. The start-up facilities for a new unit not being designed to minimise start up time delays for the unit following loss of external auxiliary AC supplies for 30 minutes or less.
6.2.6 On-load Tap Changing for Generating Plant Step-up Transformers

All *Generating Plant* step-up transformers shall have on-load tap changing with remote control capability. The range and mode of control shall be agreed between the organisation(s) responsible for the planning, development, and operation of the *KNTS* and the *Generation Licensee*.

6.2.7 Emergency Unit Capabilities

All *Generation Licensees* shall specify their units’ capabilities for providing emergency support under abnormal power system conditions, as described in Chapter 10 (Operation Chapter No. 3 - Emergency Operation).

6.2.8 Facility for Independent Generating Plant Action

Frequency control under system island conditions shall revert to the *Generating Plants* as the last resort, and units and associated plant shall be equipped to handle such situations. The required control range is from 49 to 51 Hz.

6.2.9 Automatic Under-frequency Starting

It may be agreed with the *Kenya National TSO* that a *Generating Plant* that is capable of automatically starting within 10 minutes shall have automatic under-frequency starting. This starting shall be initiated by frequency-level facilities with settings in the range 49Hz to 50Hz as specified by the *Kenya National TSO*.

6.2.10 Testing and Compliance Monitoring

a. A *Generation Licensee* shall keep records relating to the compliance by each of its units with each section of this chapter applicable to that unit, setting out such Information that the *Kenya National TSO* reasonably requires for assessing power system performance (including actual unit performance during abnormal conditions).

b. Within one (1) month after the end of June and December, a *Generation Licensee* shall review, and confirm to the *Kenya National TSO*, compliance by each of that *Generation Licensee’s* units with every *GCR* during the past six (6) month period.

c. A *Generation Licensee* shall conduct tests or studies to demonstrate each unit at the *Generating Plant* complies with each of the requirements of this code. Tests shall be carried out on new units, after every *Outage* where the integrity of any *GCR* may have been compromised, to demonstrate the compliance of the unit with the relevant *GCR*(s). The *Generation Licensee* shall continuously monitor its compliance with all the connection conditions of the *KNTGC*.

d. Each *Generation Licensee* shall submit to the *Kenya National TSO* a detailed test procedure, emphasising system impact, for each relevant part of this chapter prior to every test.

e. If a *Generation Licensee* determines, from tests or otherwise, that one of its *Generating Plants* is not complying with one or more sections of this chapter, then the *Generation Licensee* shall:

   1. Promptly notify the *Kenya National TSO* of that fact;
2. Promptly advise the Kenya National TSO of the remedial steps it proposes to take to ensure that the relevant Generating Plant (as applicable) can comply with this chapter and the proposed timetable for implementing those steps;

3. Diligently take such remedial action as will ensure that the relevant Generating Plant (as applicable) can comply with this chapter. The Generation Licensee shall regularly report in writing to the Kenya National TSO on its progress in implementing the remedial action;

4. After taking remedial action as described above, demonstrate to the reasonable satisfaction of the Kenya National TSO that the relevant Generating Plant (as applicable) is then complying with this chapter.

6.2.11 Non-compliance Suspected by the Kenya National TSO

a. If at any time the Kenya National TSO believes that a Generating Plant is not complying with this chapter, the Kenya National TSO must notify the relevant Generation Licensee of such non-compliance specifying the chapter section concerned and the basis for the Kenya National TSO’s belief.

b. If the relevant Generation Licensee believes that the Generating Plant is complying with the chapter, then the Kenya National TSO and the Generation Licensee must promptly meet to resolve their difference.

6.2.12 Unit Modification

6.2.12.1 Modification Proposals

a. If a Generation Licensee proposes to change or modify any of its units in a manner that could reasonably be expected to either adversely affect that unit’s ability to comply with this chapter, or changes the performance, information supplied, settings, etc, then that Generation Licensee shall submit a proposal notice to the Kenya National TSO which shall:

1. Contain detailed plans of the proposed change or modification;

2. State when the Generation Licensee intends to make the proposed change or modification; and

3. Set out the proposed tests to confirm that the relevant unit as changed or modified operates in the manner contemplated in the proposal, can comply with this chapter.

b. If the Kenya National TSO disagrees with the proposal submitted, it may notify the relevant Generation Licensee, and the Kenya National TSO and the relevant Generation Licensee shall promptly meet and discuss the matter in good faith in an endeavour to resolve the disagreement.

6.2.12.2 Implementing Modifications

a. The Generation Licensee shall ensure that an approved change or modification to a unit or to a subsystem of a unit is implemented in accordance with the relevant proposal approved by the Kenya National TSO.

b. The Generation Licensee shall notify the Kenya National TSO promptly after an approved change or modification to a unit has been implemented.
6.2.12.3 Testing of Modifications

a. The Generation Licensee shall confirm that a change or modification to any of its units as described above conforms to the relevant proposal by conducting the relevant tests, in relation to the connection conditions, promptly after the proposal has been implemented.

b. Within twenty (20) business days after any such test has been conducted, the relevant Generation Licensee shall provide the Kenya National TSO with a report in relation to that test (including test results of that test, where appropriate).

Equipment Requirements

Where the Generation Licensee needs to install equipment that connects directly with equipment of the organisation(s) responsible for the planning and development of the KNTS, for example in the high voltage yard of the organisation(s) responsible for the planning and development of the KNTS, such equipment shall adhere to the design requirements of the organisation(s) responsible for the planning and development of the KNTS as set out in this chapter.

6.3 Generating Plant Connection Requirements

Table 6-6: Summary of the Requirements Applicable to Specific Classes of Units Other than Hydro

<table>
<thead>
<tr>
<th>Grid Code Requirement</th>
<th>Units other than Hydro (MVA rating)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;20</td>
</tr>
<tr>
<td>GCR1 Plant availability</td>
<td>-</td>
</tr>
<tr>
<td>GCR2 Plant reliability</td>
<td>-</td>
</tr>
<tr>
<td>GCR3 Protection</td>
<td>-</td>
</tr>
<tr>
<td>- Backup Impedance</td>
<td>Yes</td>
</tr>
<tr>
<td>- Loss of Field</td>
<td>-</td>
</tr>
<tr>
<td>- Pole Slipping</td>
<td>-</td>
</tr>
<tr>
<td>- Trip to House Load</td>
<td>-</td>
</tr>
<tr>
<td>- Gen TRFR backup earth fault</td>
<td>Yes</td>
</tr>
<tr>
<td>- HV Breaker Fail</td>
<td>Yes</td>
</tr>
<tr>
<td>- HV Breaker Pole Disagreement</td>
<td>Yes</td>
</tr>
<tr>
<td>- Unit Switch onto-standstill Protection</td>
<td>-</td>
</tr>
<tr>
<td>- Main Protection only</td>
<td>Yes</td>
</tr>
<tr>
<td>- Main Protection (monitored) or main and backup</td>
<td>-</td>
</tr>
<tr>
<td>- Main and Backup Protection (both monitored)</td>
<td>-</td>
</tr>
<tr>
<td>GCR4 Ability To Island</td>
<td>-</td>
</tr>
<tr>
<td>GCR5 Excitation system requirements</td>
<td>Yes</td>
</tr>
<tr>
<td>- Power System Stabiliser</td>
<td>-</td>
</tr>
<tr>
<td>Grid Code Requirement</td>
<td>Units other than Hydro (MVA rating)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>- Limiters</td>
<td>Depends on Sys Reqts</td>
</tr>
<tr>
<td>GCR6</td>
<td>Reactive Capabilities</td>
</tr>
<tr>
<td>GCR7</td>
<td>Multiple Unit tripping</td>
</tr>
<tr>
<td>GCR8</td>
<td>Governing</td>
</tr>
<tr>
<td>GCR9</td>
<td>Restart after Station Blackout</td>
</tr>
<tr>
<td>GCR10</td>
<td>Black Starting</td>
</tr>
<tr>
<td>GCR11</td>
<td>External Supply Disturbance</td>
</tr>
<tr>
<td>GCR12</td>
<td>On load tap Changer for generating Unit step up transformers</td>
</tr>
<tr>
<td>GCR13</td>
<td>Emergency unit capabilities</td>
</tr>
<tr>
<td>GCR14</td>
<td>Independent action for control in system island</td>
</tr>
</tbody>
</table>
The table below summarizes the requirements applicable to specific classes of hydro units.

<table>
<thead>
<tr>
<th>Grid Code Requirement</th>
<th>&lt;20</th>
<th>20 to 100</th>
<th>100 to 200</th>
<th>200 to 300</th>
<th>300 - 800</th>
<th>&gt;800</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCR1 - Plant availability</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GCR2 - Plant reliability</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GCR3 - Protection</td>
<td>-</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Backup Impedance</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Loss of Field</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Pole Slipping</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Trip to House Load</td>
<td>-</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Gen TRFR backup earth fault</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- HV Breaker Fail</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- HV Breaker Pole Disagreement</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Unit Switch onto-standstill Protection</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Main Protection only</td>
<td>Yes</td>
<td>Yes</td>
<td>Depends on Sys Reqts</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- Main Protection (monitored) or main and backup</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- Main and Backup Protection (both monitored)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GCR4 - Ability To Island</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GCR5 - Excitation system requirements</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Power System Stabiliser</td>
<td>-</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Limiters</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GCR6 - Reactive Capabilities</td>
<td>Depends on Sys Reqts</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GCR7 - Multiple Unit tripping</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>If the total station output is greater than the single largest contingency as defined for instantaneous reserve</td>
<td>If the total station output is greater than the single largest contingency as defined for instantaneous reserve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GCR8 - Governing</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GCR9 - Restart after Station Blackout</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>If the total station output is greater than the single largest contingency as defined for instantaneous reserve</td>
<td>If more than 1 unit at station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GCR10 - Black Starting</td>
<td>-</td>
<td>If agreed</td>
<td>If agreed</td>
<td>If agreed</td>
<td>GCR10</td>
<td>Black Starting</td>
</tr>
<tr>
<td>GCR11 - External Supply Disturbance Withstand Capacity</td>
<td>Depends on Sys Reqts</td>
<td>If more than 5 unit at station</td>
<td>If the total station output is greater than the single largest contingency as defined for instantaneous reserve</td>
<td>If more than 1 unit at station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GCR12 - On load tap Changer for generating Unit step up transformers</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>GCR12</td>
<td>On load tap Changer for generating Unit step up transformers</td>
</tr>
<tr>
<td>GCR13 - Emergency unit capabilities</td>
<td>Depends on Sys Reqts</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GCR14 - Independent action for control in system island</td>
<td>-</td>
<td>-</td>
<td>Depends on Sys Reqts</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
This chapter contains requirements specific to both the EAPP IC and the KNTGC. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

7.1 EAPP IC REQUIREMENTS

7.1.1 Introduction

EAPP IC requirements for RPP primarily address wind and solar resources.

7.1.2 Technical Requirements for Wind and Solar Generating Plants

The requirements for Generating Plants set out in Section 6.1.8 in Chapter 6 (Connections) refer to synchronous units. Wind Turbine Generating Plants and Solar Power Generating Plants do not have the same characteristics as synchronous Generating Plants and alternative provisions are required. This section sets out the specific requirements for controllable Wind Turbine Generating Plants and Solar Power Generating Plants.

7.1.2.1 Fault Ride-through Requirements

A controllable Wind Turbine / Solar Power Generating Plant shall remain connected to the EAPP Interconnected Transmission System for Voltage Dips on any or all phases, where the system phase voltage measured at the HV terminals of the connection transformer remains above a level to be defined by the TSO and specified in the Connection Agreement.

In addition to remaining connected to the EAPP Interconnected Transmission System, the controllable Wind Turbine / Solar Power Generating Plant shall have the technical capability to provide the following functions:

a. During a Voltage Dip the controllable Wind Turbine / Solar Power Generating Plant shall provide Active Power in proportion to retained voltage and maximise reactive current to the EAPP Interconnected Transmission System without exceeding its declared limits. The maximisation of reactive current shall continue for at least 600 ms or until the voltage recovers to within the normal operational range of the EAPP Interconnected Transmission System whichever is the sooner;

b. The controllable Wind Turbine / Solar Power Generating Plant 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.

7.1.2.2 Power System Frequency Ranges

As displayed in Figure 7-1, the controllable Wind Turbine / Solar Power Generating Plant shall have the capability to:

a. Operate continuously at normal rated output at frequencies in the range 49.5 Hz to 50.5 Hz;
b. Remain connected to the EAPP Interconnected Transmission System at frequencies within the range 49.0 Hz to 51.0 Hz for a duration of 60 minutes;
c. Remain connected to the EAPP Interconnected Transmission System at frequencies within the range 47.0 Hz to 47.5 Hz for a duration of 20 seconds each time that the frequency is below 47.5 Hz, and
d. Remain connected to the EAPP Interconnected Transmission System during rate of change of frequency of values up to and including 0.5 Hz per second.

Figure 7-1: Frequency Ranges for Remaining Connected

<table>
<thead>
<tr>
<th>Frequency in Hz</th>
<th>47</th>
<th>47.5</th>
<th>48</th>
<th>48.5</th>
<th>49</th>
<th>49.5</th>
<th>50</th>
<th>50.5</th>
<th>51</th>
<th>51.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operate continually at normal output (49.5-50.5 Hz)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Remain connected to EAPP system for frequencies (49.0 - 51.0) Hz for a duration of 60 minutes</td>
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</tr>
<tr>
<td>Remain connected to EAPP system at frequency between 47.0 - 47.5 Hz for up to 20 seconds each time freq&lt;47.5 Hz</td>
<td></td>
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</tbody>
</table>

7.1.2.3 Active Power Control

The Wind Turbine / Solar Power Generating Plant control system shall be capable of operating the Generating Plant at a reduced level if the Active Power output has been restricted by the TSO. The Wind Turbine / Solar Power Generating Plant control system shall be capable of receiving an on-line Active Power Control Set-point sent by the TSO and shall commence implementation of the set-point within 10 seconds of receipt of the signal from the TSO. 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 Wind Turbine / Solar Power Generating Plant control system, as advised by the TSO.

7.1.2.4 Frequency Response

The frequency response system of Wind Turbine / Solar Power Generating Plants shall have the capabilities set out in the power frequency response curve agreed with the TSO.

7.1.2.5 Ramp Rates

The Wind Turbine / Solar Power Generating Plant 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 TSO. There shall be two maximum ramp rate settings. The first ramp rate setting shall apply to the MW per minute 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.

The power output of Solar Power Generating Plants has to be reduced in steps of 10% per minute, under any operating condition and from any working point to a maximum power value (target value) which could correspond also to 100% power reduction, without disconnection of the Generating Plant from the network.

It is recognised that falling wind speed 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 Wind Turbine Generating Plant 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 Wind Turbine / Solar Power Generating Plant operator and the TSO shall agree a procedure for setting and changing the ramp rate control.

7.2 **Kenya National Transmission Grid Code Requirements**

This section addresses KNTGC requirements for Renewable Power Plants including wind and solar. The Renewable Power Plant (RPP) Chapter was developed to address particular issues with variable wind and solar power plants.

The RPP Chapter sets out the requirements for variable Renewable Power Plants so that they will be able to contribute to the stability of the Kenya National Transmission System.

7.2.1 **Objective**

The primary objective of this Renewable Power Plant Chapter is to specify minimum grid connection technical and design requirements for variable Renewable Power Plants (RPPs) connected to or seeking connection to the Kenya National Transmission System.

7.2.2 **Scope**

The requirements in the RPP Chapter shall apply to all variable RPPs with a design capacity of 10 MVA or larger connected or seeking connection to the Kenya National Transmission System, the Kenya National TSO, and prospective electrical Transmission Network Service Providers.

This RPP Chapter shall, at minimum, apply to the following RPP technologies:

a. Wind

b. Solar Photovoltaic
7.2.3 Technical Requirements

7.2.3.1 Fault Ride-through Requirements for RPPs

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

The EAPP IC requirements specified under Section 7.1.2 shall apply to all RPPs in the KNTS.

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

a. Conditions for which the RPP Generating Plant 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.

An RPP shall remain connected to the Kenya National Transmission 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 during fault take the form of a voltage vs. time profile which dictates the level of voltage drop or increase that RPPs must be capable of withstanding along with the time for which the voltage drop or increase should be endured.

Figure 7-2 shows the combinations of voltages and time that the RPP shall be able to endure.

Area A shows that the RPP shall be able to operate continuously between 0.9 p.u. and 1.1 p.u after any single Contingency. In Area A the RPP shall stay connected to the network and uphold normal production.

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 RPP shall stay connected to the network. Figure 7-2 shows that the RPP 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 that must be endured. Just below 0.85 p.u. the voltage drop shall be endured for nearly two seconds. At 0.85 p.u. the voltage drop shall be endured a minimum of three seconds.

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 RPP shall stay connected to the network. Figure 7-2 shows that the RPP shall be able to withstand voltage increases to 1.2 p.u. for at least two seconds.
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.

**Figure 7-2: Voltage Must Remain Connected Area**

7.2.3.2 Active Power Provision During Fault

During a Voltage Dip the controllable RPP shall provide Active Power in proportion to retained voltage and maximise reactive current to the Kenya National Transmission System without exceeding its declared limits.

7.2.3.3 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 Transmission System, whichever is the sooner.

7.2.3.4 Active Power Recovery After Fault

The controllable RPP shall provide at least 90% of its maximum available Active Power as quickly as possible and in any event within one second of the voltage recovering to the normal operating range.
7.2.3.5 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 RPPs remain connected beyond the frequency range associated with normal operation.

Under normal operation, the frequency of the Kenya National Transmission System shall be nominally 50 Hz, shall be controlled between 49.50 Hz and 50.50 Hz (±1%), 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.

For a frequency band of 49.00–51.00 Hz (±2%) an RPP shall be capable of operating for at least 60 minutes.

For a frequency band of 48.00–51.50 Hz (-4% to + 3%) an RPP shall be capable of operating for at least 30 minutes.

For a frequency band of 47.50–51.50 Hz (-5% to +3%) an RPP shall be capable of operating for at least 3 minutes.

Under extreme system operation or fault conditions, an RPP shall be capable of operating at frequencies above 51.50 Hz for at least 20 seconds.

For frequencies below 47.00 Hz, an RPP shall be capable of operating for at least 200 ms.

RPPs shall remain connected during rate of change of frequency of values up to and including 1.0 Hz per second.

For frequencies above 52.00 Hz, an RPP must disconnect as indicated in Table 7-1.

<table>
<thead>
<tr>
<th>Frequency Limits</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>49.50 Hz to 50.50 Hz</td>
<td>Continuous operation (normal)</td>
</tr>
<tr>
<td>49.00 Hz to 51.00 Hz</td>
<td>For duration of at least 60 minutes</td>
</tr>
<tr>
<td>48.00 Hz to 51.50 Hz</td>
<td>For duration of at least 30 minutes</td>
</tr>
<tr>
<td>47.50 Hz to 51.50 Hz</td>
<td>For duration of at least 3 minutes</td>
</tr>
<tr>
<td>&lt;47.50 Hz or &gt;51.50 Hz</td>
<td>For duration of at least 20 seconds</td>
</tr>
<tr>
<td>&lt;47.00 Hz for more than 0.2 sec</td>
<td>May disconnect</td>
</tr>
<tr>
<td>&gt;52.00 for more than 4 sec</td>
<td>Must disconnect</td>
</tr>
</tbody>
</table>
7.2.3.6 Active Power Control

Active Power Control requirements shall be consistent with the EAPP IC requirements in Section 7.1.2.

The RPP control system shall be capable of operating the RPP at a reduced level if the Active Power output has been restricted by the Kenya National TSO. The RPP control system shall be capable of receiving an on-line Active Power Control Set-point sent by the Kenya National TSO and shall commence implementation of the set-point within 10 seconds of receipt of the signal from the Kenya National TSO. 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 RPP control system, as advised by the Kenya National TSO.

7.2.3.7 Safety Standards

Safety equipment for wind and solar Generating Plants shall include:

a. Manual disconnect switches;
b. Grounding systems; and
c. Shutoff devices.

IEC 61400-24:2010 shall be followed for grounding of wind turbine generators. IEC 61730 shall be followed for PV systems.

7.2.4 Frequency Response

Frequency response can be achieved through decreasing RPP power output when frequency exceeds the upper bound of a specified acceptable frequency range, and by increasing RPP power output when frequency falls below the lower bound of the specified range. Thus an RPP 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 RPPs shall have the capabilities set out in the power frequency response curve agreed with the Kenya National TSO.

It is usually economically beneficial for RPPs to operate at their instantaneous available capacity. If they operate below their instantaneous available capacity, wind, photovoltaic, and run-of-river hydro Plants lose some of the energy they could have captured. The same is true for other types of RPP which may lack energy storage facilities. This may be a factor in reaching agreement with the Kenya National TSO on the power frequency curve. However, RPPs shall operate below their instantaneous available capacity when instructed to do so by the Kenya National TSO.

7.2.5 Ramp Rates

Ramp Rate requirements shall be consistent with the EAPP IC requirements in Section 7.1.2.
The RPP 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 Kenya National TSO. There shall be two maximum ramp rate settings. The first ramp rate setting shall apply to the MW per minute 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 RPP 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 RPP operator and the Kenya National TSO shall agree a procedure for setting and changing the ramp rate control.

### 7.2.6 Reactive Power Capability

The Reactive Power capability of an RPP shall be available within the parameters presented in Table 7-2.

<table>
<thead>
<tr>
<th>Voltage, p.u.</th>
<th>Reactive Power Range (p.u. of full output)</th>
<th>Equivalent Full Load Power Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.20 to 0.80</td>
<td>-0.33 to 0.33</td>
<td>-0.95 to 0.95</td>
</tr>
<tr>
<td>0.80 to 1.10</td>
<td>-0.228 to 0.228</td>
<td>-0.975 to 0.975</td>
</tr>
</tbody>
</table>

### 7.2.7 Rate of Change of Frequency Range

The requirements of Chapter 5 (Planning) 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. RRP shall remain connected to the Kenya National Transmission System during rate of change of frequency of values up to and including 1.0 Hz per second.

### 7.2.8 Voltage and Frequency for Synchronisation

RPPs shall only be allowed to connect to the Kenya National Transmission 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 Kenya National Transmission System is within the range of 49.0 Hz and 50.2 Hz, or otherwise as agreed with the Kenya National TSO.

### 7.2.9 Active Power Control for Wind Generating Plants

The Wind Turbine Generating Plant shall stay connected to the Kenya National Transmission 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 Kenya National Transmission System, the wind power 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 RPP 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 units 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% of the rated power within the area between the slanted lines shown in Figure 7-3 Illustrative High Wind Downward Regulation Chart. When downward regulation is being performed, the shutting down of individual Wind Turbine Generating Plant units is allowed. The downward regulation band shall be agreed with the Kenya National TSO upon commissioning of the Wind Turbine Generating Plant.

Figure 7-3: Illustrative High Wind Downward Regulation Chart

### 7.2.10 System Reserve Requirements

Increasing penetration of wind and photovoltaic generation, and to a limited extent other RPPs, can increase the need for various kinds of reserves. The variability of their output requires higher levels of both planning and operating reserves to offset the greater chance of being or going off-line when needed. They also contribute little or no inertia to the system, increasing the need for frequency regulation, which may lead to a need for higher levels of Regulating and Spinning Reserve. These factors shall be taken into account in establishing both planning and operating reserve requirements.
7.2.11 Renewable Power Plant Hourly MW Production Forecast

Each RPP shall have the capability to produce and submit to the Kenya National TSO the day ahead and week-ahead hourly MW production. The forecasts shall be provided by each RPP by 1400 Hr on a daily basis for the following seven (7) days for each half-hour time period, by means of an electronic interface in accordance with the reasonable requirements of the Kenya National TSO’s data system.
This chapter contains requirements specific to both the \textit{EAPP IC} and the \textit{KNTGC}. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

### 8.1 EAPP IC REQUIREMENTS

#### 8.1.1 Introduction

To gain maximum benefit from the \textit{EAPP Interconnected Transmission System}, \textit{Outage} requirements for generation and transmission facilities and other factors likely to affect the operation of the system shall be coordinated between \textit{TSOs} and \textit{EAPP CC} for a period of three (3) years ahead down to real-time. In formulating \textit{Outage} placement proposals account shall be taken, where appropriate, of any commercial agreements entered into which impose constraints on \textit{Outage} duration and or placement.

In accordance with the terms of the Planning Chapter of the \textit{EAPP IC}, the \textit{TSOs} and the \textit{EAPP Sub-Committee on Planning} are required to produce a \textit{Power Balance Statement} and a \textit{Transmission System Capability Statement} on an annual basis for the succeeding ten (10) years. The \textit{Transmission System Capability Statement} forms the basis for individual \textit{Users of National Systems} to determine the potential for power transfers within the \textit{EAPP Interconnected Transmission System}.

Operations Code No. 1 (OC 1) sets out a refinement of the planning process to take account of the following:

- \textit{Outage} requirements for generation and transmission facilities whether for construction, maintenance or operational tests or \textit{System Tests};
- Changes in the characteristics of generation or transmission facilities;
- Changes in demand estimates;
- Changes in \textit{Generating Unit} availability caused by breakdown, fuel shortage or hydrological conditions;
- Current and forecast weather conditions;
- Anticipated commercial energy flows across the \textit{EAPP Interconnected Transmission System}, and
- Other information supplied by \textit{TSOs} or \textit{Users}.

The outcome of the \textit{Operational Planning} process will be a definition of the \textit{Power Balance} and \textit{Transmission System Capability} over various timescales.

\textit{TSOs} are responsible for liaison with the \textit{Users} connected to their \textit{National Systems} in respect of the \textit{Operational Planning} process.
8.1.2 Objective

OC 1 specifies:

a. The requirements for the exchange of information across the TSO-EAPP interfaces throughout the Operational Planning process, from Outage requirements identified up to three (3) years ahead for complex schemes and EAPP Interconnected Transmission and National Systems reinforcement to handover of the Operational Plan into the Control Phase;

b. The Operational Planning procedure including information required and a typical timetable for the coordination of Planned Outage requirements for Generating Units and transmission facilities including protection and associated communication channels that may have an effect on the operation of the EAPP Interconnected Transmission System, and

c. The coordination of Outages to minimise as far as possible the number and effect of constraints on the EAPP Interconnected Transmission System.

8.1.3 Scope

OC1 applies to TSOs and to EAPP CC. It should be noted that certain information and data may be required from individual Users and also from External Systems. It is the responsibility of individual TSOs to ensure such information and data is updated and made available.

8.1.4 Planning Cycle

The phases of the Operational Planning process are as follows:

a. The Operational Planning Phase covering planning of the EAPP Interconnected Transmission System for the succeeding three (3) years;

b. The Programming Phase covering planning for the operation of the EAPP Interconnected Transmission System for the period of one (1) to eight (8) weeks ahead; and

c. The Control Phase involving immediate Operational Planning for the day ahead.

8.1.5 Outage Planning Process

There are four main inputs to be considered in carrying out the Outage planning process:

8.1.5.1 Demand Forecast

By the end of October each year, TSOs shall provide the EAPP CC with the projected maximum and minimum demands on their National Systems for the three (3) years ahead on a monthly basis. The demand forecast shall be specified for each substation of the EAPP Interconnected Transmission System within each National System.

By 1000 Hr each Friday, TSOs shall provide the EAPP CC with hourly demand forecasts for the following eight (8) weeks on each node of the EAPP Interconnected Transmission System. The demand forecasts shall include Active and Reactive Power requirements for each sub-station that is part of the EAPP Interconnected Transmission System.
The *EAPP* demand forecast shall normally be based on the aggregate of individual *TSO* forecasts. Nevertheless, the *EAPP CC* may carry out its own forecast using its own criteria if it has doubts on the validity of the individual *TSO* forecasts. In the event there are significant differences between the aggregated *TSO* forecasts and the *EAPP* forecast, the *EAPP CC* shall prepare a report on the reasons for any discrepancies for presentation to the *EAPP Sub-Committee on Operations* to determine the matter.

*TSOs* shall provide the *EAPP CC* with estimates of the load which could be disconnected if required. Details shall be given of the load shedding blocks and procedures required to implement load shedding in accordance with OC 5 as in Chapter 12 (Operations Code No. 5 - Demand Control). Details shall also be provided of the *Automatic Load Shedding Scheme* installed in the *TSO’s National System*.

### 8.1.5.2 Generating Unit Outages

*Generating Unit Outages* shall be planned such that any *Outage* shall not jeopardise the security of operation of the *EAPP Interconnected Transmission System*. Particular attention is required for large *Generating Units* and those having a major impact on the Reactive Power requirements of the *EAPP Interconnected Transmission System*.

By the end of October in each calendar year, *TSOs* will provide the *EAPP CC* with:

a. Draft *Provisional Generating Unit Outage Programme* for Years 2 and 3 for its centrally despatched *Generating Units*;  
b. *Final Generating Unit Outage Programme* for Year 1 for its centrally dispatched *Generating Units*.

Between October and December of each calendar year, *EAPP CC* will consider the implications of the draft *Provisional Generating Unit Outage Programmes* submitted on the *Operating Margin* and the security of operation of the *EAPP Interconnected Transmission System* and request modifications if necessary. The *Final Generating Unit Outage Programmes* for Years 1, 2 and 3 shall be published on the *EAPP Website* at the end of December each year.

### 8.1.5.3 Transmission Outages

The planning of transmission *Outages* is dependent on the schedule of *Generating Unit Outages* and on the contracted energy transfers between *Control Areas*. *TSOs* shall plan transmission *Outages* required in Years 2 and 3 as a result of construction or refurbishment works. It is not anticipated that any detail of *Maintenance Outages* on the *EAPP Interconnected Transmission System* will be available 2 or 3 years ahead.

The planning of transmission system *Outages* in Years 0 and 1 ahead will, in addition, take into account *Outages* required as a result of maintenance and or operational or *System Tests*.  

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8.1.5.4 Net Transmission Capability

Certain Users may have pre-emptive rights over the use of Transmission System Capability.

This may occur where the User concerned has provided generation or transmission facilities as a consequence of a bilateral agreement. The TSO shall notify the EAPP CC of the existence and extent of such agreements for Operational Planning purposes.

In carrying out Operational Planning the capacity rights shall be taken into account in the placement of generation or transmission Outages. However, the security of the EAPP Interconnected Transmission System shall be the overriding consideration.


8.1.6 Outage Planning Philosophy

Transmission system Outages and Generating Unit Outages shall be coordinated so that, in general, Generating Unit Outages shall take precedence over transmission system Outages.

The EAPP CC and each TSO shall seek to resolve any Outage placement conflicts through collaboration with each other, any relevant Users and External Systems.

The philosophy of Outage co-ordination associated with the EAPP Interconnected Transmission System shall ensure that:

a. Maintenance and construction Outage programmes of transmission Plant and Apparatus are co-ordinated to minimise the loss of Transmission System Capability;

b. Planned Outages of system voltage regulation equipment, such as Automatic Voltage Regulators, synchronous compensators, shunt and series capacitors and reactors, shall be coordinated as required between TSOs by EAPP CC;

c. Unplanned Outages associated with transmission Plant and Apparatus are completed so as to restore normal operating conditions as quickly as possible. In the case of Unplanned Outages, TSOs shall consider the possibility of undertaking maintenance work during the Unplanned Outage such as to minimise subsequent Outage requirements or improve EAPP Interconnected Transmission System reliability;

d. Information is exchanged identifying maintenance work which has or could have a direct impact on the operation or transfer capability of the EAPP Interconnected Transmission System;

e. Risks of Trip of transmission elements and Generating Units are to be planned according to the same rules as for Outages, and

f. Routine maintenance of metering, telemetering, control equipment and associated communication channels shall be coordinated between TSOs and EAPP CC.
8.1.7 Data Requirements

The provision of a uniform data base of the *EAPP Interconnected Transmission System* and forecasts for interchange scheduling will allow each *TSO, EAPP Sub-Committee on Operations* and *EAPP CC* to perform power system studies for the simulation of:

a. The effects of *Generating Unit Outages* on power flows, both on *National Systems* and on the *EAPP Interconnected Transmission System*, and

b. Load flows associated with the *Outage* of lines or other elements of the *EAPP Interconnected Transmission System*, taking into consideration the influence of *Neighbouring* and *External Systems*.

8.1.8 Operating Planning Phase

The *Operational Planning* Phase is concerned with the planning of generation and transmission *Outages* on the *EAPP Interconnected Transmission System* for the succeeding three (3) years.

By the end of October in each year, each *TSO* shall prepare a draft *Maintenance Plan* covering the period up to three (3) years ahead for discussion with *EAPP CC* and other *TSOs*. *TSOs* shall notify each *User* of those aspects of the draft *Maintenance Plan* which may operationally affect such *User* including, in particular, proposed start dates and end dates of relevant *EAPP Interconnected Transmission System Outages*. The *TSO* shall indicate to a *Generation Licensee* where a need may exist to impose restrictions on the operation of *Generating Units* to allow the security of the *EAPP Interconnected Transmission System* to be maintained.

The development of the draft *Maintenance Plan* is an iterative process requiring frequent *EAPP CC* and *TSO* liaison. Each *TSO* shall review the draft *Maintenance Plan* on an ongoing basis and provide *EAPP CC* with *Outage* change requests as they become known to that *TSO*, taking account of known or advised *User Outages*.

By the end of December in each year, the draft *Maintenance Plan* will be confirmed and will become the Annual *Maintenance Plan* for the immediate year ahead (Year 1).

8.1.9 Programming Phase

During the Programming Phase, *TSOs* and the *EAPP CC* shall refine, optimise, and update the Annual *Maintenance Plan* to accommodate essential changes, additional work and previously unconfirmed *Outages*, taking into account transmission and generation profile changes.

In the Programming Phase, *Operational Planning* is carried out on a rolling eight (8) week cycle. Each Friday *TSOs* shall update the Annual *Maintenance Plan* for the following eight (8) week period beginning at 0001 Hr on the following Monday.

The *Outage* Plan for the eight (8) week period ahead will determine the transmission constraints which impact on the *Transmission System Capability*. Agreed final *Outages*, as published in the
Annual Maintenance Plan, are only to be amended if a changed requirement is brought about by an unplanned event on the EAPP Interconnected Transmission System.

Users shall give as much notice as reasonably practicable of any Outages affecting the EAPP Interconnected Transmission System. Any short notice Outage on the EAPP Interconnected Transmission System which could not be planned with ten (10) days’ notice is considered to be an Unplanned Outage. A Planned Outage is an Outage for which at least ten (10) days’ notice has been given.

Any variation in the planned return to service date or Outage start and completion times shall be brought to the notice of any other TSO involved and the EAPP CC immediately it is foreseen. The matter will be discussed between the respective TSOs and the EAPP CC in order to agree a new return to service date and or Outage start and finish times.

Where a TSO or the EAPP CC is obliged to cancel a Planned Outage in order to safeguard the operation of the EAPP Interconnected Transmission System, the Outage will be re-planned so as to minimise any adverse impact on either the User or TSO concerned.

8.1.10 Control Phase

Each day at 1500 Hr, EAPP CC and TSOs shall issue the final Operational Plan for use in real-time. This Operational Plan will cover the 24-hour period commencing at 0001 Hr on the following day. In the case of the Operational Plan issued on a Friday, the Plan will cover the three (3) days commencing at 0001 Hr on the Saturday. To minimise disruption to the existing programme and resources Outage changes in this period shall be limited to those deemed essential.

The Operational Plan shall contain details of any additional security studies, temporary protection settings and changes to operational arrangements to facilitate an Outage and agreements for operational actions including emergency return to service time, demand and Generating Unit inter-trip requirements and demand transfers. Any resource requirement for local switching shall be confirmed between relevant TSOs.

The Operational Plan will contain details of all Outages of Generating Units and transmission facilities, details of anticipated transfers, transmission constraints, Contingency plans and any other relevant information.

8.1.11 Records

TSOs and EAPP CC shall keep records of:

a. The availability of Generating Units and transmission facilities;
b. The duration and reasons for unavailability, whether planned or unplanned;
c. The changes requested for planned Outages in the Operational Planning process, and
d. The cost of any constraint imposed by unavailability.
These records shall be made available to the EAPP Steering Committee and to the Independent Regulatory Board upon request.

8.2 **KENYA NATIONAL TRANSMISSION GRID CODE REQUIREMENTS**

8.2.1 **Introduction**

The *Kenya National TSO and TNSPs* shall use the following guidelines in developing procedures for their operations planning, wherever applicable.

8.2.2 **Operating Procedures**

a. The *Kenya National TSO and TNSPs* shall develop and maintain operating procedures for the safe operating of the *Kenya National Transmission System (KNTS)*, and for assets connected to the KNTS. These operating procedures shall be adhered to by *Users* when operating equipment on the KNTS or connected to the KNTS.

b. Each *User* shall be responsible for their own safety rules and procedures. The *Kenya National TSO and TNSPs* shall coordinate to ensure the compatibility with regard to the safety rules and procedures of all *Users*.

c. In case of any equipment fault impacting the KNTS, *Users* must report such faults to the *Kenya National TSO* immediately, or in the shortest possible time. Details of such faults should be reported as soon as possible, but no later than fourteen (14) days for the purpose of post-fault analysis in order to determine causes and remedial action plans. Details regarding the fault shall include such information as: (1) date, time, and location of fault; (2) cause of fault; (3) switching operation(s); (4) injuries/damages; (5) interruptions and duration of interruptions; and (6) any other information, as appropriate. The *Kenya National TSO* shall record and maintain all relevant information pertaining to all faults on the KNTS.

d. The EAPP operational agreements shall apply in the case of operational liaison with all international power systems connected to the KNTS.

8.2.3 **Operational Liaison, Permission for Synchronisation**

a. The *Kenya National TSO* shall sanction the switching, including shutting down and synchronising, of units and changing over of auxiliaries on all units.

b. If any *User* experiences an emergency, the other *Users* shall assist to an extent as may be necessary to ensure that it does not jeopardise the operation of the networks/plant.

c. A *User* shall enter into an operating agreement with the *Kenya National TSO* and the *TNSPs* if it is physically possible to transfer load or embedded *Generating Plants* from one point of supply to another by performing switching operations on his network. This operating agreement shall cover at least the operational communication and notice period requirements and switching procedures for such load transfers.
8.2.4 Safety Coordination

a. TNSPs shall authorise only competent staff to carry out any work such as network switching on the transmission grid and at the Connection Point for Generating Plants and non-embedded Customers. TNSPs shall be the custodian of safety procedures and documents used when working on plant and / or equipment on the transmission grid and at all points of connection with the Users. TNSPs shall not impose these safety requirements for work outside the KNTS and beyond the points of connection. TNSPs and Customers both shall maintain clearly written switching logs in chronological order for all switching operations and document messages relating to safety co-ordinations. Repository of the switching logs and safety documents are maintained by the Kenya National TSO.

b. A list of authorised personnel for transmission grid and for Users at points of connection with names, designations, and telephone numbers shall be made available to the Kenya National TSO and the KNTS Users. The list must be updated and re-circulated as and when there is any change of information.

c. The designated and authorised person shall ensure that adequate safety precautions are established and maintained when any work is done on plant and equipment. To ensure safety to commence work, the following steps shall be verified:

1. Source of power removed
2. Device physically disconnected from source of power with a caution notice attached to it
3. Safety testing completed satisfactorily
4. Proper connection to the earth ensured
5. Safety documents issued
6. The equipment shall only be considered suitable for return to service when all safety documents have been cleared and isolation points normalised.

d. In the event of an accident during work on the KNTS or at points of connection, the following steps shall be taken:

1. Stop work and attend to the injured if any;
2. Notify designated authorised person for decision on whether work should continue or not;
3. Designated authorised person notifies the Kenya National TSO;
4. Designated authorised person produces a preliminary report and notify the Kenya National TSO management and the Kenya National Transmission Grid Code Review Committee as soon as possible, but no later than seven (7) days;
5. The Kenya National TSO constitutes a committee for further investigation;
6. The Kenya National TSO produces a detailed accident report;
7. The *Kenya National TSO* circulates report internally and to key people in the *Users* systems.

e. Authorised switching personnel for TNSPs shall have to be recertified every year through simulating training/testing provided by the *Kenya National TSO*.

**8.2.5 Communication**

**8.2.5.1 Safety Conditions**

To achieve a high degree of service reliability, the *Kenya National TSO* shall ensure adequate and reliable communications with the *Users*. Communication regarding safety coordination shall be made via normal operational channels. Additionally, the *Kenya National TSO* and *Users* shall share official business contact telephone numbers at which operational personnel can be reached to be used for operational purposes, if required. The *Kenya National TSO* shall ensure proper recording and monitoring of all operational lines for future replay in case of any disputes or incident investigation.

**8.2.5.2 Outage Conditions**

The *Kenya National TSO* shall monitor and/or determine system conditions from time to time, and communicate these, or changes from a previous determination, to all *Users*.

The *Kenya National TSO* shall be responsible for providing *Users* with operational information including planned and forced *Outages* as agreed upon. Any changes or modifications to the existing transmission network and/or information regarding network condition that is likely to impact the short and long-term operation of the *Users* shall be communicated in a timely manner. Planned *Outage* shall be deferred under the following circumstances:

a. Grid disturbances
b. System isolation
c. Partial blackout on the *KNTS*
d. Any other event that may have an adverse impact on the system.

*Generation Licensees* shall provide the *Kenya National TSO*:

a. A 52-weeks-ahead *Outage* plan per *Generating Plant*, showing Planned *Outage* and return dates and other known generation constraints, updated weekly by 1500 Hr every Monday (or first working day of the week).

b. An annual maintenance / *Outage* plan per *Generating Plant*, looking five (5) years ahead, showing the same information as above and issued by 31 December of each year.

c. A monthly variance report, explaining the differences between the above two plans.

The *Kenya National TSO* shall coordinate network *Outages* affecting unit output with related unit *Outages* to the maximum possible extent.
The objectives to be used by the *Kenya National TSO* in maintenance coordination are:

a. Maintaining adequate reserve levels at all times;
b. Ensuring reliability where transmission constraints exist;
c. Maintaining acceptable and consistent real-time technical risk levels

The application for an equipment *Outage*, complete with duration of the *Outage*, work details, extent of isolation, switching programme and personnel to be involved, shall be made by the *User* to the *Kenya National TSO* in a timely matter, but not later than seven (7) days prior to the due date of intended *Outage*. The *Kenya National TSO* shall evaluate the request as per the established approval procedure for *Outages*. The information regarding the *Outage* request shall be communicated back to the requester through established channels/modes of communication. Approved *Outages* shall be entered in to the appropriate log as an official record of planned system *Outages*. Applicants shall be notified via established channels of communication concerning the approval, rejection, or deferment of *Outage* applications.

The *Kenya National TSO* shall also report daily demands, energies, losses, interruptions, etc. to *Users* and archive the information. The historical information shall be available to all *Users* on request.

### 8.2.6 System Logs

An operational message, instruction or a report sent/received on radio, telephone, cell phone or carrier by the *Kenya National TSO, TNSPs, or Generation Licensees* shall be logged with all the necessary details, as listed below:

a. Name of the station information is sent/received to/from.
b. Exact time information was sent/received.
c. Name of the person sending/receiving the information.
d. Exact time of completion of carrying out the instruction.

### 8.2.7 Operational Planning

If a daily generation dispatch needs to be developed, it shall be done following the procedure guidelines shown below:

A dispatch form is created by the *Kenya National TSO* with the date/time of the dispatch and is archived. Expected half-hourly country demand is estimated using historical demands for the particular day. Available *Generating Plants* are scheduled in half hour increments to meet forecast demand based hydro energy targets, spinning reserve and other *Ancillary Service* system security and merit order requirements. The generation schedules is evaluated to determine if country demand, *Spinning Reserve* and other *Ancillary Service* system security needs, main hydro target and merit order requirements have been met.
If the requirements have not been met, the system shall be re-dispatched until requirements have been met. The Kenya National TSO shall log the dispatch form, and customised copies of the dispatch forms shall be sent to relevant recipients.

### 8.2.8 Generation System Data Requirement

Generation outputs and equipment loadings shall be recorded on half hourly basis as per requirements in purchase power agreements (PPA). *Generation Licensees*’ fuel data and energy *Meter* readings shall be taken after every midnight. Machines loading/shutdown, trip or output limitations data/reports shall be done immediately after information is received at the Kenya National TSO. Data recording and reporting shall be done following the guidelines below:

- **a.** *Meter* reading of appropriate data (including plant loading/voltage levels, fuel storage, etc.) is taken in the field at pre-determined intervals of time, and logged.
- **b.** Data is then validated at the *Generating Plant* for accuracy/metering errors, and corrected. The field readings of half hourly data shall be passed to the Kenya National TSO at appropriate intervals of time. Plant shut down, operational limitations and other constraints are reported to the Kenya National TSO along with the *Meter* readings, and appropriately logged.
- **c.** For hydrology data, dam levels received from hydro stations shall be recorded on hourly basis or appropriate intervals.
- **d.** For *Generating Plant* output/equipment loading data, half hourly outputs and relevant equipment loadings shall be logged.
- **e.** For *Generating Plant* loading/shutdown time data, the generating plant loading/shutdown times shall be logged.
- **f.** For system voltages, half hourly readings of system voltages from SCADA mimic display shall be taken and logged.
- **g.** For *Generating Plant* capacity availability data, half hourly capacity availability for *Generating Plants* shall be logged.
- **h.** For midnight energy *Meter* readings for *Generating Plants*, end of day *Energy Meter* readings shall be logged every midnight.
- **i.** For fuel stock for *Generating Plants*, end of day fuel stocks for diesel plants shall be logged. *Generating Plants* shall pass the fuel stocks to the Kenya National TSO after every midnight.
- **j.** For *Generating Plant Outage/Capacity* reports, details of *Outages* or operation limitations shall be logged. Report forms shall be filled whenever a machine trips, is shutdown on emergency or it has operational limitations.
- **k.** The Kenya National TSO shall check to confirm that data received is correct and has been entered correctly in the log sheets.
- **l.** Required corrections in data entries shall be made.
- **m.** If no corrections are required, reports shall be processed and an accurate and complete daily analysis report prepared, archived, and printed.

### 8.2.9 Transmission System Data Requirement

The capability of transmission system components for both normal and emergency conditions shall be established by technical studies and operating experience. System operation shall be co-ordinated among systems and control areas (national/regional). This includes coordination of
equipment Outages, voltage levels, MW and Mvar flow monitoring and switching that affects two or more systems of transmission components. When line loading, equipment loading or voltage levels deviate from normal operating limits or are expected to exceed emergency limits following a Contingency, and if reliability of the bulk power supply is threatened, the Kenya National TSO shall take immediate steps to relieve the conditions. These steps include notifying other systems (international/regional), adjusting Generation, changing Scheduling between control areas, initiating load relief measures, and taking such other action as may be required. Refer to Chapter 10 (Operations Chapter No. 3 - Emergency Operations) for more details.
This chapter contains requirements specific to both the EAPP IC and the KNTS. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

9.1 EAPP IC REQUIREMENTS

9.1.1 Introduction

Operations Code No. 2 (OC 2) is concerned with security aspects in the Operational Planning and real-time operation of the EAPP Interconnected Transmission System and does not deal with long-term planning for which reference should be made to Chapter 5 (Planning). OC 2 is not concerned with the commercial aspects of system operation.

System security and reliability are primary goals of the operation of the EAPP Interconnected Transmission System. Each TSO is responsible for the operation of its National System but the interrelationship between that system and the EAPP Interconnected Transmission System requires coordination by the EAPP CC at regional level.

Pending full interconnection between all countries of EAPP, the EAPP Interconnected Transmission System shall be operated in a number of Control Areas. A Control Area comprises various National Systems or parts of National Systems capable of regulating its Generating Units in order to meet its constantly changing demand and to maintain its interchange schedule with other systems or Control Areas and contributing its frequency bias obligation to the interconnection. Each Control Area shall have one of the TSOs designated as Control Area Operator. The designation of the Control Area Operator shall be agreed with the TSOs concerned and with the EAPP CC.

The Control Area Operator shall ensure that within its Control Area sufficient reserves of generation are available to allow for continuous generation and load balancing, frequency control and the maintenance of EAPP operational security standards as described in OC 2. Any failure to meet these minimum requirements can lead to reduced security or to disturbances or events causing undesirable effects on the EAPP Interconnected Transmission System.

OC 2 specifies the technical requirements and standards for the operational security of the EAPP Interconnected Transmission System as they relate to the following issues:

a. N-1 Contingency criterion;
b. Interchange scheduling;
c. Operating reserves for control of system frequency and interchange with other Control Areas or External Systems;
d. Voltage control;
e. Fault level control;
f. Protection coordination,
g. Remedial Action Schemes.

9.1.2 Objective

The objectives of OC 2 are:

a. To provide a framework of principles and requirements for achieving and maintaining the security and reliability of the EAPP Interconnected Transmission System during operation of the system under normal and emergency conditions, and

b. To ensure that the EAPP Interconnected Transmission System is operated within the technical parameters set out in Chapters 5 and 6 (Planning, and Connections).

9.1.3 N-1 Criterion

The N-1 security criterion refers to the requirements placed upon the operation of the EAPP Interconnected Transmission System to maintain the security of the system during normal and disturbed conditions.

This criterion shall be applied by all TSOs in combination with appropriate choice of generation, transmission facilities, and sufficient active and reactive reserves. TSOs shall identify by means of Operational Planning potentially insecure situations in order to take appropriate measures in advance.

Control Area Operators are responsible for the application of the N-1 Criterion throughout their Control Area.

9.1.3.1 Contingency

The loss of any element of the EAPP Interconnected Transmission System shall not cause:

a. A frequency deviation outside operating limits;

b. A voltage deviation leading to voltage instability;

c. Thermal overloading of equipment;

d. Islanding of any part of the EAPP Interconnected Transmission System;

e. Angular instability in the EAPP Interconnected Transmission System, and

f. Cascading Outages.

It is acceptable in some cases for TSOs to allow for loss of load on condition that its magnitude is compatible with secure operation and is predictable and locally limited. The following normal Contingencies shall be considered:

a. A single transmission line;

b. A single Generating Unit or combination of Generating Units;

c. A single transformer;

d. A voltage compensation installation;
e. An HVDC link considered as either a Generating Unit or a End-use User.

TSOs shall also take account of multiple Contingencies when such Contingencies may occur with sufficiently high probability to threaten the security of operation. Examples of such multiple Contingencies are:

a. A double circuit line, which refers to two circuits on the same towers over a considerable distance;

b. A single busbar, during periods when the TSO assesses there is a significantly higher risk of Outage;

c. A common mode failure with the loss of more than one Generating Unit.

The Contingency monitoring process includes the loss of single or multiple elements of generation or transmission equipment at any time. This monitoring shall also take account of temporary weather conditions or temporary limitation of transmission facilities.

9.1.3.2 Responsibilities

It is the responsibility of each TSO to monitor the N-1 Criterion on its own National System, to carry out computer simulations for Contingency analysis and to notify the EAPP CC, the TSOs of Neighbouring Systems and External Systems of potential problems in the application of the criterion. The TSOs concerned shall jointly verify the compliance with the N-1 criterion taking into consideration cross-border power transfers.

After a Contingency, each TSO shall return its power system to N-1 compliant condition as soon as possible and in case of a delay, it shall immediately notify the EAPP CC and all other TSOs affected.

9.1.4 Interchange Scheduling

The net amount of interchange scheduling between National Systems or Control Areas shall not exceed the mutually agreed transfer limits of the EAPP Interconnected Transmission System.

The entire EAPP Interconnected Transmission System shall be operated in such a way that sufficient transmission capacity is available for the delivery of reserve power for Primary Response for the National Systems or Control Areas which may be affected by the most severe single Contingency.

Requirements for interchange scheduling on the EAPP Interconnected Transmission System are set out in the Interchange Scheduling and Balancing Chapters 14 through 16.

9.1.5 Operating Reserves

TSOs shall continuously maintain adequate reserve generating capacity to control the frequency of the EAPP Interconnected Transmission System within the limits set out in Chapter 6 (Connections), and to avoid unexpected loss of load following transmission or generation Contingencies. The reserve generating capacity is also required to maintain agreed interchange schedules following changes in demand or generation. The requirements for operating reserve on the EAPP Interconnected
Transmission System are set out in the Chapter 15 (ISBC Chapter No. 2 Balancing and Frequency Control.)

9.1.6 Voltage Control

9.1.6.1 Basic Principles

To maintain the EAPP Interconnected Transmission System security and integrity, and avoid damage to transmission and User's equipment, each TSO shall maintain voltages within the limits set out in Section 6.1.4 in Chapter 6 (Connection) and shall contract for voltage control Ancillary Services in accordance with Chapter 16 (ISBC Chapter No. 3 - Ancillary Service Chapter).

Each TSO shall operate reactive resources within its National System to maintain system and interconnection voltages within limits. Each TSO shall maintain reactive resources to support its voltage under N-1 Contingency conditions and shall disperse and locate the reactive resources so that they can be applied promptly and effectively when Contingencies occur. The TSO shall direct corrective action, including load shedding, necessary to prevent voltage collapse when reactive resources are insufficient.

Reactive Power flows on the EAPP Interconnected Transmission System shall be maintained at a minimum level in order to limit voltage drop and to allocate the total Transmission System Capability mainly to Active Power. In the event that sufficient reactive resources are not available within a TSO’s National System, bilateral agreements may be made with Neighbouring Systems to transfer Reactive Power through cross-border connections.

9.1.6.2 Responsibilities

Each TSO individually and jointly with other TSOs and the EAPP CC shall ensure that formal policies and procedures are developed, maintained, and implemented for monitoring and controlling voltage levels and Mvar flows within their National Systems and with Neighbouring Systems.

Without limitation, the procedures shall include the following methods of voltage control:

a. Adjusting Generating Unit Reactive Power output;

b. Transformer tap changing, cable switching, reactor and capacitor switching, and other control methods;

c. Tap changing on Generating Unit transformers;

d. Scheduling must-run generation, and

e. Switching out of transmission lines.

TSOs shall ensure that data on all generation and transmission Reactive Power resources, including the status of voltage regulators, tap changers and Power System Stabilisers, is available to neighbouring TSOs and the EAPP CC.
9.1.7 Fault Levels

The *EAPP Interconnected Transmission System* is subject to short circuits between phases or to earth mainly due to atmospheric conditions and to faults in equipment. Short-circuit protective devices are installed on all system equipment in order to promptly and effectively disconnect any fault with selectivity.

*TSOs* shall ensure that the setting and function of the protection equipment is checked regularly. If there are significant changes in operating conditions, the settings of protection devices shall be adjusted to suit the new conditions.

9.1.7.1 Standards

Each *TSO* shall operate its *National System* such that, at any node of the *EAPP Interconnected Transmission System*, short-circuit currents do not exceed the breaking capacity of the switchgear installed at that node, so that failure to clear a fault does not lead to cascading *Outages*. The *TSO* shall use an appropriate protection strategy as set out Chapter 6 (Connections) to ensure selectivity and to provide backup protection in case of failure of the main protection system to isolate a fault.

9.1.7.2 Corrective Action

In the event of fault levels exceeding permissible levels at any particular location, *TSOs* shall take immediate action to manage the values within limits.

Each *TSO* shall calculate where appropriate the short-circuit currents at each node of its *National System* taking into account the contributions of *Neighbouring Systems* to the short circuit current. *TSOs* of *Neighbouring Systems* shall exchange the data required for short circuit calculations.

In order to limit fault levels in operational timescales, *TSOs* have a number of options including the switching out of lines and the operation of busbars in separate sections. However, *TSOs* shall take into account the operational security standards when considering such measures.

9.1.8 Protection Coordination

*TSOs* and the *EAPP CC* shall coordinate the application and maintenance of protection systems on the *EAPP Interconnected Transmission System*. Protection systems shall be used to detect abnormal system conditions and to trip selectively circuit breakers on generation and transmission facilities to prevent danger to persons or damage to equipment.

Each *TSO* and the *EAPP CC* shall ensure that its *Control Centre* personnel are familiar with the purpose and limitations of the protection system schemes applied in the *EAPP Interconnected Transmission System*. Power system protection procedures shall be made available to all appropriate system personnel and shall provide for instructions and training where applicable.

The procedures shall cover the following:

a. Planning and application of protection systems;
b. Review of protection systems and settings;
c. Intended operations under normal, abnormal and emergency conditions;
d. Regular scheduled testing and preventive maintenance, and
e. Analysis of the actual protection system operation.

9.1.9 Requirements

Since protection systems in one National System can affect operations in Neighbouring Systems, all protection systems in the EAPP Interconnected Transmission System shall be co-ordinated between Users and the relevant TSOs. Protection systems on transmission interconnections with External Systems shall also be coordinated to prevent operational problems which may impact on the EAPP Interconnected Transmission System.

Each TSO shall supervise the status of its protection system and notify all relevant neighbouring TSOs of every change in status.

Each protection device shall be tested and recalibrated as necessary at least once a year. A review of the protection settings shall also be carried out whenever there is an expansion or change to the transmission or generation facilities. Any incorrect operation of a protection device shall be reported in accordance with OC 4, Chapter 11 (Operating Code No. 4 – Incident Reporting), investigated immediately and corrective action implemented as soon as possible.

Neighbouring TSOs shall be notified in advance of changes in generating sources, transmission, load or operating conditions, which may require adjustments to their protection systems.

9.1.10 Remedial Action Schemes

Remedial Action Schemes (RAS), also known as Special Protection Schemes (SPS), are designed to automatically perform system protection functions other than the isolation of an electrical fault. RAS are designed to trip, or remove from service, generation units or transmission facilities under a set of carefully defined conditions. RAS are normally used in order to increase Transmission System Capability under specified conditions. They may also be used to permit higher loading levels on the EAPP Interconnected Transmission System in those instances where additional facilities cannot be built or have been delayed. Their application is specific to particular circumstances.

RAS installed on the EAPP Interconnected Transmission System shall be subject to agreement between the relevant TSOs and the EAPP CC unless the automatic actions following operation of RAS are confined to the area of a single TSO. RAS shall be subject to procedures detailing the operation and the conditions for switching into service of the scheme. The effects of the automatic actions arising from the operation of the RAS shall be subject to the specific agreement of all TSOs and Users involved.

TSO Control Centres shall monitor the status of all RAS and notify all relevant TSOs and the EAPP CC of any change of status.
9.1.11  **Power System Monitoring**

Each *TSO* shall maintain *Power System Security* by monitoring the status of its *National System* and of relevant parts of the *EAPP Interconnected Transmission System*. *TSOs* shall therefore ensure that their *Control Centres* and the *EAPP CC* are able, as a minimum, to monitor in real-time the following information:

a. System frequency;

b. Transmission line status;

c. *Active* and *Reactive Power* flow on transmission circuits and across *User Connection Points*;

d. *Active* and *Reactive Power* from *Generating Units*;

e. Voltages at transmission and generation busbars;

f. Dynamic and static *Reactive Power* reserves, and

g. Appropriate alarms including overload and protection alarms.

Each *TSO* shall agree with neighbouring *TSOs* and the *EAPP CC* the real-time data to be exchanged on-line and its format.

In addition, each *TSO* shall provide computing facilities for:

a. Evaluating *Contingencies* on the *EAPP Interconnected Transmission System*;

b. Determining thermal, voltage and stability limits;

c. Evaluating reserves of both *Active* and *Reactive Power*, and

d. Carrying out post event analysis of power system incidents in accordance with *OC 4*, Chapter 11 (Operating Code No. 4 - *Incident Reporting*) with the aid of recorded data.

### 9.2  **KENYA NATIONAL TRANSMISSION GRID CODE REQUIREMENTS**

This section specifies guidelines to be used in developing criteria and procedures to be applied by the *Kenya National TSO* for operational security of the *Kenya National Transmission System (KNTS)*.

#### 9.2.1  Additional Responsibilities

**9.2.1.1  Auxiliary Supply**

The auxiliary supply to all *Generating Plants* shall be regarded as the most important load on the *KNTS*. The *Kenya National TSO* shall regard all essential supplies as identified by the *Distribution Licensees* as having the same priority.

**9.2.1.2  Supply Restoration**

The *Kenya National TSO* shall be responsible for efficient restoration of the *KNTS* after supply interruptions.
9.2.1.3 Continuity of Operation

The *Kenya National TSO* shall ensure continuous operation of the *KNTS*.

9.2.1.4 Switchgear Operation

Any time that switchgear in the *KNTS* is to be operated, the *Kenya National TSO* shall issue the switching sequence for such operation including equipment identification. *TNSPs* shall follow procedures on the instructions.

If the *TNSP* has no objections, the procedures for the switching sequence shall be followed.

The *TNSP* shall carry out switchgear operation as instructed as expeditiously as possible. Whenever switchgear interlocks exist, the *TNSP* shall carry out an operation to defeat interlocks before performing switchgear operation. Interlocks should not be defeated except under emergency or extreme circumstances and then only by designated operational crew.

The *TNSP* shall inform the *Kenya National TSO* of completion of carrying out switchgear operation.

The *Kenya National TSO* shall write down the exact time of operating the switchgear in the standard daily switching log sheet.

If the *TNSP* has objections to carrying out switchgear operations, the *TNSP* shall inform the *Kenya National TSO*, and the *Kenya National TSO* shall investigate the matter.

In case of stressed switchgear noticed through alarm or physical observation, the *Kenya National TSO* shall be informed by the *TNSP*, and the *TNSP* shall follow appropriate actions as directed by the *Kenya National TSO*.

9.2.1.5 Equipment with Dual Responsibility

For equipment and its auxiliaries falling under the responsibility of both the *Kenya National TSO* and the *Regional Control Centres (RCC)*, the *Kenya National TSO* shall identify the need to operate in dual control mode, and liaise with the respective *RCC* on the sequence of operations to be carried out.

The *Kenya National TSO* shall check and determine if there are any communication problems in the co-ordination of the operations.

If there are no communication problems, the *Kenya National TSO* shall co-ordinate switching operations.

If there are any communication problems in carrying out the operations, *Kenya National TSO* shall delegate co-ordination of operations to the respective *RCC*. The designated *RCC* shall co-ordinate the operations as delegated by the *Kenya National TSO*.
The designated RCC shall notify the Kenya National TSO of completion of carrying out required operations.

The Kenya National TSO shall log down the exact time of completion of carrying out the operations on the dual equipment.

9.2.1.6 Generating Plant Operation

Where there is a need for plant regulation/plant shutdown/plant loading identified by the Kenya National TSO, the appropriate Generating Plant operator shall be instructed to carry out the operational guidelines as listed below:

The need is identified by the Kenya National TSO from the system status as displayed by the SCADA system. The Kenya National TSO shall instruct the appropriate Generating Plant to carry out the required operation.

If there are no objections, the Generating Plant shall carry out required operation as instructed as expeditiously as possible. The Generating Plant shall inform Kenya National TSO of completion of carrying out required operation.

If there are objections, the Generating Plant shall notify the Kenya National TSO and the Kenya National TSO shall investigate the refusal to carry out the operation.

Kenya National TSO and the Generating Plant shall log the following information upon sending or receiving an operational message/instruction/report on radio/telephone/cell phone/carrier:

- Message, instruction or report details.
- Name of the station information is sent/received to/from.
- Exact time information was sent/received.
- Name of the persons sending/receiving the information.
- Exact time of completion of carrying out the instruction.

Generating Plant AVR’s and VAR limiter relays (where fitted) should be in service continuously. Whenever a Generating Plant is operating without its AVR or VAR limiter, the Kenya National TSO must be immediately informed.

The Kenya National TSO shall instruct the Generating Plant when to turn on and off and the Generating Plant shall comply. When the Generating Plant is on, it shall follow the Kenya National TSO’s instructions regarding output (MW and Mvars).

Generating Plants shall not be taken out of service or rendered unavailable without reference to the Kenya National TSO except in cases of emergency when it should be informed as soon as possible of the action taken.
The Kenya National TSO shall as soon as possible be notified of any factors which may affect the output, efficiency or inflexibility of operation of any Generating Plant.

Free Governor action must be allowed within the prescribed limits whenever practicable to assist frequency control.

9.2.1.7 Loss of System Neutral Earthing

Any missing system neutral earthing noticed by the substation operator shall be immediately notified to the Kenya National TSO.

The TNSP on noticing a missing neutral shall immediately notify the Kenya National TSO giving details of the exact area missing the neutral earthing. The Kenya National TSO shall determine whether it is possible to restore the neutral earthing or not.

If it is possible to restore the system neutral earthing, the Kenya National TSO shall issue instruction to switch in the system neutral earthing.

The TNSP shall switch in system neutral earthing as fast as possible.

The TNSP shall inform the Kenya National TSO of completion of switching in neutral earthing.

If it is not possible to restore system neutral earthing, The Kenya National TSO shall quickly coordinate activities to make that part of the system without neutral earthing dead.

The Kenya National TSO shall log down exact time of switching in system neutral earthing.

9.2.1.8 Protection Equipment

In case there is any need to work on the system protection devices (e.g., relays, power supply, fuses, miniature circuit breakers, communication channel), the TNSP shall coordinate with the Kenya National TSO according to the operational guidelines below.

The TNSP shall inform the Kenya National TSO of the intention to carry out work on the protective apparatus. The TNSP shall also provide details of work to be carried out.

The Kenya National TSO shall assess the request and determine if work can proceed or not according to the following conditions:

a. It is unsafe to work.
b. There will be no adequate protection.
c. There will be a disturbance in case of any tripping.

If none of the three cases exists the Kenya National TSO shall approve the request and inform the TNSP to proceed with work. Work shall be carried out in accordance with a procedure for such kind of work.
If any of the above conditions exist, the *Kenya National TSO* shall reject the request for work and inform the applicant of the rejection.

### 9.2.1.9 Transmission Line Fault

The *Kenya National TSO* shall develop and communicate formal procedures for correcting transmission line faults.

When breakers controlling a line trips due to a line fault, the *TNSP* shall coordinate with the *Kenya National TSO* as per the operational guidelines below:

The *Kenya National TSO* shall notice the unexpected trip from the SCADA and check to confirm whether the line has auto-reclosed or locked out. If line has auto-reclosed, the *TNSP* shall note the relays operated and distance of fault from the distance fault recorder and pass them to the *Kenya National TSO*. The *Kenya National TSO* shall log the relays operated and the distance of fault along with other information such as location of fault, identified by station, if possible; exact time of event; name of person working on the event; and exact time the fault was cleared. The incident shall be logged and relevant personnel shall be informed.

If line has locked out, the *Kenya National TSO* shall evaluate impact of the trip on the system by observing system response to the trip.

If there is any serious impact on the system, the *Kenya National TSO* shall take relevant appropriate action to stabilise the system.

If there is no serious impact as a result of the trip, the *Kenya National TSO* shall check to confirm with the *TNSP* if any work is being carried out on the line. If so, the *Kenya National TSO* shall determine if the fault is caused by the *TNSP*. If fault is caused by the *TNSP*, the *Kenya National TSO* shall instruct the *TNSP* to eliminate the cause of fault, and the *TNSP* shall notify the *Kenya National TSO* of the completion of eliminating the fault.

If no work is being carried out on the line, the *Kenya National TSO* shall check to confirm if line is from a manned substation or not. If the line is from manned substation, the *Kenya National TSO* shall issue instructions for reading and resetting relays and distance of fault from the distance fault recorder. If the line is from an un-manned substation, the *Kenya National TSO* shall direct the *TNSP* to the relevant substation. The *TNSP* shall note down relays operated, reset them and also record the distance of the fault from the fault recorder.

The *Kenya National TSO* shall check to confirm whether breaker-operating commands are available or not, and if so issue instructions for closing of line breakers. The *Kenya National TSO* shall close breakers controlling the line by sending a closing command using SCADA. If breaker-operating commands are not available, the *Kenya National TSO* shall issue instructions to the *TNSP* for closing of line breakers. The *TNSP* shall close circuit breakers controlling the line as instructed by the *Kenya National TSO* after selecting breakers on remote or local mode. The *TNSP* shall try a reclosure on
the line and notify the Kenya National TSO of completion of carrying out a reclosure. If line holds, the Kenya National TSO shall check to confirm whether the line trips again or not. The TNSP shall notify the Kenya National TSO of completion of closing the breakers. The Kenya National TSO shall create, update and log the incident.

The Kenya National TSO shall inform relevant personnel about the incident.

If the line holds, the Kenya National TSO shall check to find out if any Customers are interrupted as a result of the trip. If Customers are interrupted and there is alternative source of supply, the Kenya National TSO shall transfer or co-ordinate activities to transfer Customers to alternative source of power.

If no Customers are interrupted or if they are interrupted and there is no alternative source of power, the Kenya National TSO shall check to confirm whether there is a switch along the transmission line or not. If there is an isolator along the line, the Kenya National TSO shall direct the TNSP to the isolator. The TNSP shall confirm arrival at the isolator, and the Kenya National TSO shall issue instructions to open the isolator on the line. Instruction shall be issued keeping in mind Electrical safety rules. The Kenya National TSO shall try a reclosure on the two line sections one after the other. If there is no trip, The Kenya National TSO shall issue instruction to close the isolator properly and normalise the line.

If there is no isolator along the line, the Kenya National TSO shall issue instructions to isolate the faulty section. Isolation of the fault shall be done by the TNSP, who shall open isolators controlling the affected section and securing them in open position as instructed by the Kenya National TSO. The Kenya National TSO shall notify the TNSP about the faulty part of the system. The Kenya National TSO shall log the incident.

The TNSP shall patrol the line to determine the fault. The Kenya National TSO shall wait for a report from the TNSP.

Upon finding the fault, the TNSP shall report to the Kenya National TSO details of isolations required for repairs to be carried out, and the Kenya National TSO shall issue instructions to isolate the location of the fault. The TNSP shall inform the Kenya National TSO of completion of carrying out isolations.

The TNSP shall carry out repair of fault using appropriate tools and shall notify The Kenya National TSO of completion of carrying out repairs. The Kenya National TSO shall issue instructions to normalise the line and the system.

The TNSP shall normalise line and system as instructed by The Kenya National TSO, and confirm of completion of normalising the system. The Kenya National TSO shall normalise and log the incident.
9.2.1.10 SCADA Equipment Failure

The Kenya National TSO upon detection of SCADA equipment failure shall first determine total or partial failure and then coordinate with the RCCs. Actions in case of a SCADA Equipment failure shall be follow the operational guidelines below:

The Kenya National TSO shall establish whether it is a total or partial SCADA failure.

If partial failure, the Kenya National TSO shall assess the effects the failure has on generation, transmission and sub-transmission systems.

If a total failure, the Kenya National TSO shall instruct the RCCs to begin diagnosis, repair and restoration work. Upon the completion of the work the RCCs will inform the Kenya National TSO. The Kenya National TSO shall issue instructions to normalise the sub system and report back to the Kenya National TSO. In case of a total SCADA failure, the Kenya National TSO shall inform the TNSPs and the RCCs of the failure.

The Kenya National TSO shall instruct the TNSPs and the RCCs to monitor system parameters i.e. system Frequency and Voltage and report any significant variations/changes.

The Kenya National TSO shall instruct all Generating Plants and TNSPs to report any trip of a machine or line.

In case of a major disturbance on the Kenya National Transmission System affecting SCADA equipment:

a. An incident shall be reported to the Kenya National TSO as soon as possible by TNSPs or RCCs with the following information: nature of incident; equipment affected; location of equipment; Customers affected; and actions to be carried out. The Kenya National TSO shall evaluate whether incident has severe impact on the system.

b. If there is a severe impact, the Kenya National TSO shall take the necessary appropriate action to ensure the integrity of the system, and determine if assistance is required or not.

c. If assistance is required, the Kenya National TSO shall call relevant staff, inform them about the incident, and instruct them to call from desired locations.

d. The Kenya National TSO shall check to find out if there are any casualties as a result of the incident. In case of any casualty, the Kenya National TSO shall call and inform the safety officer of the affected installation; location of the equipment; cause of the incident; and damage incurred.

e. Depending on the impact caused, the Kenya National TSO shall make sure whether the incident is newsworthy. If it is newsworthy, the Kenya National TSO shall inform relevant communications officers of the following: nature of incident; affected installation; and affected Customers.

The Kenya National TSO shall direct work for the identification of fault and repair. Upon the completion of the work, the Kenya National TSO shall normalise the system and log the incident.
9.2.1.11 Access Security

The *Kenya National TSO* shall have a detailed plan and procedures governing security and access to *User’s SCADA*, computer, and communications equipment. The procedures shall allow for adequate access to the equipment and information by the *Kenya National TSO* or its nominated representative for purposes of maintenance, repair, testing, taking of readings/measurements, and periodic checking as deemed necessary. *Users* shall ensure reasonable security against unauthorised access, use, and loss of information and a backup storage strategy for the systems that contain the information.

9.2.1.12 Hydro Generating Plants

Hydro *Generating Plants* equipped with over frequency protection at a set value, shall not be set at a level likely to compromise the system security and safety.

9.2.1.13 Solar and Wind Power Generating Plants

The *Kenya National TSO* shall ensure that solar/wind *Generating Plants* back down generation on consideration of the security of the *KNTS* or safety of any equipment or personnel. The *SCADA* facility shall provide appropriate information to the *Kenya National TSO* in this regard.
This chapter contains requirements specific to both the EAPP IC and the KNTS. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

### 10.1 EAPP IC REQUIREMENTS

#### 10.1.1 Introduction

Operations Code No. 3 (OC 3) is concerned with maintaining the security and integrity of the EAPP Interconnected Transmission System in emergency operating conditions. Experience has shown that even a simple incident can trigger a large-scale disturbance which may have widespread implications for electricity supply to the population at large.

Although the EAPP Interconnected Transmission System may be designed and operated in line with the security standards set out in Chapter 5 (Planning) and the OCs, unexpected circumstances may arise where faults and disturbances outside the defined Contingencies may occur. Such circumstances require timely and decisive action to prevent further propagation of the disturbance. Disturbances can result from a number of causes but most typically may be due to the simultaneous loss of a number of Generating Units or transmission failures resulting from severe weather conditions or mal-operation of protection systems.

This is particularly the case where power systems today tend to be operated closer to the security limits due to environmental constraints and market pressures. The overriding principle is that the effects of faults and disturbances should be confined to as small a part of the EAPP Interconnected Transmission System as possible.

#### 10.1.2 Objective

The objectives of OC 3 are to ensure that TSOs and the EAPP CC:

a. Are able to identify insecure operating conditions on the EAPP Interconnected Transmission System;

b. Have procedures and plans in place to manage emergency conditions;

c. Have comprehensive contingency plans in place for the restoration of supplies in the shortest possible time using the most effective means.

#### 10.1.3 Identification of Risks

TSOs and the EAPP CC shall ensure that they are in a position to identify the risk of insecure operating conditions either on their own National System or on the EAPP Interconnected Transmission System. The risks to secure operation of the EAPP Interconnected Transmission System may arise from but are not limited to the following:

a. Flows on parts of the EAPP Interconnected Transmission System exceeding security limits;
b. Lack of operating reserves (caused, for example, by Outages of Generating Units, by hydrological conditions or by restricted transmission capacities);

c. Human error when carrying out switching operations on the EAPP Interconnected Transmission System;

d. Frequency excursions outside normal operating limits;

e. Significant Reactive Power constraints leading to critical high or low voltage conditions;

f. High Reactive Power flows giving rise to potential protection mal-operations;

g. Indications of instability such as voltage drop, undamped power swings or increase of phase angles;

h. Lack of reliable real-time data, and

i. Adverse climatic conditions.

10.1.4 System Warnings

TSOs and the EAPP CC require common definitions for NORMAL, ALERT, and EMERGENCY conditions to enable them to act appropriately and predictably as system conditions change. They should have a common understanding of each other’s functions, responsibilities, capabilities, and authorities under emergency or near-emergency conditions.

10.1.4.1 Normal State

In its NORMAL state the EAPP Interconnected Transmission System is operating within its technical parameters. It has sufficient generation reserves, all transmission elements are operating within limits and voltage and frequency are normal.

In the event of identifying a risk of insecure operation a TSO or the EAPP CC may issue an ALERT or an EMERGENCY warning in real-time. These warnings shall be issued to all Users within a TSO’s National System and to the EAPP CC and any Neighbouring System which may be affected by the risk. Any warning issued by a TSO may be applied to the whole or part of its National System and by agreement with neighbouring TSOs to the whole of or part of their National Systems. The EAPP CC may also issue warnings when in its view there is a serious risk to the whole EAPP Interconnected Transmission System.

10.1.4.2 Alert State

In an ALERT state, a Contingency has occurred but the EAPP Interconnected Transmission System is stable and all operational reserves for both transmission and generation balance has been committed. The TSOs and the EAPP CC may be uncertain as to when the EAPP Interconnected Transmission System can be returned to its NORMAL state due to system constraints and or low operating reserves and the situation is potentially dangerous.
10.1.4.3 Emergency State

In an EMERGENCY state the EAPP Interconnected Transmission System is in an unstable condition and phenomena such as cascade tripping, low frequency and or voltage, loss of synchronism, loss of supplies, whether partial or total, and islanding may occur. The security of the EAPP Interconnected Transmission System is endangered. Exceptional actions such as load shedding may be necessary to limit the spread of the dangerous phenomena and prevent the collapse of part of or the whole EAPP Interconnected Transmission System. In this state, the system passes rapidly towards dangerous conditions of operation with system parameters outside the limits fixed for secure operation.

10.1.5 Responsibilities of TSOs

TSOs and the EAPP CC shall draw up emergency plans and procedures and ensure that appropriate measures and resources are in place to enable the early identification of risks to secure operation of the EAPP Interconnected Transmission System.

TSOs shall act to alleviate emergencies and to implement emergency procedures in cooperation with neighbouring TSOs and the EAPP CC.

10.1.5.1 Real-Time Data

TSOs shall provide a SCADA system giving a complete overview of TSO’s National System and of relevant parts of Neighbouring Systems. The SCADA system shall be of dual redundant design with a back-up system in a remote location away from the Control Centre. The back-up system shall be subject to periodic testing to ensure its functionality.

The Control Centre SCADA system shall also provide facilities for post-mortem review to enable a detailed analysis of events and disturbances to be carried out.

Each TSO shall make available real-time data of relevant parts of its National System to neighbouring TSOs and the EAPP CC. Details of the data to be exchanged in real time shall be agreed between the parties.

TSOs shall ensure the provision of a direct telephone line to neighbouring TSOs and the EAPP CC.

10.1.5.2 Security Analysis

TSOs shall make arrangements to carry out studies of the effects of various Contingencies on the behaviour of the EAPP Interconnected Transmission System within their National System. These studies shall cover load flow, constraint analysis, static and dynamic stability and voltage stability. As a minimum such studies shall be carried out by each TSO in off-line mode on a weekly basis. In addition real-time studies based on SCADA data should be carried out wherever possible.

The EAPP CC shall make arrangements to carry out a similar series of studies for the whole EAPP Interconnected Transmission System.
TSOs and the EAPP CC shall agree the list of Contingencies to be considered in carrying out the studies. The data required for the security analysis studies is contained in Section 19.8 of Chapter 19 (Data Exchange).

10.1.5.3 Coordination of Automatic Systems

TSOs shall ensure that procedures are in place for the coordination of automatic systems, including protection, having an effect on the system of a neighbouring TSO and shall agree on the type and the settings of devices for automatic tripping of cross-border connections.

10.1.5.4 Auxiliary Supplies

TSOs shall ensure that appropriate back-up auxiliary supplies are available at all substations and Control Centres. These back up sources shall not rely upon a supply being made available from the EAPP Interconnected Transmission System and shall have a resilience of at least six (6) hours.

10.1.6 Emergency Procedures

TSOs and the EAPP CC have a primary obligation to maintain the integrity of the EAPP Interconnected Transmission System and to prevent any unplanned disturbance to the system. However, once a large-scale disturbance does occur they must be prepared to react and adapt to the dynamic environment of restoration operations.

Fundamental to re-establishing the integrity of the EAPP Interconnected Transmission System is effective communications and coordination that enables TSOs and the EAPP CC to understand the nature of the disturbance as well as how one TSO’s actions may impact on Neighbouring Control Areas. This communication and coordination is a continuous and evolving process tailored to the demands of the disturbance.

Each TSO and the EAPP CC shall develop, maintain and implement robust and comprehensive procedures for emergency situations and have a strategy and plans in place for the safe and prompt restoration of electricity supply. TSOs shall also ensure that their personnel and any of their Users involved in implementing the emergency procedures are fully aware of and trained and tested in their responsibilities.

TSOs shall provide copies of their emergency plans and procedures to neighbouring TSOs, EAPP CC and to relevant Users within their National Systems. These plans and procedures shall be coordinated with other TSOs, the EAPP CC and External Systems.

The emergency plans and procedures agreed between TSOs, EAPP CC and relevant Users shall include, but not be limited, to the following:

a. The procedures for the dissemination of the system state warnings set out in Section 10.1 in Chapter 10 (Operations Code No. 3 - Emergency Operations – System Warnings) to neighbouring TSOs, EAPP CC and relevant Users and the actions to be taken on receipt of a warning;
b. The requirement to establish and maintain reliable communications between all interested parties and the communications protocols to be used;

c. A list of personnel appropriately authorised to take action in emergencies together with their contact details;

d. Any requirement under national legislation to inform government and other public authorities of the existence of an emergency condition on the EAPP Interconnected Transmission System and the possible effects of the situation on population and infrastructure;

e. The requirement to ensure rapid information exchange between TSOs about system conditions particularly close to their common borders. This information should include the topology of the system and its weak points and the potential risks of tripping;

f. The possible need to arrange new interchange agreements to provide for emergency capacity or energy transfers if existing agreements cannot be used;

g. A contingency plan to continue safe and reliable operations in the event of total loss of a TSO’s Control Centre or communications facilities;

h. The need to ensure that sufficient resources of trained, tested and authorised personnel are available in control rooms and for operation under all conditions;

i. The need to modify cross-border transfers to alleviate overloading;

j. The application of load shedding in some parts of the EAPP Interconnected Transmission System in order to limit the risk of cascade tripping;

k. The regular training of all personnel in operation under emergency conditions.

TSOs shall make every effort to remain connected to the EAPP Interconnected Transmission System under emergency conditions. If a TSO however considers that its National System is endangered if it remains connected, it may implement any remedial action necessary to protect its own National System.

10.1.6.1 Review of Emergency Procedures

TSOs shall review and update their emergency plans and procedures every year or whenever significant changes are made to the EAPP Interconnected Transmission System. They shall also take account of deficiencies noted when carrying out simulations and exercises of the emergency plan and procedures and any recommendations arising from reports prepared under OC 4, or Chapter 11 (Operations Code No. 4 – Incident Reporting).

The EAPP Sub-Committee on Operations is responsible for the review of the emergency procedures annually to ensure that the emergency plans and procedures comply with OC 3, or Chapter 10 (Operations Code No. 3 – Emergency Operations).

10.1.7 System Restoration and Black Start

The procedure necessary for a recovery from a Total Shutdown or Partial Shutdown is known as a Black Start Procedure. The main objective of a Black Start is the restoration of the EAPP
Interconnected Transmission System as an integrated whole in the shortest possible time using the most effective means following a Total Shutdown or Partial Shutdown.

The complexities and indeterminate nature of recovery from a Total Shutdown or Partial Shutdown require that any Black Start Procedure is sufficiently flexible in order to accommodate the full range of Generating Unit and EAPP Interconnected Transmission System characteristics and operational possibilities. This precludes the setting out of concise chronological sequences. The overall strategy may include the overlapping phases of establishment of isolated groups of Generating Units together with complementary local demand. These groups are termed Power Islands. The step-by-step integration of these Power Islands into larger sub-systems will eventually result in the re-establishment of the EAPP Interconnected Transmission System.

10.1.7.1 Responsibilities

TSOs are responsible for the preparation of the strategy and plan for system restoration and Black Start as part of the procedures set out in Section 10.1.6 (Operations Code No. 3 – Emergency Operations – Emergency Procedures).

When a Total Shutdown or Partial Shutdown exists on its National System, the TSOs shall notify the TSOs of Neighbouring Systems and the EAPP CC and shall agree the initial steps in the restoration process.

Each TSO is primarily responsible for re-starting its respective National System after a Total or Partial Shutdown that disconnects its system from the EAPP Interconnected Transmission System.

Each TSO shall be responsible for ensuring Generating Units with Black Start Capability are available within its National System. TSOs shall contract for Black Start capability in accordance with the Chapter 16 (ISBC Chapter No. 3 - Ancillary Services).

Appropriate tests and simulations shall be carried out on an annual basis to ensure that:

a. Black Start Units are capable of starting up without any external power supply;

b. the National System can be energised and loaded from the Black Start Unit(s), and

c. The National System can be re-synchronised with the EAPP Interconnected Transmission System.

Black Start Tests may involve synchronisation of generation to the EAPP Interconnected Transmission System or connection of demand remote from the Black Start Unit.

10.1.7.2 Procedure

In the event that the systems of neighbouring TSOs remain de-energised after a Total Shutdown of the EAPP Interconnected Transmission System, TSOs shall determine, by means of tests or simulations, the amount of system and load that could be energised from their National System.
Whenever possible the TSOs affected by a Total Shutdown shall coordinate the restoration process. If they consider it necessary to re-configure the EAPP Interconnected Transmission System or disconnect some cross-border connections, they shall request the EAPP CC to coordinate the operation with all other TSOs that may be affected by the action.

Each TSO shall recover its National System and obtain the balance between generation and demand in coordination with its Users, handling the synchronisation operations of their systems until complete integration with the EAPP Interconnected Transmission System is achieved. The EAPP CC shall be responsible for the overall supervision of the restoration process of the EAPP Interconnected Transmission System.

During the initial stages of restoration normal operational security standards may not be appropriate or possible and the EAPP Interconnected Transmission System or a National System may be operated outside normal voltage and frequency limits provided that it does not result in damage to Plant and or Apparatus, or a safety hazard to persons.

10.1.7.3 Power Islands

EAPP CC shall coordinate the formation of Power Islands where such Power Islands include the parts of more than one National System. The EAPP CC shall designate one TSO to act as the Control Area Operator for such a Power Island until such time as re-synchronisation with the EAPP Interconnected Transmission System has occurred.

The designated TSO of a Power Island shall ensure that the Power Island is managed in a secure and safe manner. Where possible a Power Island should be operated in accordance with the following frequency and voltage criteria:

a. The frequency in the Island shall be nominally 50 Hz and shall be controlled within the limits 49.5 – 50.5 Hz;

b. The voltage on the Transmission System in the Island shall normally remain within +/- 10% of nominal. Voltages of +20% and –15% should not prevail for more than 15 minutes.

Close coordination between TSOs and Users is required to achieve and maintain these frequency and voltage levels.

10.1.7.4 Completion of Black Start and System Restoration

When the Black Start and system restoration are complete the EAPP CC shall formally notify TSOs that the Black Start is complete and normal operation has been resumed.

10.1.8 Reporting of Emergency Conditions

The reporting of significant incidents during emergency conditions and or Black Start shall be in accordance with Chapter 11 (Operations Code No. 4 – Incident Reporting), or OC 4, which also contains provision for the Joint Investigation of incidents.
10.2 **KENYA NATIONAL TRANSMISSION GRID CODE REQUIREMENTS**

10.2.1 **Introduction**

This section specifies guidelines for developing criteria and procedures that are specific to the *Kenya National TSO* for emergency operations of the *Kenya National Transmission System (KNTS).*

10.2.2 **Emergency and Contingency Planning**

The following emergency and *Contingency* planning actions are specific for the *Kenya National TSO* and are elaborated where needed:

a. The *Kenya National TSO* shall develop and maintain *Contingency* plans to manage system contingencies and emergencies that are relevant to the performance of the *KNTS*. Such *Contingency* plans shall be developed in consultation with all *Users* shall be consistent with internationally acceptable utility practices, and shall include but not be limited to:
   1. Under-frequency load shedding
   2. Meeting Kenya’s disaster management requirements, if any, including the necessary minimum load requirements
   3. Forced *Outages* at all points of interface, and
   4. Supply restoration

b. Emergency plans shall allow for quick and orderly recovery from a partial or complete system collapse, with least cost solution and minimum impact on *Customers*.

c. Emergency plans shall comply with *EAPP* agreements and guidelines.

d. The *Kenya National TSO* shall periodically verify *Contingency* and/or emergency plans by actual tests to the greatest practical extent possible. In the event of such tests causing undue risk or undue cost to a *User*, the *Kenya National TSO* shall take such risks or costs into consideration when deciding whether to conduct the tests. Any tests shall be carried out at a time that is least disruptive to the *Users*. The costs of these tests shall be borne by the respective asset owners. The *Kenya National TSO* shall ensure the co-ordination of the tests in consultation with all affected *Users*.

e. The *Kenya National TSO* shall specify minimum emergency requirements for *Regional Control Centres*, *Generating Plant* local control centres and substations to ensure continuous operation of their control, recording, annunciator and communication facilities.

f. It shall be ensured that other *Users* comply with the *Kenya National TSO*’s reasonable requirements for *Contingency* and emergency plans.

g. The *Kenya National TSO* shall set the requirements for automatic and manual load shedding. *Users* shall make available loads and schemes to comply with these requirements. When the *SCADA* system displays a sudden loss of generation accompanied by a drastic drop in system frequency without the operation of under frequency scheme, the *Kenya National TSO* shall monitor the system for a voltage collapse. If a voltage collapse is imminent, controlled load shedding is initiated according to *Kenya National TSO* documented procedures.
h. If a sudden loss of a large generation plant occurs on the system followed by an operation of under frequency scheme, the Kenya National TSO shall initiate action according to documented procedures.

i. The Kenya National TSO shall be responsible for determining all operational limits on the KNTS, updating these periodically and making these available to the Users.

j. The Kenya National TSO shall conduct load flow studies regularly as indicated in Section 10.1.5 (Responsibilities of TSOs – Security Analysis) to determine the effect that various component failures would have on the reliability of the system. At the request of the Kenya National TSO, TNSPs shall perform related load flow studies on their part of the network and make the results available to the Kenya National TSO.

k. Studies shall be made on a coordinated basis to: (1) determine the facilities on each system which may affect the operation of the coordinated area; (2) determine operating limitations for normal operation when all transmission components are in service; and (3) determine operating limitations of transmission facilities under abnormal or emergency conditions. In determining ratings of transmission facilities, consideration shall be given to: (4) Thermal and stability limits; (5) Short and long time loading limits; (6) Voltage limits.

l. Periodic studies shall be made to determine the Emergency Transfer Capability of transmission lines interconnecting control areas. Studies shall be made annually or at such other time that changes are made to the power system which may affect the Emergency Transfer Capability.

m. Studies shall be made to develop operating voltage or reactive schedules for both normal and Outage conditions.

n. Adequate coordination with the Neighbouring Systems to use uniform line identifications and ratings when referring to transmission facilities of a transmission system network shall foster consistency when referring to facilities and reduce the likelihood of misunderstandings.

o. The scheduling of Outages of transmission facilities which may affect Neighbouring Systems shall be co-ordinated with the appropriate authorities.

p. Any Emergency Outage which may have a bearing on the reliability of the KNTS shall be communicated to all systems which may be affected.
11 OPERATIONS CODE NO. 4 – INCIDENT REPORTING

This chapter contains requirements specific to both the EAPP IC and the KNTS. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

11.1 EAPP IC REQUIREMENTS

11.1.1 Introduction

Operations Code No. 4 (OC 4) sets out the requirements for reporting significant incidents that have caused, or could have caused, damage to persons, system equipment, or operation of the EAPP Interconnected Transmission System outside the standards set out in Operations Code No. 2 (OC 2) of Chapter 9.

OC 4 also describes the procedure for the joint investigation of significant incidents and for the technical audit of TSO’s procedures and Plant and or Apparatus connected to, or forming part of, the EAPP Interconnected Transmission System.

11.1.2 Objective

The objectives of OC 4 are:

a. To specify the roles and responsibilities of TSOs and EAPP CC with regard to significant incident reporting;

b. To provide for the joint investigation by TSOs, EAPP Steering Committee and the Independent Regulatory Board of any significant incident that has had, or could have had, a widespread impact on any part of the EAPP Interconnected Transmission System, and

c. To make provision for the technical audit of a TSO’s procedures and Plant and / or Apparatus connected to, or forming part of, the EAPP Interconnected Transmission System.

11.1.3 Reporting Requirements

Where a TSO becomes aware of a significant incident on its National System which, in the TSO’s view, compromised, or may have compromised the integrity or secure operation of the EAPP Interconnected Transmission System, the TSO shall notify the EAPP CC and other affected TSOs of such significant incident as a matter of urgency.

The EAPP Steering Committee and the Independent Regulatory Board may require the provision of a report on a significant incident which in their view has compromised the secure operation of the EAPP Interconnected Transmission System.

Without limiting the requirements of OC 4, TSO’s shall report any of the following incidents that have or could have adversely affected the security of the EAPP Interconnected Transmission System or the safety of persons or system equipment:
a. Manual or automatic tripping under emergency conditions of system circuits and Plant associated with the EAPP Interconnected Transmission System;
b. An uncontrolled loss of generation of greater than 30 MW;
c. A loss of demand greater than 20 MW for more than 15 minutes from a single incident;
d. Load shedding of more than 20 MW implemented for local reasons;
e. The occurrence of a system separation or islanding;
f. Deviation of voltage and or frequency outside the limits of the CC;
g. System instability;
h. Implementation of Black Start procedures;
i. Sabotage, vandalism, terrorism and cyber-attacks affecting the security of the EAPP Interconnected Transmission System;
j. Major safety incident.

The Report shall provide a detailed description of the incidents that occurred as well as the actions taken for the re-establishment of normal conditions on the EAPP Interconnected Transmission System.

11.1.4 Incident Reports

11.1.4.1 Initial Report

The Initial Report shall be prepared immediately and shall be submitted to the EAPP CC within four (4) hours of the occurrence of the significant incident. The Initial Report shall include, in the format of Section 11.1.7 (Sample Report) of this chapter, without limitation, the following information:

a. A description of the significant incident detailing the sequence of events;
b. The time and date of the significant incident;
c. The location(s) of the significant incident;
d. Plant and or Apparatus directly involved and not merely affected by the significant incident;
e. A preliminary diagnosis of probable cause(s) of the significant incident;
f. The consequences on the EAPP Interconnected Transmission System (loss of load, unavailability of generating and transmission facilities, protection operations);
g. Immediate actions performed to restore the system to a normal operative state; and
h. Any other information available in relation to the significant incident.

Those incidents that were not identified until sometime after they occurred shall be reported to the EAPP CC within four (4) hours of being recognised.

11.1.4.2 Interim Report

Depending on the severity or complexity of the significant incident, an Interim Report may be issued. This report shall be submitted to the EAPP CC within five (5) business days of the occurrence of the incident. It shall contain further analysis of the incident together with provisional recommendations for action to be taken, on an urgent basis, regarding procedures or facilities of the EAPP Interconnected Transmission System.
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Transmission System. The purpose of the Interim Report is to alert the EAPP CC and other TSOs of the possible need to take immediate action.

11.1.4.3 Final Report

A Final Report shall be presented to the EAPP CC within thirty (30) business days of the occurrence of the significant incident. As a minimum the Final Report shall contain a description of the incident, the identification of its root cause, the conclusions reached and recommendations for corrective actions, if applicable, to prevent recurrence of this type of incident.

When a TSO requires more than thirty (30) business days to submit a Final Report, it may request additional time and agree a new timescale to carry out the relevant investigations.

11.1.4.4 Evaluation and Approval of Reports

All reports shall be circulated by the EAPP CC to the EAPP Steering Committee, to the Independent Regulatory Board and to other relevant TSOs.

The Final Report is subject to the approval of the EAPP Steering Committee and of the Independent Regulatory Board. If either body fails to approve the Final Report, the incident shall be subject to a Joint Investigation in accordance with Section 11.1.4 in this chapter.

11.1.4.5 Actions Arising from Incidents

When the Final Report of a significant incident concludes that action is required to implement the recommendations of the Report, the TSOs concerned shall draw up an implementation timetable. The actions required as a result of incidents are likely to involve the following:

a. Modification of operating procedures;

b. Modification of equipment (e.g. control systems or Remedial Action Schemes);

c. Identification of any lessons learned;

d. Non-compliance with operational or technical procedures or any provision of the EAPP/EAC Interconnection Code or National Grid Codes or equivalent documents.

The EAPP Sub-Committees on Planning and Operations shall track and review the status of all recommendations from Final Reports at least twice a year to ensure they have been implemented in due time. If any recommendation has not been implemented within two (2) years, or if the tracking and review process indicates at any time that the recommendation(s) are not being pursued with due diligence, the matter shall be bought formally to the attention of the EAPP Steering Committee and the Independent Regulatory Board for further action.

11.1.5 Joint Investigation

Where an incident has occurred and a Final Report submitted under Section 11.1.3 in this chapter, the affected TSOs or the EAPP CC may request in writing that a Joint Investigation be carried out. A Joint Investigation shall also be carried out in accordance with the provisions of Section 11.1.3
where approval of the Final Report by the *EAPP Steering Committee* and or the *Independent Regulatory Board* has been withheld.

The composition of the Joint Investigation Committee shall be appropriate for the incident to be investigated and agreed by all parties involved. If an agreement cannot be reached on the composition of the Committee, the *EAPP Steering Committee* and the *Independent Regulatory Board* shall decide.

The terms of reference and all matters relating to the Joint Investigation shall be agreed by the parties in good faith and in a timely manner. The investigation shall begin within fifteen (15) business days from the request for a Joint Investigation.

### 11.1.6 Technical Audit

Based on an analysis made by the *EAPP Sub-Committees on Planning and Operations* or the *Independent Regulatory Board* of all Final Reports, it may be decided to carry out a technical audit of the *EAPP Interconnected Transmission System* facilities or of the operational procedures used by TSOs and the *EAPP CC*.

These technical audits shall be carried out by experts nominated by the *EAPP Sub-Committees on Planning and Operations* or *Independent Regulatory Board* as the case may be. TSOs shall allow access for the inspection of their facilities, provide the required information, and accept and comply with the recommendations of the technical audit.
### 11.1.7 Sample Report

[Suggested Format of Reports]

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNIFICANT INCIDENT REPORT NO</td>
<td></td>
</tr>
<tr>
<td>REPORTING TSO</td>
<td></td>
</tr>
<tr>
<td>TYPE OF REPORT (CIRCLE) INITIAL / INTERIM / FINAL</td>
<td></td>
</tr>
<tr>
<td>TIME OF INCIDENT</td>
<td></td>
</tr>
<tr>
<td>DATE OF INCIDENT</td>
<td></td>
</tr>
<tr>
<td>LOCATION OF INCIDENT</td>
<td></td>
</tr>
<tr>
<td>PLANT OR APPARATUS DIRECTLY INVOLVED</td>
<td></td>
</tr>
<tr>
<td>ESTIMATED TIME AND DATE OF RETURN TO SERVICE</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION OF SIGNIFICANT INCIDENT</td>
<td></td>
</tr>
</tbody>
</table>
OTHER RELEVANT INFORMATION (Weather conditions, change in output of Generating Units etc.)

_____________________________________________________________________________________

_____________________________________________________________________________________

_____________________________________________________________________________________

CAUSE OF SIGNIFICANT INCIDENT where known at time of Report

_____________________________________________________________________________________

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_____________________________________________________________________________________

_____________________________________________________________________________________

_____________________________________________________________________________________

_____________________________________________________________________________________

RECOMMENDATIONS FOLLOWING INVESTIGATIONS

_____________________________________________________________________________________

_____________________________________________________________________________________

_____________________________________________________________________________________

_____________________________________________________________________________________
11.2 **KENYA NATIONAL TRANSMISSION GRID CODE REQUIREMENTS**

11.2.1 **Incidents for Reporting**

This section specifies guidelines for developing procedures for incident reporting that are specific to the KNTS.

A major incident is defined as an incident where (a) Load was interrupted for more than allowable time as determined by the Kenya National TSO; and (b) Severe damage to plant or system equipment has occurred. In case of a major incident, a User shall have the right to request an independent audit of the report, at their own cost, if they are not satisfied with it. If these audit findings disagree with the report, the User may follow the dispute resolution mechanism. If the audit agrees with the report, the report recommendations shall prevail and be implemented within the time frames specified.

An incident is reported to the Kenya National TSO by TNSPs or the RCCs when a major disturbance occurs on the KNTS resulting in casualties, loss of supplies or damage to equipment. An incident shall be reported with the information on the nature of incident, its location, people/Customer/installations affected, and corrective actions taken as soon as possible.

Procedure for handling incident reporting shall be followed as per documented Kenya National TSO procedures. Following are some guidelines regarding incident reporting, investigation, and analysis:

a. *Generation Licensees* shall report loss of output and tripping of units and change of status of AGC and governing to the Kenya National TSO within fifteen (15) minutes of the event occurring.

b. In the event of a multiple unit tripping, the relevant *Generation Licensee* shall submit a written report to the Kenya National TSO within one (1) month identifying the root causes of the incident and the corrective actions taken.

c. The Kenya National TSO shall be responsible for developing and maintaining an adequate system of fault statistics.

d. Incidents shall be reported to the Regulatory Authority as defined in the licence conditions.

e. A User may issue an incident report to the Kenya National TSO on becoming aware of an occurrence. The Kenya National TSO shall provide a reason for the incident, what has been done to address it, and, if appropriate, indicate what action it shall take to avoid such an incident(s) in the future.

f. The Kenya National TSO may also issue an incident report to a User, where the User does not comply with necessary requirements. The User shall provide the Kenya National TSO with reasons for the incident and, where appropriate, indicate the measures that will be taken to address the problem.

g. Incidents involving sabotage or suspected sabotage, as well as threats of sabotage on the power system shall be reported to the Kenya National TSO.

h. Any incident that materially affected the quality of the service to a User shall be formally investigated. These include interruptions of supply, disconnections, under or over voltage incidents, quality of supply contraventions, etc. A preliminary incident report shall be available.
after three (3) business days and a final report within three (3) months. The Kenya National TSO shall initiate such an investigation, arrange for the writing of the report and involve all affected Users. All these Users shall make all relevant required information available to the Kenya National TSO. The confidentiality status of information involved shall be maintained.

High risk incidents include ones causing: (a) significant disruption of supply to Customers; (b) substantial damage to equipment and switchgears; (c) fires; and (d) adverse environmental consequences (e.g. bushfires, environmental pollution, etc.). As per this document, the following actions shall be necessary for incident reporting:

a. Copies of events, sequence of events and post mortem review (PMR) print-outs from the SCADA system (includes loading and generation situation before the disturbance, and historical performance of the failed equipment).

b. Details regarding the fault containing chronological description of the incident’s occurrence, operations during the incident and the cause of the incident.

c. Any shortcomings experienced such as: Protection malfunctions; Malfunction of Electrical Plant equipment; Malfunction of telecommunications and SCADA; Transport problems; Manpower problems.

d. Any of the following actions taken after occurrence of the incident: Emergency actions taken; Strategies taken to operate the system under fault condition; Operating procedures used during the disturbance; instructions issued, timings for execution; Restoration actions initiated.

e. Any conclusions/recommendations that include: Weaknesses found in the disturbance handling, equipment mal-operations performance; System response to the disturbance; Any mal-operations; Evaluation of all aspects of operation; Any modifications of disturbance handling procedures and why.

f. Any remedial actions taken to restore supplies and equipment.

g. Submission of completed reports to the Kenya National TSO.

Despite the urgency of the situation, careful, prompt, and complete logging of all operations and operational messages shall be ensured by all Users to facilitate subsequent investigation into the incident and the efficiency of the restoration process.
This chapter contains requirements specific to both the EAPP IC and the KNTS. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

12.1 EAPP IC REQUIREMENTS

12.1.1 Introduction

Operations Code No. 5 (OC 5) sets out the provisions to be made by a TSO, in cooperation with the EAPP CC, to permit reductions in demand in the event of insufficient generation capacity being available to meet demand or in the event of breakdown or thermal overloading of any part of the EAPP Interconnected Transmission System leading to the possibility of unacceptable frequency or voltage conditions. Without limitation, the provisions of OC 5 may be used in the event of both a steady-state shortfall of generation and a transient shortfall following an instantaneous loss of generation.

TSOs shall, after taking all other remedial actions, disconnect Customer demand rather than risk an uncontrolled failure of Plant and or Apparatus or cascading Outages of the EAPP Interconnected Transmission System.

12.1.2 Objective

The objective of OC 5 is to require TSOs to have procedures in place to enable a reduction in demand on the EAPP Interconnected Transmission System in order to avoid a breakdown or overloading of the system or in the event of generation shortage.

12.1.3 Methods of Demand Control

To preserve the security of the EAPP Interconnected Transmission System, OC 5 deals with the following types of demand control:

a. Automatic Load Shedding activated by low frequency and low voltage relays;

b. Emergency manual load shedding, and

c. Planned manual load shedding including voltage reduction and Rota Load Disconnection;

The type of demand control utilised by the TSO in any particular circumstances will depend upon the amount of time between the TSO becoming aware of the need for implementing demand control and the time at which it needs to be implemented. In the event of a sudden and unexpected loss of generation on the EAPP Interconnected Transmission System, the requisite demand control will normally be achieved by means of Automatic Load Shedding but, occasionally, emergency manual disconnection may additionally be required. In all cases when demand control is necessary, the TSO shall use demand disconnection as the last option.
12.1.4 Risk of Demand Reduction

The TSO and or the EAPP CC shall issue a notification of a risk of demand control whenever it is anticipated that there may be insufficient generating capacity available to meet demand or that there is a risk of serious disturbance to the EAPP Interconnected Transmission System.

Any such notification issued shall be provided as soon as reasonably possible after the TSO or the EAPP CC has grounds to believe that there is a risk of demand reduction. The notice shall include an estimate of:

(a) The required level of demand control in MW;
(b) The expected start time and duration of demand control.

Under the terms of Operations Code No. 3 – Emergency Operations of Chapter 10, TSOs and or EAPP CC are responsible for the issue of ALERT and EMERGENCY warnings. The existence of a risk of demand reduction shall normally be included within one of these warnings.

12.1.5 Automatic Load Shedding Schemes

Under generation shortfall conditions, the frequency graded Automatic Load Shedding Scheme is used prevent frequency collapse on the EAPP Interconnected Transmission System and to restore the balance between generation output and demand.

Each TSO shall establish plans for Automatic Load Shedding for under-frequency and under-voltage conditions. The overall Automatic Load Shedding Scheme for the EAPP Interconnected Transmission System shall be coordinated by the EAPP CC in order to prevent excessive transfers across the EAPP Interconnected Transmission System and possible instability.

A TSO shall implement load shedding in steps established to minimise the risk of further uncontrolled separation, loss of generation, or system shutdown.

TSOs shall coordinate Automatic Load Shedding in their National Systems with under-frequency isolation of Generating Units, tripping of shunt capacitors, and other automatic actions that will occur under abnormal frequency, voltage, or power flow conditions.

12.1.6 Procedure

The following procedures are to be followed by a TSO in the implementation of the Automatic Load Shedding Scheme on its National System:

a. Each TSO shall make available up to 60% of its annual peak demand for the Automatic Load Shedding Scheme;

b. Schemes shall be based on system dynamic performance where the greatest probable imbalance between demand and generation is simulated;

c. Schemes should be analysed to ensure that no unacceptable over-frequency, over-voltage or transmission overload will occur;
d. The demand on the *EAPP Interconnected Transmission System* subject to an *Automatic Load Shedding Scheme* will be split by the TSO into discrete blocks. The number, location, size and the associated low frequency or low voltage settings of these blocks will be as determined by the TSO in consultation with the *EAPP CC* and shall not unduly discriminate against or unduly prefer any one group of *Users*. The TSO and *EAPP CC* shall also take into account constraints on the *EAPP Interconnected Transmission System* when determining the size and location of demand reduction by *Automatic Load Shedding*;

e. If the *EAPP Interconnected Transmission System* is still in a critical condition following frequency or voltage recovery after the activation of the *Automatic Load Shedding Scheme*, a TSO may implement manual disconnection of additional demand to permit restoration of the previously disconnected demand;

f. Demand disconnected by the *Automatic Load Shedding Scheme* shall only be restored on the instruction of the TSO with the agreement of the *EAPP CC* unless there are particular local circumstances;

g. The settings of under-frequency and under-voltage relays shall be coordinated with the emergency plans and procedures required by Operations Code No. 3 – *Emergency Operations*.

h. TSOs and *EAPP CC* shall review annually the settings of under-frequency and under-voltage relays and the levels of demand to be disconnected.

### 12.1.7 Planning and Emergency Manual Load Shedding

Planned manual disconnection is the procedure adopted when the TSO has reasonable notice that a generation shortfall and or *EAPP Interconnected Transmission System* problems may require demand control. TSOs may also initiate voltage reduction in lieu of demand disconnection as necessary.

Each TSO shall be responsible for maintaining *Rota Load Disconnection* plans for use where a shortage of generation is anticipated over a prolonged period. The *Rota Load Disconnection* plans shall provide for the disconnection and reconnection of defined blocks of demand on instruction from the TSO. In this way the TSO can instruct the necessary level of disconnection (and reconnection) required by the circumstances at the time. The *Rota Load Disconnection* plans of each TSO shall be coordinated by the *EAPP CC* to ensure that where the generation shortage is common to a number of countries of *EAPP* the resulting demand control is applied equitably.

Emergency manual disconnection is utilised by the TSO when a loss of generation or a mismatch of generation output and demand is such that there is an operational requirement to disconnect demand at short notice or in real time to maintain a margin between generation output and demand and in certain circumstances to deal with operating problems such as unacceptable voltage levels and thermal overloads. TSOs shall maintain emergency manual disconnection plans and procedures, coordinated with *EAPP CC*, to implement manual load shedding in a timeframe adequate for responding to an emergency.

TSOs shall ensure that, as far as practicable, demand reductions are deployed equitably. In the case of protracted generation shortage or transmission system overloading, large imbalances of generation and demand may cause excessive power transfers across the *EAPP Interconnected Transmission System*.
12.1.8 Demand Restoration

When EAPP Interconnected Transmission System conditions have returned to normal, TSOs may, with the consent of EAPP CC, initiate demand restoration. Demand restoration will normally be instructed in stages as equitably as practicable. Two or more stages of demand restoration may be carried out simultaneously where appropriate. Procedures for demand restoration after a Total or Partial Shutdown shall be in accordance with OC 3, Section 10.1.7 of Chapter 10 (Emergency Operations – System Restoration and Black Start).

12.2 Kenya National Transmission Grid Code Requirements

12.2.1 Introduction

This section specifies guidelines for developing criteria and procedures to be applied by the Kenya National TSO for demand control of the Kenya National Transmission System (KNTS). Provisions of this section are to enable the Kenya National TSO to implement demand reduction or demand addition in a manner that ensures the continued balance between supply and demand under normal or emergency conditions.

The objective of demand control is to achieve reduction in demand in the transmission grid in order to: (a) manage system security during low operating reserve; and (b) prevent system overload or voltage collapse.

Demand control shall, in general, apply to Generation Licensees, TNSPs, Distribution Licensees, and End-use Users.

12.2.2 Planned Demand Control

If a supply-demand mismatch is foreseen, the Kenya National TSO will alert Users drawing power from the Kenya National TSO grid in terms of the times and load quantum to be curtailed. The Kenya National TSO shall consult the Users in producing a load shedding programme that shall be followed when there is planned load demand control. During emergency conditions the Kenya National TSO may curtail load in a manner that does not strictly follow the agreed load shedding programme. Planned demand control is detailed under Section 12.1.6 in this chapter, Emergency Demand Control.

Emergency automatic demand control occurs when there is a sudden loss of generation substantially in excess of spare plant capacity. The Kenya National TSO in consultation with KNTS Users shall prepare the plan for automatic load shedding during the low frequency conditions. For details on automatic load shedding, refer to Section 12.1.5 in this chapter. During periods of low
frequency conditions, *Generating Plants* shall assist through the following: (a) Make every effort to assist the system frequency to rise to 50 Hz, by increasing generation whenever possible; (b) Not disconnecting manually from the transmission system unless there is definite evidence that a complete failure of generation would otherwise result. The *Kenya National TSO* shall enforce demand control in such a manner that does not unduly discriminate against, or unduly prefer anyone.

If the *Kenya National TSO* anticipates any generation shortfall based on the difference between anticipated maximum demand and available generation capacity, the *Kenya National TSO* shall work with all relevant personnel following the operational guidelines below:

a. The *Kenya National TSO* shall work out the anticipated generation shortfall by working out the difference between anticipated maximum demand and available generation capacity.

b. The *Kenya National TSO* shall work out each region’s required load rationing during the shortfall period, and inform RCCs of their required load rationing targets.

c. The RCCs shall liaise with the *Kenya National TSO* to determine the *End-use Users* and feeders to be affected.

d. The RCC’s shall inform the *End-use Users* of their required load reduction magnitudes and the time period.

e. The RCCs shall be at the relevant *End-use Users* premises before start of reduction period to ensure and confirm compliance by such Users.

f. The RCCs shall inform the *Kenya National TSO* of *End-use Users*’ compliance with load reductions.

g. The *Kenya National TSO* shall evaluate system status and determine if the *End-use Users*’ load reduction is adequate. If reduction is inadequate, the *Kenya National TSO* shall instruct RCCs to carry out additional load shedding.

h. RCCs shall carry out load shedding as instructed by the *Kenya National TSO*. RCCs shall instruct operators to carry out load shedding in places where there are no SCADA commands.

i. RCCs shall notify the *Kenya National TSO* of completion of carrying out load shedding.

j. The *Kenya National TSO* shall evaluate system status. If load shedding is inadequate, The *Kenya National TSO* shall instruct RCCs to carry out further load shedding.

k. If load shedding is adequate, the *Kenya National TSO* shall wait for the recovery of the system while monitoring system status parameters (voltage and frequency) on the SCADA.

l. The *Kenya National TSO* shall determine if system has recovered from generation shortfall.

m. If the system has not recovered from generation shortfall, the *Kenya National TSO* shall wait for the recovery of the system while monitoring system status parameters (voltage and frequency) on the SCADA.

n. If system has recovered from generation shortfall, the *Kenya National TSO* shall instruct RCCs to restore Customers/ inform Customers to pick load.
o. RCCs shall restore Customers where there is remote control. RCCs shall instruct operators to restore Customers where there is no remote control. RCCs shall also inform End-use Users who had reduced load to resume normal operation. Restoration of such Users shall be done systematically as directed by the Kenya National TSO.

p. The Kenya National TSO shall compile a detailed Load Shedding report.
This chapter contains requirements specific to both the EAPP IC and the KNTS. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

13 OPERATIONS CODE NO. 6 – SYSTEM TESTS

13.1 EAPP IC REQUIREMENTS

13.1.1 Introduction

Operations Code No. 6 (OC 6) sets out the arrangements and procedures across the EAPP Interconnected Transmission System for System Tests or operational tests including Black Start tests and Power Island tests.

System Tests are those tests which involve either a simulated or a controlled application of irregular, unusual or extreme conditions on the EAPP Interconnected Transmission System. In addition they include commissioning and or acceptance tests on Plant and Apparatus to be carried out by a User and which may have a significant impact upon the EAPP Interconnected Transmission System.

System Tests or operational tests may involve single items of Plant and or Apparatus through to whole sections of the EAPP Interconnected Transmission System and may be proposed by EAPP Sub-Committees on Planning or Operations or a TSO.

To minimise disruption to the operation of the EAPP Interconnected Transmission System and or to other TSO’s National Systems, it is necessary that these tests be subjected to central coordination by the EAPP CC in cooperation with the relevant TSO.

OC 6 also describes the data exchange and communication requirements between EAPP and the TSOs to facilitate planning, implementation and reporting of System Tests or operational tests.

13.1.2 Objective

The objectives of OC 6 are to specify procedures for central co-ordination and control of a System Test or operational test required by a TSO or the EAPP Sub-Committees on Planning or Operations, where such test will or may:

a. Affect the secure operation of the EAPP Interconnected Transmission System;

b. Have a significant effect on the operation of the EAPP Interconnected Transmission System or a National System;

c. Affect the economic operation of the EAPP Interconnected Transmission System, or

d. Affect the quality or continuity of supply of electricity from the EAPP Interconnected Transmission System.
13.1.3 Procedure

13.1.3.1 General

Tests shall be planned to ensure all Plant and Apparatus remain within the applicable capability limits specified by the relevant TSO and carried out such that there is minimal impact on the EAPP Interconnected Transmission System or TSOs’ National Systems. System Tests required by TSOs or EAPP CC shall include, but not be limited to the following:

a. Tests involving the controlled application of frequency and or voltage variations aimed at gathering information on the behaviour of the EAPP Interconnected Transmission System;
b. Black Start and system restoration tests;
c. Testing of procedures and plans for system ALERT and EMERGENCY conditions;
d. Testing or monitoring of power quality under various system conditions and generation configurations.

TSOs shall be responsible for obtaining the agreement of the relevant User(s) before tests proceed.

All Outage requests for Tests shall be progressed in accordance with the guidelines in Chapter 8 (Operations Code No. 1 – Operational Planning).

The category of Tests shall be agreed by the EAPP Sub-Committees on Planning and Operations and relevant TSOs.

Major Tests are those considered sufficiently complex by either Party to require a detailed Test programme to be submitted in accordance with the Test Proposal in Section 13.1.3 of this chapter.

OC 6 is not intended to deal with Tests categorised as minor or routine. Such tests do not require a detailed Test programme to be submitted.

Any System Tests on the EAPP Interconnected Transmission System which may affect an External System or tests on an External System which may affect the EAPP Interconnected Transmission System shall be carried out in accordance with the appropriate bilateral agreements.

13.1.3.2 Test Proposal

The level of demand on the EAPP Interconnected Transmission System varies substantially according to the time of day and time of year and, consequently, certain System Tests which may have a significant impact on the system can only be undertaken at certain times of the day and year. Other System Tests, for example, those involving substantial Mvar generation or full load rejection tests, may also be subject to timing constraints. It therefore follows that notice of System Tests should be given as far in advance of the date on which they are proposed to be carried out.

The Test Proposer shall provide a Test Proposal to EAPP Sub-Committees on Planning or Operations who shall be responsible for circulation to relevant TSOs.
Individual TSOs shall ensure that any of their Users who may be involved in or affected by the Test shall be provided with a copy of the Test Proposal and any updates thereof. Where practicable, the Test Proposal shall be submitted at least three (3) months prior to the proposed date of the Test. The Test Proposer shall ensure that sufficient detail is included in the Test Proposal to allow the affected parties to assess the impact of the Test on the EAPP Interconnected Transmission System, TSOs’ National Systems and Users’ Systems.

The Test Proposer shall be responsible for change control of the Test Proposal and shall issue a revised Test Proposal to EAPP Sub-Committees on Planning or Operations. EAPP Sub-Committees on Planning or Operations is responsible for liaising with any other affected TSOs who in turn shall notify any Users affected by the change.

EAPP Sub-Committees on Planning or Operations and the affected TSOs shall assess the implications and agree the category of the Test within a reasonable time. TSOs shall liaise with each affected User and seek their agreement to the Test Proposal and collate and coordinate their responses to the EAPP Sub-Committees on Planning or Operations.

Following receipt of the Test Proposal and evaluation of the Test’s likely impact, including discussions of test requirements with the Test Proposer and other affected parties, the EAPP Sub-Committees on Planning or Operations taking into account the criteria set out in this chapter will decide if approval for the Test is granted.

If the Test Proposal is not acceptable to the EAPP Sub-Committees on Planning or Operations, an affected TSO or User, EAPP Sub-Committees on Planning or Operations shall refuse the Test Proposal and shall immediately notify the Test Proposer. The Test Proposer may choose to revise and re-submit the Test Proposal in accordance with this procedure or raise a Dispute under the terms of Section 3.11 of Chapter 3 (Dispute Resolution).

Any Test Proposal made by the EAPP Sub-Committees on Planning or Operations shall be subject to the prior approval of the EAPP Steering Committee and Independent Regulatory Board and shall otherwise be subject to the procedure set out above.

13.1.3.3 Detailed Test Programme

As soon as practicable after agreement to the Test Proposal, the Test Proposer shall provide an Outage request, in accordance with Section 8.1.5 of Chapter 8 (Operations Code No. 1 – Operational Planning – Outage Planning Process), to EAPP CC detailing the Plant and Apparatus involved.

The Test Proposer shall provide, within a reasonable time, a draft Test programme to a level of detail including, but not limited to, the content shown in Section 13.1.5 Sample Test Programme Report.

The Test Proposer shall be responsible for change control of the draft Test programme and shall issue within a reasonable time, a revised Test programme where appropriate to EAPP CC. EAPP CC
is responsible for liaising with any other affected TSOs who in turn shall notify any Users affected by the change.

EAPP CC shall provide to each affected TSO a copy of the draft Test Programme and all updates thereof.

TSOs shall liaise with each affected User and seek their agreement to the Test Programme and collate and co-ordinate their responses to the EAPP CC.

EAPP CC and affected TSOs shall assess the implications of the Test programme on the safety, security, and reliability of the EAPP Interconnected Transmission System, individual TSO National Systems and User Systems.

When all issues raised have been addressed to the reasonable satisfaction of all parties and the draft Test programme agreed by all parties, the agreed Test programme shall be issued by EAPP CC to relevant TSOs at least fifteen (15) business days prior to the commencement date of the Test unless otherwise agreed.

In the event that there is a Dispute regarding the acceptability or otherwise of a Test programme or associated Outage, the Test shall not take place until the Dispute has been resolved.

13.1.3.4 Operational Process

EAPP CC shall be responsible for operational liaison and obtaining agreement from any affected TSO for the Test to proceed and shall co-ordinate the Test.

When Tests have commenced, any change in System, site or Test conditions that could affect or invalidate the Test or have an Operational Effect shall be communicated to other parties as soon as reasonably practicable. The Tests shall be suspended until all parties involved have assessed the implications of the change in system, site, or Test conditions.

In the event of a failure of communications between EAPP CC and relevant TSOs or the Test location during the Test, then the Test shall be suspended until satisfactory communications are restored and agreement is reached to continue with the Test programme.

13.1.3.5 Other Considerations

Tests shall normally only be carried out by EAPP CC or a TSO on Plant and Apparatus in operational service when the results of off-load Tests would not be sufficiently rigorous in the reasonable opinion of either Party to confirm the continued satisfactory performance of the Plant or Apparatus involved.

13.1.3.6 Operational Intertripping

No Tests shall take place that could result in operation of an operational intertripping scheme unless this is the stated purpose of the Test and agreement has been reached with all affected Parties.
Where testing of an operational intertripping scheme is not the stated purpose of testing then no Tests shall take place involving a circuit associated with an operational intertripping scheme unless the operational intertripping scheme is not required in service. The scheme must be deselected from service by a means agreed with all affected Parties.

13.1.4 Reporting of System Tests

Within three (3) months of the completion of the System Test or operational test, the Test Proposer shall prepare a Final Report on the Test. The Report shall be submitted to the EAPP Steering Committee, to the Independent Regulatory Board and to all TSOs affected by the Test.

The Final Report shall include a description of the Plant and or Apparatus tested and a description of the System Test carried out together with the results, conclusions and recommendations as they relate to the EAPP and TSOs.

13.1.5 Sample Test Programme Report

A detailed test programme for major testing shall:

a. Have a unique identifier allocated by the Test Proposer and indicate the current version and issue number;

b. Define the means of communication and location of all parties involved in the Test;

c. Follow an agreed change control process for changes to the Test programme;

d. Specify any associated documentation and diagrams including the numbering and nomenclature of Plant and Apparatus forming part of the Test programme and ensure these shall be accessible to all recipients of the Test programme;

e. Identify the Plant and Apparatus subject to the Test and any other Plant and Apparatus that could be affected;

f. Identify any Operational Effects or potential Operational Effects associated with the Test;

g. Outline the initial conditions of the Plant and Apparatus subject to the test;

h. Detail any temporary protection settings or protection equipment required for the purposes of the tests together with the settings applied;

i. Provide a detailed tests schedule with location, action, any expected result and or Operational Effect identified for each item of the test’s programme;

j. For complex tests, breakpoints should be identified where the tests programme can be suspended and restarted without undue risk and with minimum disruption.

13.2 Kenya National Transmission Grid Code Requirements

This chapter discusses those tests which involve either a simulated or a controlled application of irregular, unusual or extreme conditions on the KNTS, not addressed in Section 13.1.
13.2.1 Commissioning Tests

The TNSP or Users shall perform all commissioning tests required in order to confirm that the plant and equipment meet all the requirements of the KNTGC that have to be met before going on-line. The Kenya National TSO may request relevant tests (or results of such tests) to be demonstrated in accordance with the KNTGC before accepting such plant for operating. The party performing the test shall notify the Kenya National TSO and the Regulatory Authority at least one week in advance of any such tests, so that they may witness the tests.

In addition to the safety of the system as described in Section 13.1.3.3 (Detailed Test Programme), it is necessary to ensure that the safety of personnel or members of the public are not threatened while conducting system tests.

It is important to ensure that the test programme specifies: switching sequence and proposed timings, list of staff involved in the test, and site safety responsible persons.

If a Generating Plant fails the system test, the Generation Licensee shall:

a. Promptly notify the Kenya National TSO of that fact.
b. Promptly advise the Kenya National TSO of the remedial steps it proposes to take to rectify the situation along the proposed timetable for implementing those steps.
c. Diligently take remedial action to ensure that the relevant Generating Plant can comply if there is any compliance issue.
d. Regularly report in writing to the Kenya National TSO on its progress in implementing the remedial action.
e. Demonstrate to the reasonable satisfaction of the Kenya National TSO that the relevant Generating Plant passes the test and is compliant.

Procedures for Commissioning of a new Generating Plant shall be as follows:

a. The Generation Licensee shall send to the Kenya National TSO details of the equipment to be commissioned including a diagram of the high voltage connection points prior to the commissioning date.
b. The Generation Licensee shall avail to the Kenya National TSO protective relay settings of the new Generating Plant prior to the commissioning date.
c. Before the commissioning date, the Generation Licensee shall ensure that labels have been affixed to the equipment and its auxiliaries of the new Generating Plant.
d. The Generation Licensee shall arrange for a training session for System Controllers/Operators of the Kenya National TSO responsible for operating the equipment prior to the commissioning date.
e. The Generation Licensee shall send a copy of the clearance certificate to the Kenya National TSO before the commissioning date of the new Generating Plant.
f. The *Generation Licensee* shall send to the *Kenya National TSO* a copy of the commissioning programme, to connect the equipment to the system, seven (7) days before the commissioning date.

g. The *Generation Licensee* shall give notice of commissioning the equipment at least seven (7) days before the commissioning date.

h. The *Kenya National TSO* shall check and determine if there are any problems with the commissioning taking place. If there are any problems, the *Kenya National TSO* shall discuss with the *Generation Licensee* and agree on the appropriate date when commissioning can take place.

i. The *Kenya National TSO* shall log the commissioning of the new equipment and capture *Planned Outages* in the Generation Dispatch schedule.

j. The *Kenya National TSO* shall organise for switching personnel to assist during the commissioning.

k. Before commissioning commences, the *Generation Licensee* shall report to the *Kenya National TSO* the position of all circuit breakers (CBs), isolators, earth switches that are included in the New Equipment of the new *Generating Plant*.

l. The *Kenya National TSO* shall co-ordinate all commissioning.

m. After successful commissioning of the equipment, the *Kenya National TSO* shall declare the New Equipment to be under control of the *Kenya National TSO*.

Testing shall be carried out to confirm compliance of *Generating Plants* as per approved standards, and *Ancillary Services* provision. Details of testing for a *Generating Plant* shall typically include:

Protection Integrity Tests - Trip testing of all protection functions, from origin (e.g. Buchholz relay) to all tripping output devices (e.g. HV Breaker), shall be carried out and documented providing details of all trip test responses. Testing shall include:

a. **Excitation Response Test** - With the *Generating Plant* in the open circuit mode, carry out the large signal performance testing as described in IEEE 421.2 of 1990; Determine time response, Ceiling voltage, voltage response. With the *Generating Plant* connected to the network and loaded, carry out the small signal performance tests according to IEEE 421.2.1990. Also carry out power system stabiliser tests and determine damping with and without Power System stabiliser. Document all responses.

b. **Reactive Power Capability Test** - Reactive output for a *Generating Plant* shall be fully variable between its rated limits under *Automatic Voltage Regulation (AVR)*, manual or other control. The duration of the test will be for a period of up to sixty (60) minutes during which period the system voltage at the grid entry point for the relevant *Generating Plant* shall be maintained by the *Generating Plant* at the voltage specified by adjustment of Reactive Power on the remaining *Generating Plant* units, if necessary, for a period of sixty (60) minutes. The *Generating Plant* shall demonstrate maintaining its reactive capability within ±5% of its rated capability.

c. **Governor Response Tests** - Prove that the unit is capable of the minimum requirements required for governing frequency deviations.

d. **Black Start Test** - *Black Start* Units shall perform appropriate tests and simulations on an annual basis to ensure that the *Black Start* facility is available. Such tests shall be witnessed...
and approved by the Kenya National TSO. A Black Start Station shall demonstrate that it can be synchronised to the system within thirty (30) minutes of the commencement of the Black Start procedure.

Other tests include:

a. Contingency/Emergency plan Verification - Tests shall be periodically carried out to the greatest practical extent, as agreed by the parties, without causing undue risk or undue cost.

b. Under-frequency load shedding (UFLS) Test - Test shall be done by isolating all actual tripping circuits, injecting a frequency to simulate a frequency collapse and checking all related functionality.
14.1 EAPP IC REQUIREMENTS

14.1.1 Introduction

One of the objectives of the EAPP is to facilitate trading in electricity among the EAPP Member Countries. In its initial stages such trading will consist of bilateral cross-border transactions between Neighbouring Systems. Once further infrastructure is developed more complex arrangements including multilateral transactions with or without transit through Neighbouring Systems will become possible and a Regional Power Pool Market will be established. Accordingly, the provisions of the ISBCs will be modified to reflect any EAPP/EAC new electricity market rules.

To operate the EAPP Interconnected Transmission System and to facilitate bilateral trade between EAPP Member Countries it is necessary to schedule in advance the Active Power and Active Energy to be transferred between TSO National Systems and to be imported from or exported to External Systems.

The term Interchange Scheduling in ISBC Chapter No. 1 (or ISBC 1) specifically refers to the intended delivery of Active Power and Active Energy from one Control Area to another Control Area within the EAPP Interconnected Transmission System or to be imported from or exported to External Systems.

ISBC 1 Interchange Scheduling deals with the following aspects of the scheduling process:

a. Determination of the Net Transmission Capability (NTC) between Neighbouring Control Areas and or External Systems over the Operational Planning timescales;

b. Publication of NTC values to enable TSOs and Users to evaluate possible Active Power and Active Energy interchanges;

c. Allocation of NTC to TSOs and or External Systems in accordance with predetermined rules and the issue of Interchange Schedules.

14.1.2 Objectives

The objectives of the ISBC are:

a. To enable EAPP CC and TSOs to establish and publish the NTC on the interconnections between Control Areas and or External Systems corresponding to the Operational Planning Phase, Programming Phase and Control Phase respectively as set out in Chapter 8 (Operations Code No. 1 Operational Planning) and

b. To require TSOs to allocate the NTC to Users in accordance with certain rules.

14.1.3 Determination of Transmission Capability

NTC relates to the physical capability of the interconnection between Control Areas, and with External Systems to transfer Active Power and Active Energy and shall be determined by the TSOs concerned. The determination shall be based on the operational security standards set out in OC 2 and on such current technical and operational factors as are of significance to the NTC. TSOs are
individually responsible for assessing these factors within their own National Systems and will determine in conjunction with EAPP CC the method of calculation of NTC between Control Areas and or External Systems. In determining NTC TSOs shall also take account of the following factors:

a. Deviations of Active Power flows resulting from the operation or functioning of Primary Response to frequency changes;

b. Emergency exchanges between Control Areas and or External Systems to cope with unexpected mismatch between generation and demand in real time, and

c. Inaccuracies in data collection and measurements.

14.1.4 Capacity Allocation

Certain Users may have acquired rights over the use of NTC. This may occur where the User concerned has provided generation or transmission facilities in accordance with a bilateral agreement. TSOs shall notify other relevant TSOs and the EAPP CC of the existence and extent of such agreements.

The NTC of the interconnection between Control Areas or with External Systems is firstly allocated to those Users with pre-emptive rights over the capability based on their bilateral agreements. After allocating NTC to Users who hold pre-emptive rights, TSOs may allocate the remaining capability of a particular interconnection in accordance with commercial agreements which are not the subject of this chapter.

14.1.5 Interchange Scheduling Process

The Interchange Scheduling process is concerned with:

a. Providing an indication of feasible electricity trading scenarios;

b. Determining NTC over various timescales;

c. The coordination of Outages to minimise the loss of trading benefit to Users and to the EAPP Interconnected Transmission System; and

d. The evaluation of potential actions by TSOs to mitigate constraints on the EAPP Interconnected Transmission System as set out in Operations Code No. 1 (OC 1).

As part of the Operational Planning process under OC 1, TSOs are required to make an assessment over various timescales of the NTC available on the interconnections between Control Areas and External Systems. This assessment is based on the commissioning of new facilities and on the Outages required for planned maintenance of generating and transmission facilities. TSOs are required to publish details of the NTC on the EAPP Website.

Where a constraint in the NTC is identified when carrying out Interchange Scheduling in any of the Operational Planning timescales, the TSOs concerned shall seek to reallocate the Interchange Schedule to Users in the following priority order:

a. Lowest priority will be energy exchanged as compensation for Inadvertent Deviations;
b. Energy transfers scheduled on a commercial basis by TSOs over and above the pre-emptive rights;

c. Energy transfers scheduled as a consequence of pre-emptive rights, and

d. Any agreements between TSOs for the provision of operating reserve

14.1.5.1 Annual Scheduling

By the end of September each year TSOs shall exchange data on the cross-border NTC for the following year (Year 1). The data shall be copied for information to the EAPP CC. The data shall also indicate the pre-emptive rights over the NTC held by the TSO on behalf of a User connected to its National System.

By the end of October each year, TSOs shall agree on the allocation of transmission capability and shall publish an Annual Interchange Schedule. This Interchange Schedule is indicative only and is used to advise Users of potential availability of power trading opportunities over and above those pre-emptive rights held by the TSO on behalf of a User connected to its National System.

14.1.5.2 Weekly Scheduling

Interchange scheduling on a weekly basis is carried out on a rolling eight (8) week cycle in accordance with OC 1 Section 8.1.9. Each Friday at 1000 Hr, TSOs shall agree the Interchange Schedule across their cross-border connections for the following eight (8) weeks, commencing at 0001 Hr on Monday of Week 1, including the following data:

a. Its forecast of interchange MW profiles on an hourly basis, based on the pre-emptive rights held at the time of issue of the data to the EAPP CC;

b. Confirmation of pre-emptive rights currently held on behalf of Users; and

c. Details of any changes to data included in the Annual Schedule issued under this chapter.

EAPP CC shall develop the Weekly Interchange Schedule to achieve the operating reserve requirements as set out in Chapter 15 (ISBC Chapter No. 2 - Balancing and Frequency Control), and shall finalise the NTC based on the data received from TSOs.

14.1.5.3 Daily Scheduling

On a daily cycle, TSOs shall carry out the process of revising progressively the Weekly Interchange Schedule. This process is phased and iterative to allow:

a. Appropriate interactions with Neighbouring Systems, EAPP CC and External Systems;

b. Identification of changes to constraints on the EAPP Interconnected Transmission System;

c. Forecasts of demand, and

d. The NTC of all interconnections between Control Areas, Neighbouring Systems and External Systems to be determined and properly allocated.
In accordance with Chapter 8 (Operations Code No. 1 – Operational Planning) at 1500 Hr each day, TSOs shall finalise the *Operational Plan* for use on the following day commencing at 0001 Hr. The *Operational Plan* shall be issued and published by the EAPP CC. In the case of the *Operational Plan* issued on a Friday, the Plan will cover the three (3) days commencing at 0001 Hr on the Saturday.

Apart from the information set out in OC 1, the *Operational Plan* will contain the following:

a. The NTC between each *Control Area, Neighbouring Systems* and *External Systems* and its allocation between *Users*;

b. The transfer in MW between each *Control Area, Neighbouring Systems* and *External Systems* on an hourly basis;

c. The Operating Reserve levels to be maintained within the TSO’s *National System* on an hourly basis;

d. The Operating Reserves contracted with other TSOs on an hourly basis and for which NTC has been reserved.

Any additional information that may be reasonably considered to be of relevance to the daily Schedule for that TSO shall be included. This may include:

a. Weather;

b. Voltage control issues;

c. System stability issues;

d. *System Tests* in accordance with Chapter 13 (Operations Code No. 6 - System Tests) to be carried out in another part of the *EAPP Interconnected Transmission System* which may compromise security of supply.

In real-time, neither the total of the schedules of individual *Users*, nor the actual power transfer between *Control Areas, Neighbouring Systems and External Systems* may exceed the NTC for that interconnection.

### 14.1.6 Adjustments to the Interchange Schedule

After the completion of the scheduling process, and the issuing of the Interchange Schedule, a TSO may consider it necessary to make adjustments to the transfers as determined by the scheduling process. Such adjustments could be made necessary by any of the following factors:

a. Changes to *Generating Unit* availability or demand reduction;

b. Changes to demand forecasts;

c. Changes to *EAPP Interconnected Transmission System* constraints, emerging from the system security assessment;

d. Changes to any conditions which in the reasonable opinion of a TSO or EAPP CC would impose an increased risk to the *EAPP Interconnected Transmission System* and would therefore require an increase in the operating reserves.
This chapter contains requirements specific to both the *EAPP IC* and the *KNTS*. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

### 15.1 EAPP IC Requirements

#### 15.1.1 Introduction

The frequency of a power system is an indicator of power balance between generation and the summation of demand and losses in the system. In the *EAPP Interconnected Transmission System*, this power balance is necessary to control system frequency and the power exchange between *Control Areas* and *External Systems*. In order to achieve this balance, each TSO shall ensure it has sufficient reserve capacity in order to maintain the interchange schedule within the *EAPP Interconnected Transmission System* and with *External Systems* and to control system frequency to meet the minimum standards under both normal and emergency conditions.

ISBC Chapter No. 2 - Balancing and Frequency Control, or ISBC 2, sets out the procedure which TSOs will use to direct frequency control. The frequency of the *EAPP Interconnected Transmission System* will be controlled by:

- a. Automatic response from synchronised *Generating Units*;
- b. The dispatch of *Generating Units* including *Automatic Generation Control (AGC)*;
- c. Response from interconnections with *External Systems*, and
- d. Demand control.

Frequency control is an Ancillary Service and TSOs shall contract for its provision in accordance with Chapter 16 (ISBC Chapter No. 3 - Ancillary Services), or ISBC 3.

#### 15.1.2 Objective

The objective of the ISBC 2 is to establish:

- a. Procedures to ensure adequate operating reserves are maintained by each TSO when connected to the *EAPP Interconnected Transmission System*;
- b. Procedures for the minimisation of *Area Control Error (ACE)*, and
- c. Procedures for the calculation and settlement of *Inadvertent Deviations* from scheduled interchanges.

#### 15.1.3 Operating Reserves

Operating reserves are the additional output from *Generating Units* or a reduction in demand which are realisable in real-time operation to contain and correct any frequency deviation on the *EAPP Interconnected Transmission System*. TSOs shall maintain at all times adequate operating reserves to control the frequency of the *EAPP Interconnected Transmission System* within the limits set out in
Section 6.1.4 (Connections), and to avoid sudden, unexpected loss of load following transmission or generation Contingencies. Operating reserves are also required to maintain agreed interchange schedules following changes in demand or generation.

The control of the frequency of EAPP Interconnected Transmission System is a multi-stage process. For every stage of control adequate reserves are needed. The Operating reserves have three components which are realisable in the following distinct timescales.

15.1.3.1 Primary Response

Primary Response is the automatic response by synchronised Generating Units to a rise or fall in the frequency of the EAPP Interconnected Transmission System requiring changes in the Generating Unit’s Active Power output, to restore the frequency to within operational limits. The response to a change in system frequency shall be fully available within ten (10) seconds of the frequency change and be sustainable for a further twenty (20) seconds.

Demand side also participates in Primary Response through the self-regulating effect of frequency-sensitive loads such as Induction Motors or the action of under frequency relays that disconnect some demand at given frequency thresholds.

15.1.3.2 Secondary Response

Secondary Response is a centralised automatic control that adjusts the Active Power production of Generating Units to restore the frequency and the interchanges with other Control Areas and with External Systems to their target values following a frequency deviation. Primary Response limits and arrests frequency deviations whilst Secondary Response restores the frequency to its target value.

Secondary Response is the automatic response to a frequency change which is fully available by thirty (30) seconds from the time of frequency change to take over from Primary Response, and which is sustainable for a period of at least thirty (30) minutes. Secondary Response is provided by Generating Units already synchronised to the EAPP Interconnected Transmission System and is normally controlled by the TSO by AGC where available.

Secondary Response replaces Primary Response within minutes. Once replaced, Primary Response is again available to cover any further incidents that cause frequency deviation from the EAPP Interconnected Transmission System target frequency.

15.1.3.3 Tertiary Reserve

Tertiary Reserve refers to TSO instructed changes in the dispatching and commitment of Generating Units. Tertiary Reserve is used to restore both Primary and Secondary Response, to manage constraints on the EAPP Interconnected Transmission System and to bring the frequency and the interchanges back to their target value when the Secondary Response has been depleted.

Where Tertiary Reserve is held on Generating Units not synchronised to the EAPP Interconnected Transmission System, the Units shall be capable of being synchronised within a specified time
generally between fifteen (15) minutes and one (1) hour. Non synchronised Tertiary Reserve could consist of, for example, fast start hydro and gas turbine Generating Units and steam turbine Generating Units on hot-standby.

Tertiary Reserve capability (ie hydro and gas turbines) in the EAPP Interconnected Transmission System is considered an Ancillary Service that is delivered when a Generating Unit is able to start up and synchronise or change its loading within the timescales specified by the TSO.

15.1.4 Distribution of Operating Reserves

Operating reserves shall be distributed evenly throughout the EAPP Interconnected Transmission System on Generating Units in operation. Possible EAPP Interconnected Transmission System constraints shall be taken into account by the TSOs and EAPP CC in the reserve calculation, in order to avoid a limitation in case of activation of operating reserves.

TSOs shall monitor operating reserves continuously, particularly after a loss of generation or demand and shall re-establish the required amount of reserve as soon as practicable, in order to protect against a further Contingency and to avoid endangering the EAPP Interconnected Transmission System.

15.1.5 Primary Response

The amount of Primary Response to be provided on the EAPP Interconnected Transmission System shall be equal to the capacity of the largest Generating Unit connected to the system.

In calculating the amount of Primary Response required the demand-frequency response within the Control Area or National System shall be taken into account. For initial calculations the demand-frequency response can be assumed to be 1%/Hz i.e. a load decrease of 1% following a frequency drop of 1 Hz.

Each TSO is responsible for calculating its demand-frequency characteristic in response to a disturbance (loss of a Generating Unit), based on measurements of the system frequency and other key values and on a statistical analysis.

15.1.5.1 Control Area Contribution Coefficient

Each Control Area shall contribute to the correction of a frequency deviation in accordance with its respective contribution coefficient for Primary Response.

The Contribution Coefficient is the ratio of the energy generated within one year in the relevant Control Area to the total energy generated in the EAPP Interconnected Transmission System.

The contribution coefficients shall be determined by the EAPP Sub-Committee on Operations and published annually on January 1 for each Control Area. The contribution coefficients are binding for the corresponding Control Area for the following calendar year.
Each Control Area must contribute to the Primary Response as required. The respective shares are defined by multiplying the required Primary Response for the EAPP Interconnected Transmission System by the contribution coefficient of the Control Area.

The actual Primary Responses shall be monitored in real-time by TSOs and the EAPP CC.

15.1.5.2 Accuracy of Frequency Measurements
For Primary Response purposes, the accuracy of frequency measurements used in the primary controllers must be better than or equal to 10 mHz.

The insensitivity range of primary controllers shall not exceed ±10 mHz. Where dead bands exist in specific controllers, these must be reduced as much as possible.

15.1.6 Secondary Response
Each TSO shall operate sufficient Generating Units under AGC:

a. To continuously balance its generation and interchange schedules to its demand, and;
b. To provide its contribution to EAPP Interconnected Transmission System Secondary Response as specified below.

15.1.6.1 AGC Requirements
AGC shall continuously compare:

a. Total net actual interchange adjusted for actual frequency and;
b. Total net scheduled interchange adjusted for target frequency, to determine the ACE and respond by adjusting generation output to reduce the ACE to zero.

Each TSO shall provide adequate Secondary Response by AGC to regulate interchange and frequency and shall operate its AGC in tie-line bias mode, unless such operation is adverse to the reliability of the EAPP Interconnected Transmission System.

Secondary Response shall only be used to correct an overall system deviation and shall not be used to minimise unintentional electricity exchanges or to correct other imbalances.

15.1.6.2 Data Recording
Each TSO and the EAPP CC shall have appropriate equipment installed for the recording of all values needed for monitoring the response of secondary controllers (AGC) and for analysis of frequency events in the EAPP Interconnected Transmission System.

15.1.7 Tertiary Reserve
Tertiary Reserve is usually activated manually by TSOs in case of observed or expected sustained activation of Secondary Response. It is primarily used to release Secondary Response in a balanced system situation, but it is also activated as a supplement to Secondary Response after larger
frequency deviations to restore the frequency and consequently free the system wide activated Primary Response.

TSOs shall, therefore, immediately activate Tertiary Reserve in case of large imbalances between generation and demand and or for the restoration of sufficient Secondary Response.

Tertiary Reserve can include the following:

a. That part of the reserve of Generating Units operating in parallel with the EAPP Interconnected Transmission System but which has not been included in the Primary and Secondary Response;

b. Generating Units that can be synchronised and loaded within specified timescales;

c. Demand control that can be implemented on the instructions of the TSO within specified timescales;

d. Standby capacity in other TSO National Systems that can be made available upon request and for which adequate NTC exists.

The amount of Tertiary Reserve required at the day ahead and in subsequent timescales shall be determined by each TSO on the basis of historical trends in the reduction in availability of Generating Units and increases in forecast demand up to real-time operation.

As a minimum each TSO shall arrange at least enough Tertiary Reserve to cover the loss of the largest Generating Unit on its National System.

15.1.8 Accounting for Inadvertent Deviations

15.1.8.1 Introduction

During daily operation, the interchange schedules are followed by means of AGC installed in each Control Area. Notwithstanding AGC, Inadvertent Deviations invariably occur in energy exchanges. For this reason, it is necessary to co-ordinate the interchange schedule between TSOs, observe in real-time Inadvertent Deviations from the schedules and co-ordinate accounting and calculate the compensation programmes to balance unintentional deviations.

Inadvertent Deviations in the EAPP Interconnected Transmission System shall be balanced by the import or export of an equal number of MWh at the same hours on the same day of the following week.

The measurement and accounting for Inadvertent Deviations shall be carried out using metering equipment installed in accordance with the metering codes as described in Chapter 17 (Kenya Metering) and Chapter 18 (Interconnection Metering).

15.1.8.2 Recording and Compensation Periods

The standard recording period comprises seven (7) days (one week), from Monday 0001 Hr to Sunday 2400 Hr.
The standard compensation period comprises seven (7) days (one week), from Thursday 0001 Hr to Wednesday 2400 Hr. In case of holidays or for other reasons, exceptions to this rule may apply. In any case a compensation period shall last at least four (4) days and shall commence three (3) business days after the end of the corresponding recording period.

15.1.9 HVDC Interconnections

TSOs shall ensure that each HVDC interconnection is fitted with a fast acting control device to provide frequency response under normal and emergency operating conditions. The control device must be designed and operated to contribute to frequency control by continuous modulation of Active Power supplied to the EAPP Interconnected Transmission System.

The settings and other parameters of each HVDC Interconnection shall be determined by the relevant TSOs and the EAPP Sub-Committee on Operations.

15.2 Kenya National Transmission Grid Code Requirements

The Kenya National TSO shall balance supply and demand in real time through the implementation of the energy schedules and utilisation of Ancillary Services based on the normal and abnormal conditions as described below.

15.2.1 Description of Normal Conditions

a. The control area is considered to be under normal conditions when:
   1. The immediate demand can be met with the available scheduled resources, including any Contingency resources; and
   2. The ACE deficit does not exceed the available reserves for longer than ten (10) minutes; and
   3. The frequency is not less than 49.8 Hz for longer than ten (10) minutes; and
   4. The frequency is within the range 49.5 to 50.5 Hz; and
   5. The interconnections are intact; and
   6. There are no security and safety violations

b. The control area is considered to be under abnormal conditions if it is not in a normal condition as defined above.

15.2.2 Requirements for Maintaining Normal Conditions

The Kenya National TSO shall maintain the system frequency between 49.7 and 50.2 Hz. Excursions outside of this range will be permitted for no more than 1.25% of the time, to be checked on a quarterly basis. The Kenya National TSO shall maintain voltage on the KNTS within +/- 10% of nominal.
15.2.3 Operation during Abnormal Conditions

a. When abnormal conditions occur, corrective action shall be taken, until the abnormal condition is corrected.

b. Possible corrective action includes both supply-side and demand-side options. Where possible, warnings shall be issued by the *Kenya National TSO* on expected utilisation of any *Contingency* resources.

c. Termination of the use of emergency resources shall occur as the plant shortage situation improves and after frequency has returned to normal.

d. During emergencies that require load shedding, the request to shed load shall be initiated in accordance with agreed procedures prepared and published by the *Kenya National TSO*.

e. Automatic under-frequency systems shall be kept armed at all times.

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<table>
<thead>
<tr>
<th>Condition for Usage</th>
<th>Resources in Default Order of Usage</th>
</tr>
</thead>
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<tr>
<td><strong>Warnings</strong></td>
<td></td>
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</table>
| When a shortfall in supply is expected to occur, issue warnings in sequence until sufficient capacity is obtained to cover the shortfall | *Emergency generation warning*  
*Interruptible load shedding warning* |
| Generation deficit foreseen with load shedding expected | *Warning to RCCs* |
| **Gradual frequency decline – refer to merit order in control room for order of use** |                                     |
| **CONDITION FOR USAGE** | **RESOURCES IN DEFAULT ORDER OF USAGE** |
| If frequency falls below 50 Hz and an abnormal condition exists, the *Kenya National TSO* shall apply resources in the order most suitable to ensure system security depending on the conditions existing at the time | a. Run all available units at *Maximum Continuous Rating*  
b. Dispatch emergency capacity according to *Kenya National TSO* merit order, voltage profiles, and equipment loading |

<table>
<thead>
<tr>
<th>Rapid Frequency Decline - Automatic Operation by Under-frequency Relays – Apply in Order</th>
<th>RESOURCES IN ORDER OF USAGE</th>
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</thead>
<tbody>
<tr>
<td><strong>CONDITIONS FOR USAGE</strong></td>
<td><strong>RESOURCES IN ORDER OF USAGE</strong></td>
</tr>
<tr>
<td>a. ( F &lt; 49.2 \text{ Hz} )</td>
<td>a. Stage 1 loads shed on select feeders* at 74 MW / 33 MW (Peak / Off-Peak)</td>
</tr>
<tr>
<td>b. ( F &lt; 48.9 \text{ Hz} )</td>
<td>b. Stage 2, 88 MW / 51 MW (Peak / Off-Peak)</td>
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<tr>
<td>c. ( F &lt; 48.6 \text{ Hz} )</td>
<td>c. Stage 3, 130 MW / 62 MW (Peak / Off-Peak)</td>
</tr>
<tr>
<td>* Target loads from planning analysis. Actual load reductions will depend on conditions.</td>
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<tr>
<td>Frequency Restoration after Rapid Decline</td>
<td></td>
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<tr>
<td>-------------------------------------------</td>
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<tr>
<td>By the <em>Kenya National TSO</em></td>
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<tr>
<td>Take restoration action as soon as possible after under frequency relays have operated</td>
<td></td>
</tr>
</tbody>
</table>
This chapter contains requirements specific to both the EAPP IC and the KNTS. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

16.1 EAPP IC REQUIREMENTS

16.1.1 Introduction

The Ancillary Services Chapter (ASC), or ISBC 3, deals with the provision of Ancillary Services used to describe those services that must be exchanged among generation resources and TNSPs to operate the EAPP Interconnected Transmission System in a reliable fashion and allow separation of generation, transmission, and distribution functions.

The ASC defines those services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the EAPP Interconnected Transmission System in accordance with Prudent Utility Practice. These Ancillary Services are required to ensure that TSOs meet the obligations and responsibilities under the Interconnection Code for a safe secure and reliable operation of the EAPP Interconnected Transmission System.

The ASC does not cover the commercial arrangements between TSOs and Ancillary Service providers for the provision of Ancillary Services. Such arrangements are the subject of bilateral agreements.

16.1.2 Objective

The objective of this section is to define the Ancillary Services to be provided by TSOs to support the transmission of energy across the EAPP Interconnected Transmission System and to maintain reliable operation.

16.1.3 Categories of Ancillary Services

The operation of EAPP Interconnected Transmission System requires the provision by TSOs of the following Ancillary Services grouped into three major categories:

a. Frequency Control;
b. Network Control, and
c. System Restart Capability.

The above Ancillary Services are the traditional mechanisms to provide the required capability in relation to:

a. Operating Reserves;
b. Demand Control;
c. Voltage Control
d. Power Flow Control;
16.1.3.1 Frequency Control

Frequency control Ancillary Services are used by TSOs to maintain the frequency on the EAPP Interconnected Transmission System within the limits set out in the CC. The Ancillary Service is necessary to provide for the continuous balancing of resources (generation and scheduled interchange) with load and to maintain the frequency of the EAPP Interconnected Transmission System at 50 Hz.

In general, frequency control action can be provided at any location within the EAPP Interconnected Transmission System. However, when transmission facilities are operating at or near their limits, sufficient control action is needed on each side of the limiting facility to prevent overloading of the facility.

TSOs are required to provide the following frequency control Ancillary Services:

a. **Primary Response of Generating Units** in accordance with Section 6.1.8 of Chapter 6 (Connections) and Section 15.1.3 of Chapter 15 (ISBC Chapter No. 2 - Balancing and Frequency Control – Operating Reserves). This Ancillary Service is being delivered if the Generating Unit is responding to changes in frequency within ten (10) seconds and is able to sustain the response for a further twenty (20) seconds;

b. **Secondary Response of Generating Units** in accordance with Chapter 9 (Operations Code No. 2 – Operational Security) and Section 15.1.3 of Chapter 15 (ISBC Chapter No. 2 – Balancing and Frequency Control). This Ancillary Service is provided by AGC and is being delivered if the Generating Unit’s output is correctly responding to signals sent from the TSO’s AGC equipment in response to changes in frequency;

c. **Tertiary Reserve** in accordance with OC 2 and ISBC 2. This Ancillary Service is being delivered when a Generating Unit is able to start up and synchronise or change its loading within the timescales specified by the TSO;

d. **Demand control** in accordance with the provisions of OC 5, Chapter 12 (Operations Code No. 5 – Demand Control). This service is being delivered if: (1) Demand can be automatically disconnected in response to an under frequency condition (Automatic Load Shedding); or (2) Demand can be disconnected on request from the TSO (Emergency Manual Load Shedding). Emergency Manual Load Shedding Ancillary Service can be provided by industrial load, commercial load, residential load or hydro Generating Units operating as pumps.

Sufficient control range should be available at all times to control frequency within the limits specified in Chapter 6 (Connections) under various circumstances including unexpected load and generation changes.
16.1.3.2 Network Control

Network control Ancillary Services are primarily used to:

a. Control the voltage at different points of the electrical network within the prescribed standards;

b. Control the stability of the EAPP Interconnected Transmission System, and

c. Control the power flow on network elements to within the physical limitations of those elements.

In accordance with the voltage standards set out in Chapter 6 (Connections), TSOs shall control system voltages within specific ranges. One method of controlling voltages on the EAPP Interconnected Transmission System is through the dispatch of voltage control Ancillary Services. Under these Ancillary Services, Generating Units absorb or generate Reactive Power from or onto the EAPP Interconnected Transmission System and control the local voltage accordingly. Voltage control requirements are location dependent because of technical limitations inherent in transporting Reactive Power.

Stability control services are required to prevent instability following a Contingency which is more severe than defined for the purposes of determining NTC. Stability control can be achieved by Generating Units which can rapidly respond to a control signal to increase or decrease generation. This network Ancillary Service is being delivered if the EAPP Interconnected Transmission System remains stable after any Contingency (N-1) and oscillations are damped out. Remedial Action Schemes (RAS) are considered to be a network control Ancillary Service. Power flows on the EAPP Interconnected Transmission System shall be maintained within the NTC limits, as imposed by thermal ratings, stability, and voltage. In the event of a Contingency (N-1), equipment loadings should not exceed short-term ratings, but may exceed long-term ratings provided the loadings can be reduced to within the long-term ratings in an appropriate time period by either manual or automatic means. It is proposed to obtain network loading Ancillary Services by superimposing signals on the AGC and by emergency manual load shedding.

16.1.3.3 System Restart

Black-Start Ancillary Services are required to enable the system to be restarted following a Total or Partial System Shutdown. Following consultation with EAPP CC, TSOs shall arrange for appropriate Generating Units to provide this Ancillary Service in accordance with the provisions of Chapter 6 (Connections) and Chapter 10 (Operations Code No. 3 – Emergency Operations), or OC 3.

16.1.3.4 Ancillary Services Requirements

The amount and location of Ancillary Services will be determined by EAPP CC and TSOs as part of the Operational Planning Process in the Programming and Control Phases. The commitment of Ancillary Services in an operational situation, however, is the responsibility of individual TSOs.

TSOs may also contract for Ancillary Services with other TSOs. All such contracts shall be notified to EAPP CC.
16.2 **Kenya National Transmission Grid Code Requirements**

The *Kenya National TSO* shall follow the procedure as described in the ISBC Chapter 15 for directing frequency control and power balance.

The *Kenya National TSO* shall be responsible for the provision of all short-term reliability services for the *KNTS*. These include restoration, the balancing of supply and demand, as well as the provision of quality voltages and the management of the real-time technical risk.

The *Kenya National TSO* shall certify providers of *Ancillary Services* and keep a register of all certified providers.

The *Kenya National TSO* shall determine reliability targets for the purposes of acquiring *Ancillary Services* in consultation with relevant *Users*.

The *Kenya National TSO* shall be responsible for procuring the required *Ancillary Services* as appropriate, in accordance with the licence and market rule. The *Kenya National TSO* shall state opportunities for the provision of *Ancillary Services* as identified.

The various *Ancillary Services* that can be used by the *Kenya National TSO* are described below:

- **a. Reserves as defined in Section 16.1 of this chapter**
- **b. Black Start and unit islanding**
- **c. Reactive Power supply and voltage control from units**

### 16.2.1 Operating Reserves

Operating reserves are required to secure capacity that will be available for reliable and secure balancing of supply and demand within ten (10) minutes and consistent with energy restrictions. Operating reserves shall consist of *Spinning Reserve, Regulating Reserve* and *Tertiary Reserve*. The total reserve make-up is described below.

#### 16.2.1.1 Spinning Reserve

The provision of *Spinning Reserve* is a *Primary Response*.

The *Kenya National TSO* shall ensure *Spinning Reserve* is available as needed to arrest the frequency at acceptable limits following a *Contingency*, such as a unit trip or a sudden surge in load.

#### 16.2.1.2 Regulating Reserve

The provision of *Regulating Reserve* is a *Secondary Response*.

*Regulating Reserve* is reserve that is under centralized AGC and can respond within ten (10) seconds and be fully active within thirty (30) seconds of activation and be sustained for thirty (30) minutes.
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This reserve is used for second-by-second balancing of supply and demand. The reserve is also used to restore *Spinning Reserve* within ten (10) minutes of the disturbance.

16.2.1.3 Tertiary Reserve

*Tertiary Reserve* is consistent with the EAPP definition of *Tertiary Reserve*.

*Tertiary Reserve* is required to balance supply and demand for changes between the day-ahead and real time such as load forecast errors and unit unavailability. *Tertiary Reserve* is used to restore *Regulating Reserve* when required.

The amount of reserve required is to be calculated by the *Kenya National TSO* and shall be based on *EAPP* minimum requirements and other reserve considerations.

16.2.2 Black Start and Generating Plant Islanding

Islanded *Generating Plants* shall be capable of running in the islanded state for at least two (2) hours before reconnecting to the network.

All units capable of *Generating Plant* islanding are required to contract the service provision to the *Kenya National TSO*. The *Kenya National TSO* shall certify units capable of islanding.

To ensure optimal operation of the *KNTS*, the *Kenya National TSO* may deploy system islanding schemes on the network, e.g. an out-of-step tripping scheme.

The *Kenya National TSO* shall determine the minimum requirements for each Black Start supplier and ensure that the contracted suppliers are capable of providing the service.

16.2.3 Reactive Power Supply and Voltage Control from Units

Voltage control and the supply or consumption of *Reactive Power* are inter-related in the sense that the voltage is affected by changes in the *Reactive Power* flow. System stability depends on the voltage profile across the system. In view of these considerations it is necessary from time to time to employ certain power stations to supply or consume *Reactive Power*, provided that the unit is not required to operate outside of its effective capability diagram for the purpose of voltage control.

The *Kenya National TSO* shall control the amount of *Reactive Power*. This may be done directly through the *Energy Management System* or by telephone.

When a unit is generating or pumping, *Reactive Power* supply is mandatory in the full operating range as specified.
17.1 Kenya National Transmission Grid Code Requirements

The metering requirements of the *EAPP IC* deal exclusively with the metering of each point of interchange of energy between *Control Areas*. The metering requirements of the *KNTGC* deal primarily with metering points that do not have exchanges between *Control Areas*. The metering requirements of the two codes have many areas of similarity.

To avoid confusion regarding the two chapters that deal with metering, they have different names. The name of the metering chapter based on the *EAPP IC* is the Interconnection Metering Chapter (IMC), Chapter 18 of the *KNTGC*, and the name of the metering chapter applicable specifically to the *KNTS* is the Kenya Metering Chapter (KMC), this chapter of the KNTGC.

The IMC deals with metering of each point of interchange of energy between *Control Areas* and is not concerned with Metering of *Connection Points* between *Users* and National Systems.

The KMC deals primarily with metering entirely within Kenya, to which the IMC does not apply. The KMC also includes each metering point connecting Kenya’s networks to a neighbouring country. The IMC applies to those inter-country connections.

Appendix B provides a complete list of standards that shall apply to *Metering Equipment*.

17.1.1 Introduction

The Kenya Metering Chapter (KMC) specifies the minimum technical, design and operational criteria to be complied with for the metering of each *Connection Point* of a *User* to the Kenya National Transmission System.

a. This chapter ensures a metering standard for all current and future *Users*. It specifies metering requirements to be adhered to, and clarifies levels of responsibility.

b. Wherever applicable, the code of practice for electricity metering shall follow nationally adopted metering standards currently in place that include KS IEC 62053, KS IEC 62054, KS IEC 62056 and KS IEC 62059 as appropriate. The *Regulatory Authority* however reserves the right to override specifications should it find them inadequate or divergent from the principles of the *KNTGC*.

17.1.2 Scope

The Kenya Metering Chapter addresses the following:

a. Application;

b. Principles and responsibility;

c. Installations and testing;

d. Database, data validation, verification and inconsistencies;
17.1.3 Application of the Kenya Metering Chapter

a. This chapter shall apply to all Users in respect of any metering point of the Kenya National Transmission System.

b. This chapter sets out provisions relating to:
   1. Main Metering installations and Check Metering installations used for the measurement of Active and Reactive Energy;
   2. The collection of metering data;
   3. The provision, installation and maintenance of equipment;
   4. The accuracy of all equipment used in the process of electricity metering;
   5. Testing procedures to be adhered to;
   6. Storage requirements for metering data;
   7. Competencies and standards of performance; and
   8. The relationship of entities involved in the electricity metering industry.

17.1.4 Principles of the Kenya Metering Chapter

a. The following points shall have a metering installation:
   1. Each Point of Supply connecting a Distribution Licensee or End-use User to the Kenya National Transmission System.
   2. Each Connection Point between a Generating Plant or a Distribution Licensee and the Kenya National Transmission System.
   3. Each point connecting Kenya’s networks to a neighbouring country.

b. Items 17.1.4(a).1 and 17.1.4(a).2 shall not be subject to the requirements of the IMC. Item 17.1.4 (a).3 shall meet all metering requirements specified in the EAPP IC.

c. The type of metering installation at each metering point shall comply with IEC metering specifications.

d. Each metering point shall be installed with Main and Check Metering where practical and economical. Customers with a maximum demand of at least 5 MVA shall have Main and Check Metering, with the same accuracy as of the main Meter. All CTs and VTs installed after the implementation of the KNTGC shall have separate Main and Check CT and VT cores.

e. A metering point shall be located as close as practicable to the Connection Point. A metering point may be located at a point other than the Connection Point or the Point of Supply by mutual agreement between applicable Users.

f. Customers may request the installation of their own separate Check Meters. Any extra costs shall be borne by the requesting Party. The Transmission Metering Administrator (TMA) shall install and control such Meters.
17.1.5 Responsibility for Metering Installations

a. For the purposes of this chapter, the TNSP who is the owner of the Meter shall perform the role of the Transmission Metering Administrator (TMA).

b. The TNSP shall be responsible for ensuring that all points identified as metering points in accordance with Sections 17.1.3 and 17.1.4 in this chapter have metering installations.

c. The TMA shall be responsible for managing and collecting metering information.

d. Users connected to or wanting to connect to the Kenya National Transmission System shall provide the TMA with all information deemed necessary to enable performance of its metering duties.

e. In case of a material difference in location between the metering point and Connection Point, an adjustment for losses between these two points shall be calculated and agreed upon by the Transmission Metering Administrator (TMA) and the Customer.

f. The TMA shall ensure that an adequate level of security is applied to the metering system with appropriate seals that will only be broken in the presence of the TMA unless agreed otherwise.

g. In the event of a metering installation being positioned between two TNSPs, the following shall apply:

1. Both TNSPs shall be responsible for installing and maintaining the metering installation in accordance with the requirements of this chapter.

2. All costs related to this metering installation shall be borne by both TNSPs.

3. The TNSPs shall ensure that the TMA is given remote/electronic access to the metering installation. Should access to the metering installation compromise the Security of the installation, then metering data shall be supplied to the TMA on a daily basis in an appropriate format.

17.1.6 Metering Installation Components

a. The following principles shall apply to all metering installations:

1. The Meter(s) or recorder(s) shall be able to store data in memory for forty (40) days or more.

2. Data stored in either a Meter or a recorder shall be remotely (where possible) and locally retrievable.

3. A Meter shall be remotely interrogated on a daily basis where possible or as mutually agreed by the affected Users.

4. A Meter shall be visible and accessible, but such access shall be restricted to authorised access only. Data for Customers shall be historical data situated on a secure server. As and when required, metering impulses shall be provided.

5. A telecommunications medium shall be connected to the Meter/recorder where possible.

6. The Meter data retrieval process shall be a secure process whereby Meters or recorders are directly interrogated to retrieve billing information from their memories.

7. The accuracy of Meters and recorders shall be in accordance with the minimum requirements of IEC standards.
8. Commissioning of the metering installation and metering data supporting systems shall take place in accordance with the requirements of KS IEC 62056 and/or other IEC, IEEE, or currently existing local prevailing standards.

9. Both *Active and Reactive Energy* shall be measurable without compromising any requirements of this chapter.

10. The *Meters* shall accurately measure both *Active and Reactive Energy* flow in both directions in accordance with IEC standards.

11. The *Meters* shall be configured to store/record metering data in half-hourly integration periods.

b. In the event of a metering installation being used for purposes other than metering data
   1. Such use shall not in any way obstruct metering data collection and accuracy requirements;
   2. The secondary use shall be communicated to all *Users* who may be affected by the secondary use of the installation;
   3. No secondary user shall interfere with *VT/CT* circuitry.

c. *Metering* installations shall be audited in accordance with *KS IEC standards* or equivalent.

17.1.7 Data Validation and Verification

17.1.7.1 Data Validation

Data validation shall be carried out in accordance with KS IEC standards.

In the event of electronic access to the *Meters* not being possible, an emergency bypass or other scheme having no metering system, or *Metering* data not being available, the following options may be resorted to by the *TMA*:

a. Manual *Meter* data downloading;
   b. Estimation or substitution subject to mutual agreement between the affected parties;
   c. Profiling;
   d. Reading of the *Meter* at scheduled intervals.

In the event of an estimation having to be made, the following shall apply:

a. A monthly report shall be produced for all estimations made.
   b. No estimation shall be made on three (3) or more consecutive time slots, and if such estimation had to be made, the *TMA* shall ensure that the *Meter* readings are downloaded for the billing cycle.
   c. Any logs on data estimation shall be kept for the entire period of data retention. Five (5) years' data retention shall be made available.

Not more than ten (10) slots may be estimated per Meter point per month. If such estimation had to be made, the *TMA* shall ensure that the *Meter* readings are downloaded for the billing cycle.
Meters needing three (3) or more consecutive estimations or a total of ten (10) or more estimations in a month shall be tracked for problems needing attention.

17.1.7.2 Meter Verification

In addition to the verification requirements, Meter readings shall be compared with the metering database at least once a year.

17.1.8 Metering Database

a. The TMA shall create, maintain and administer a metering database containing the following information:
   1. Name and unique identifier of the metering installation
   2. The date on which the metering installation was commissioned
   3. The connecting parties at the metering installation
   4. Maintenance history schedules for each metering installation
   5. Telephone numbers used to retrieve information from the metering installation
   6. Type and form of the Meter at the metering installation
   7. Fault history of a metering installation
   8. Commissioning documents for all metering installations

b. Information relating to raw and official values shall form part of the metering database and shall be retained for at least five (5) years for audit trail purposes.

17.1.9 Testing of Metering Installations

a. Commissioning, auditing and testing of metering installations shall be done in accordance with the KS IEC metering specifications.

b. Any User may request to the Kenya National TSO and/or the Regulatory Authority that testing of a metering installation be performed. Such a request shall not be unreasonably refused. The costs of such test shall be for the account of the requesting User if the Meter is found to be accurate and to the account of the TMA if the Meter is found to be inaccurate. If errors are found with the metering after testing or auditing, the requesting User’s account will be adjusted according to the rectified Data.

17.1.10 Metering Database Inconsistencies

In the event of testing revealing that data in the metering database is inconsistent with the data in the Meter, the TMA shall inform all affected Users and corrections shall be made to the official metering data in all the impacted areas.

17.1.11 Access to Metering Data

a. Metering data shall be accessed through a central database that shall store all Customer information.

b. The TMA shall control access to all metering installations.
c. No electronic access to the *Meters* shall be granted to the *Customer* or any other *Party* unless special permission has been granted by the *Regulatory Authority*.

d. Schedules for accessing metering data from the central database shall be administered by the *TMA* in line with IEC specifications.

e. All Security requirements for metering data shall be as specified in KS IEC 62056.

17.1.12 Confidentiality

*Metering* data and passwords are confidential information and shall be treated as such at all times.

17.1.13 Customer Query on Metering Integrity and Metering Data

If a *User* has a query or complaint related to metering, the relevant *TMA* shall comply with the applicable requirements as per KS IEC 62056.
18.1 EAPP IC REQUIREMENTS

The metering requirements of the *EAPP IC* deal exclusively with the metering of each point of interchange of energy between *Control Areas*. The metering requirements of the *KNTGC* deal primarily with metering points that do not have exchanges between *Control Areas*. The metering requirements of the two Codes have many areas of similarity.

18.1.1 Introduction

The Interconnection Metering Chapter (IMC) specifies the minimum technical, design, and operational criteria to be complied with for the metering of each point of interchange of energy between *Control Areas*. The metering at the *Interchange Point* is required for real-time operation of *AGC* systems and for the accounting of *Inadvertent Deviations* in accordance with the Chapter 15 (ISBC Chapter No. 2 - Balancing and Frequency Control). The IMC also specifies the associated Data Collection and the related metering procedures required for the operation of the *EAPP Interconnected Transmission System*.

The IMC is not concerned with:

a. *Metering of Connection Points* between *Users* and *National Systems*, and
b. *Metering* for commercial purposes.

These metering systems are subject to National Grid Codes or Regulations and or Power Purchase Agreements.

18.1.2 Objectives

For the metering of the interconnections between *Control Areas* of the *EAPP Interconnected Transmission System* and between *Control Areas* and *External Systems*, the IMC specifies the conditions governing the following:

a. Technical, design and operational criteria;

b. Accuracy and calibration;

c. Approval, certification and testing, and

d. Meter reading and data management

18.1.3 Technical Design and Operational Criteria

*Metering* equipment shall be installed and maintained to measure and record the hourly *Active and Reactive Energy* and *Active and Reactive Power* transferred to and from a *Control Area* at its *Interconnection Point (IP)* with other *Control Areas* and or *External Systems*. This *Metering* Equipment will be the primary source of data for *TSOs* to operate *AGC* systems in real-time and to account for *Inadvertent Deviations*. 
TSOs are responsible for the maintenance and operation of the Metering Equipment at each IP and shall be responsible for the initial design, installation, testing and commissioning of the Metering and Check Metering Equipment.

Main and Check Metering Equipment procured, installed, operated and maintained for the purpose of the IMC shall meet the standards of accuracy and calibration in relation to Meters and Metering Equipment as set out in this IMC.

18.1.3.1 General Technical Criteria

This section defines the general technical requirements for the Metering Equipment for the measurement and recording of electricity transfers on the interconnections between Control Areas and between Control Areas and External Systems. The provisions of the IMC shall apply equally to Main and Check Meters.

TSOs and the EAPP CC shall establish metering related policies, procedures and standards in support of the IMC including, but not limited to registration, testing and calibration, sealing, loss adjustments, data security, inspection, testing and audit of Metering Equipment and measurement error correction.

18.1.4 Metering Information Register

EAPP CC shall maintain a Meter Information Register of all Meters at Defined Metering Points (DMPs). This register will contain, but not be limited to:

a. A unique Meter identification/serial number;

b. Location of the Main Meters, Check Meters and Metering Equipment including metering data recording systems;

c. The identification of the TSO concerned;

d. Meter manufacturer, type and model;

e. The specification of Metering Equipment including accuracy class;

f. The adjustment factors including circuit losses to be applied;

g. Date of installation; and

h. Calibration certificate.

18.1.5 Main and Check Metering

At all DMPs Main and Check Metering shall be provided. Main and Check Meters shall operate from separate Current Transformer (CT) and Voltage Transformer (VT) windings. All Check Meters shall meet the standards specified in the IMC as if they were the only Metering Equipment at the DMP.

CT and VT windings and cables connecting such windings to Main Meters shall be dedicated for such purposes and such cables and connections shall be securely sealed.
CT and VT windings and cables connecting such windings to Check Meters may be used for other purposes provided the overall accuracy requirements are met and evidence of the value of the additional burden is available for inspection by or on behalf of the EAPP Independent Regulatory Board.

The Main Meter, Check Meter and additional burdens shall have separately fused VT supplies.

18.1.6 Measurement Parameters

For each DMP, the Metering Equipment shall be capable of measuring the following parameters in both import and export directions: MW, Mvar, MWh and Mvarh.

18.1.7 Metering Equipment Standards

All Metering Equipment shall comply with the provisions set out in the IMC. These provisions may be revised from time to time in accordance with the provision set out in Chapter 3 (General Conditions) to take account of changing technologies or new requirements of the electricity industry.

A CT in accordance with IEC 60044-1 and a VT, in accordance with IEC 60044-2 shall be provided for metering as required.

Where a combined unit measurement transformer (VT & CT) is provided the “Tests for Accuracy” in Clause 8 of IEC Standard 60044-3 covering mutual influence effects shall be met.

All Meters shall include a non-volatile meter register for each measured quantity. The Meter register(s) shall not rollover more than once within the normal Meter reading cycle.

18.1.8 Equipment Accuracy and Error Limits

The accuracy of the various items of Metering Equipment shall conform to the relevant IEC standards or equivalent national standards where agreed between the EAPP CC and the TSO concerned. The accuracy limits set out in the IMC shall be applied after adjustments have been made to Metering Equipment to compensate for any errors due to secondary equipment and connections.

Meters shall be calibrated by an independent calibrating agency approved by the EAPP Independent Regulatory Board for this purpose. The agency shall provide a calibration certificate with expiry date of the calibration.

Where combined instrument transformers to IEC60044-3 are used they shall meet the accuracy requirements of IMC Sections 18.1.9.1 and IMC 18.1.9.2 in this chapter.

18.1.8.1 Voltage Transformers (VT)

The VTs shall be of 0.2 Accuracy Class and comprise three (3) single phase units, each of which complies with:

a. IEC Standard 60044-2: Instrument Transformers - Part 2: Inductive Voltage Transformers,
b. **IEC Standard 60044-5 Part 5: Capacitor Voltage Transformers for metering.**

The voltage drop in each phase of the VT connections will be such as to maintain the same accuracy and class and shall not exceed 0.2 Volts. The VT shall be connected through appropriate isolation and test facilities to the Meter with a total burden that shall not affect the accuracy of measurement.

### 18.1.8.2 Current Transformers (CT)

The CTs shall be of 0.2 accuracy class and comprise three (3) units for a three phase set, each of which complies with the **IEC Standard 60044-1: Instrument Transformers-Part 1: Current Transformers** for metering.

The CT's rated secondary current shall be either 1 or 5 Amperes. The neutral conductor shall be effectively grounded at a single point and shall be connected to the Meter and other series technical equipment via separate “bridge type” isolation and test facilities with a total burden that shall not affect the accuracy of measurement.

### 18.1.8.3 Meters

*Meters* shall be of the three-element type independent for each phase, rated as appropriate and shall comply with **IEC Standard 62052-11: Electricity Metering Equipment (AC) - General requirements, tests, and testing conditions for static watt-hour Meter and other types of Meters**, and shall be of the accuracy class of 0.2 or better.

The Meters shall measure and locally display at least the MW, MWh, Mvar, Mvarh, and cumulative demand, with additional features such as time-of-use, maintenance records and power quality monitoring. *Meters* shall be digital unless agreed otherwise by EAPP CC. A cumulative register of the parameters measured shall be available on the internal storage facilities of the digital meters for a minimum of thirty (30) calendar days with one (1) hour values. Bi-directional *Meters* shall have two such registers available.

The loss of auxiliary supply to the *Metering* Equipment shall not erase these registers. The Meter registers shall be readable by both the TSO’s SCADA and by the DCS of EAPP CC. Where data storage is not provided internally it shall be provided externally to the *Metering* Equipment by way of a data logger which summates the pulse outputs of the *Meters*. The internal registers of these devices shall provide a register per measured quantity that can be interrogated by the TSO’s SCADA system and by the DCS of EAPP CC.

### 18.1.9 Inspection, Calibration and Testing

#### 18.1.9.1 Initial Calibration

All new meters shall undergo relevant certification tests and initial calibration of *Meters* shall be performed in a recognised test facility. These tests shall be performed in accordance with the relevant IEC standards and shall confirm that Meter accuracy is within the limits stated in Section...
18.9.1. A unique identifiable calibration record shall be provided before the connection is commissioned.

VTs and CTs shall be tested according to the relevant IEC standards prior to installation at the DMP. The TSO shall provide manufacturer’s test certificates to EAPP CC to show compliance with the accuracy standards in this IMC.

18.1.9.2  Periodic Calibration and Testing

The TSO as owner of Metering Equipment shall undertake calibration testing upon request by the EAPP Independent Regulatory Board or another TSO. In addition TSOs shall carry out routine calibration of the Meters every three (3) years and connections for the CTs and VTs shall be checked every five (5) years. If the Meters have been adjusted to compensate for errors in the CTs and VTs, then the CTs, VTs and their connections will be checked at the same periodicity as the Meters.

Where, following a test, the accuracy of the Metering Equipment is shown not to comply with the requirements of this IMC, the TSO shall take such measures as are required to restore the accuracy of the Metering Equipment to the required standard.

The cost of routine testing shall be met by the TSO as owner of the Metering Equipment.

The cost of calibration testing shall be met by the Party requesting the test unless the test shows the accuracy of the Metering Equipment does not comply with the requirements of the IMC, in which case the cost of the tests shall be met by the TSO.

TSOs shall ensure that all Metering Equipment at DMPs is physically inspected and read by it or on its behalf not less than once in every three (3) months. The purpose of this reading is to reconcile cumulative register readings on site with readings collected remotely. Physical checks shall be carried out at the same time to identify such things as missing seals or damage or any other issues for concern.

Where a Metering Equipment is found to be faulty or to be non-compliant with the IMC, EAPP CC and the other relevant TSO shall be informed of the failure or non-compliance promptly. Such notification shall include the plans by the TSO concerned to restore the Metering Equipment to compliance with the IMC.

The EAPP CC shall in cooperation with the TSOs involved assess the duration of the period where the Metering Equipment has been faulty. For that period recorded data from the Check Meter shall be used.

18.1.10  Data Collection

The TSO shall collect all data relating to the parameters measured by Metering Equipment at DMPs by remote or manual on-site interrogation in accordance with the terms of this IMC. For the purposes of remote interrogation the TSO may use its own data communications network or failing this, shall enter into, manage and monitor contracts to provide for the maintenance of all data links.
by which data is passed to the TSO and to the EAPP CC. In the event of any fault or failure on such communication links or any error or omission in such data the TSO shall, if possible, retrieve such data by manual on-site interrogation.

18.1.11 Security

Each TSO as owner of the Metering Equipment at the DMPs shall ensure that the equipment itself is sealed and that any links and secondary circuits are sealed where practically possible. The seals shall only be broken in the presence of representatives of the EAPP Independent Regulatory Board and the TSO unless agreed otherwise by the parties involved.

18.1.12 Disputes

Disputes concerning this IMC will be dealt with in accordance with the procedures set out in Section 3.11 of Chapter 3 (General Conditions - Dispute Resolution).

18.1.13 Meter Data Confidentiality

Meter data may be commercially sensitive and confidential and appropriate measures shall be taken to ensure the meter data cannot be divulged to or obtained by third-parties.

18.1.14 Operational Metering

An operational metering system is required to support real time operation of the EAPP Interconnected Transmission System. Because operational requirements differ from Interchange Metering requirements, the operational metering system does not necessarily have the same requirements for accuracy of measurement. However, timely operational metering data is critical for the efficient, safe, and timely operation of the EAPP Interconnected Transmission System. EAPP CC and TSOs shall agree on the types of operational data to be exchanged in real-time and shall ensure that appropriate systems are in place.
19.1 INTRODUCTION

The Data Exchange Chapter (DEC) defines the system data to be exchanged between TSOs and EAPP Sub-Committees on Planning and Operations for the purpose of the modelling and analysis of steady-state and dynamic conditions for the EAPP Interconnected Transmission System.

The DEC sets out the information flows required between TSOs and EAPP Sub-Committees on Planning and Operations to produce EAPP system models for the various processes that require system studies to be undertaken.

These processes include those associated with System Planning as set out in the PC, including the preparation of the Transmission System Capability Statement, and with Operational Planning as set out in OC 1, Chapter 8 (Operations Code No. 1 – Operational Planning).

19.2 OBJECTIVE

The objectives of the DEC are:

a. To detail how EAPP system models are produced and agreed;

b. To address the methods of information management across the interface between EAPP Sub-Committees on Planning and Operations and TSOs to ensure consistency of the EAPP system model, and

c. To provide a basis for cooperation between EAPP Sub-Committees on Planning and Operations and TSOs in the field of power system analysis. The power system analysis studies are required in order to resolve balance and capacity problems and for secure exploitation of the advantages of the EAPP Interconnected Transmission System.

19.3 POWER SYSTEM MODEL

Power System Model refers to the power system data that are needed in order to carry out load flow, fault, transient and dynamic studies on all or part of the EAPP Interconnected Transmission System.

The Model will characterise Generating Unit responses to system disturbances such as voltage and frequency deviations, and oscillations and control signals for power and voltage scheduling. The dynamic model will be part of the Power System Model used in the system studies to determine operating transfer limits and system reinforcements.

Power system studies are required for two distinct purposes:

19.3.1 System Planning

System planning studies generally involve studies of the system from three (3) years to ten (10) years ahead. They identify deficient areas in the transmission and generation systems and solutions
are proposed which may include facility additions, upgrades, or other modifications. Studies are performed for all projected seasonal periods. Generation output in the study case is based on the principles of economic dispatch. The combination of load and capacity studied is a snapshot of projected EAPP Interconnected Transmission System conditions and therefore subject to a degree of uncertainty. Additional studies may need to be performed to evaluate off-peak periods and study specific Outages of transmission and generation facilities.

19.3.2 Operational Planning

Operational Planning studies are normally performed for conditions from three (3) years ahead down to real time. These studies identify Contingency related transmission deficiencies that may be encountered, and assist in formulating corrective measures in operational timescales to mitigate the deficiency.

19.4 PROVISION OF SYSTEM DATA

TSOs shall provide data of two types:

19.4.1 Basic Data

The EAPP Sub-Committee on Planning shall prepare the basic data for use in system studies. The data shall be prepared annually with input from TSOs. The basic data shall include the electrical characteristics and ratings of transmission facilities and the timing of new facilities maintained in a chronological database. Basic datasets shall be produced by the EAPP Sub-Committee on Planning for each year up to ten (10) years ahead.

The system data to be provided by TSOs to the EAPP Sub-Committee on Planning is set out in Section 19.8 of this chapter.

19.4.2 Study Data

In order to carry out system studies in accordance with the requirements for Planning or Operations, TSOs shall supply appropriate system data to the EAPP Sub-Committees on Planning and Operations. This data includes, but is not limited to, the following:

a. The demand on the EAPP Interconnected Transmission System for the period under study. The distribution of demand across the nodes shall be consistent with the period under study;

b. Generation indicative of the conditions under study. Generation in individual National Systems shall be based on that system's economic dispatch with base load units, hydrological factors, pumped storage and distributed generation given proper consideration;

c. Evaluation of Transmission System Capability;

d. Interchange with External Systems modelled as demand or generation as the case may be. Equivalents of the External Systems shall be used if studies other than load flow are being carried out;

e. Ratings of transmission facilities based on appropriate ambient temperature and seasonal conditions;
f. Timing of new facilities and Outage schedules for existing facilities; and
g. A list of Contingencies to be considered during programme execution agreed between TSOs and EAPP Sub-Committees on Planning and Operations.

19.5 RESPONSIBILITY FOR SYSTEM MODELS

The EAPP Sub-Committee on Planning shall be responsible for the coordination and production of the EAPP Interconnected Transmission System models and shall define the software to be used in EAPP executed studies.

TSOs are responsible for the production of models of their own National Systems and they may determine the software to be used. If the software is different from that in use by EAPP then appropriate data format conversion shall be carried out. The data shall be the latest version available unless a specific version of the data is requested and in all cases the data must be complete.

EAPP Sub-Committee on Planning shall perform data verification to ensure correct TSO model conversion, that the system configuration is maintained, and that the parameters for all lines, transformers, and reactors are properly converted. The EAPP Sub-Committee on Planning shall maintain a database of all problems encountered during data conversion and the solutions found.

19.6 EQUIVALENTS

An equivalent is a simplified version of the complete EAPP Interconnected Transmission System model. Equivalents can be supplied to and used by third-parties for their studies. The aim is that the characteristics of the equivalent at the Connection Points should be the same as those of the complete model in terms of load distribution, impedances, and dynamic response.

19.7 DATA CONFIDENTIALITY

Where the data exchanged between TSOs and EAPP Sub-Committees on Planning and Operations is not in the public domain in the country to which it refers, the data shall be considered confidential in accordance with Section 3.15 in Chapter 3 (General Conditions – Confidentiality).
19.8 BASIC DATA REQUIREMENTS

List of Basic Data required by EAPP for use in the Power System Model

a. **Substation**: name, nominal voltage, demand supplied (consistent with the aggregated and dispersed substation demand data supplied) and location.

b. **Generating Units (including synchronous condensers, pumped storage, etc.)**: location, minimum and maximum Ratings (net Real and Reactive Power), regulated bus and voltage set point, and equipment status.

c. **AC Transmission Line or Circuit (overhead and underground)**: nominal voltage, impedance, line charging, Normal and Emergency Ratings, equipment status, and metering locations.

d. **HVDC Transmission Line (overhead and underground)**: line parameters, Normal and Emergency Ratings, control parameters, rectifier data, and inverter data.

e. **Transformer (voltage and phase-shifting)**: nominal voltages of windings, impedance, tap ratios (voltage and/or phase angle or tap step size), regulated bus and voltage set point, Normal and Emergency Ratings and equipment status.

f. **Reactive Compensation (shunt and series capacitors and reactors)**: nominal Ratings, impedance, percent compensation, connection point, and controller device.

g. **Interchange Schedules**: Existing and future Interchange Schedules and/or assumptions.

Notes

a. Design data shall be provided for new or refurbished excitation systems (for Synchronous Generating Units and synchronous condensers) at least three (3) months prior to the installation date.

b. Unit-specific dynamics data shall be reported for Generating Units and synchronous condensers (including, as appropriate to the model, items such as inertia constant, damping coefficient, saturation parameters, and direct and quadrature axes reactances and time constants), excitation systems, voltage regulators, turbine-governor systems, power system stabilisers, and other associated generation equipment.

c. Estimated or typical manufacturer's dynamics data, based on units of similar design and characteristics, may be submitted when unit-specific dynamics data cannot be obtained.

d. The Interconnection-wide requirements shall specify unit size thresholds for permitting:
   1. The use of non-detailed vs. detailed models,
   2. The netting of small generating units with bus load, and
   3. The combining of multiple generating units at one plant.

e. Device specific dynamics data shall be reported for dynamic devices, including, among others, static VAR controllers, high voltage direct current systems, flexible AC transmission systems, and static compensators.
20 INFORMATION EXCHANGE

20.1 INTRODUCTION

This chapter defines the reciprocal obligations of parties with regard to the provision of information for the implementation of the KNTGC. The information requirements, as defined for the Transmission Network Service Provider (TNSP), the Kenya National TSO, the Regulatory Authority and Users, are necessary to ensure non-discriminatory access to the Kenya National Transmission System (KNTS) and the safe, reliable provision of transmission services.

The information requirements are divided into planning information, operational information and post-dispatch information.

Information criteria specified in the Information Exchange Chapter are supplementary to the other chapters within the KNTGC. In the event of inconsistencies between other chapters and the Information Exchange Chapter with respect to information exchange, the requirements of the Information Exchange Chapter shall prevail.

Requirements in this chapter apply to communications between the Kenya National TSO and Users.

20.2 INFORMATION EXCHANGE INTERFACE

a. The parties shall identify the following for each type of information exchange:
   1. The name and contact details of the person(s) designated by the information owner to be responsible for provision of the information
   2. The names, contact details of, and the parties represented by persons requesting the information
   3. The purpose for which the information is required.

b. The parties shall agree on appropriate procedures for the transfer of information.

20.3 SYSTEM PLANNING INFORMATION

a. Users shall provide such information as the TNSP and/or the Kenya National TSO may reasonably request on a regular basis for the purposes of planning and developing the KNTS. Each request shall specify the information sought and the requested frequency upon which it would be provided. Users shall submit the information within the specified time period without unreasonable delay. Such information may be required for the planning and development of the KNTS, monitoring current and future power system adequacy and performance, and fulfilling statutory or regulatory obligations. Reasons for any anticipated delay in providing the requested information shall be communicated for effective mitigation.

b. Users shall submit to the TNSP and/or the Kenya National TSO the following information. The TNSP and/or Kenya National TSO may request additional information reasonably required.
   1. Hourly/daily/monthly load forecast data, and the source of the forecast
2. Transmission system losses data with indication of percent losses included in the load forecast
3. Identification of non-conforming load data
4. Demand response (DR) resources
5. Network topology, and capacity/rating data
6. Daily list of transmission reservations to and hourly increment of new reservations, if any
7. Transmission system connected transformer data
8. Shunt capacitor or reactor data requirements
9. Series capacitor or reactor data requirements
10. Phase shifting transformers
11. *Flexible AC Transmission System (FACTS)* devices
12. *High voltage direct current (HVDC)* data
13. Information on *Customer* networks
14. Overhead line data
15. Cable data
c. *Generation Licensees* shall submit to the *TNSP and/or Kenya National TSO* the following information for *Generating Plants*. The *TNSP and/or Kenya National TSO* may request additional information reasonably required.
   1. *Generating Plant* data including regulated bus, target voltage and actual voltage
   2. *Generating Plant* data including unit owner and bus location in the model, seasonal ratings, PMIN, PMAX, QMIN, QMAX
   3. Rules for sharing output between joint owners, if any
   4. Station auxiliaries to the extent gross generation has been reported
   5. Reserve capability
   6. Unit parameters
   7. Excitation system
   8. Control devices and protection relays
   9. *Generating Plant* step-up transformer
   10. *Generating Plant* forecast data
   11. Mothballing of *Generating Plants and/or units*
   12. Return to service of mothballed *Generating Plants*
   13. Decommissioning of *Generating Plants and/or units*
   14. De-rating of *Generating Plants and/or units*
d. *Users* shall submit to the *TNSP and/or Kenya National TSO* and to all other relevant *TNSPs their planning schedules*, including a ten-year demand forecast and information on embedded *Generating Plants* larger than five (5) MVA.
e. The *TNSP* shall provide the *Generation Licensees* with information about equipment and systems installed in HV yards, including:
1. Circuit breaker
2. Current transformer (CT) and Voltage Transformer (VT)
3. Surge arrester
4. Protection
5. Power consumption
6. Link
7. Outgoing feeder
8. Transformer
9. Compressed air system
10. Fault recorder

f. The TNSP and/or the Kenya National TSO shall keep an updated technical database of the KNTS for purposes of modelling and studying the behaviour of the KNTS.

g. The TNSP and the Kenya National TSO shall provide Users or potential Users, upon any reasonable request, with any relevant information that they require to properly plan and design their own networks/installations or comply with their other obligations in terms of the KNTGC.

h. The TNSP and/or the Kenya National TSO shall make available all relevant information related to network planning.

i. Users shall, upon request to upgrade an existing connection or when applying for a new connection, provide the TNSP and the Kenya National TSO with information relating to Table 20-1 below:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioning</td>
<td>Projected or target commissioning test date</td>
</tr>
<tr>
<td>Operating</td>
<td>Target operational or on-line date</td>
</tr>
<tr>
<td>Reliability of connection requested</td>
<td>Number of connecting circuits, e.g. one or two feeders, or firm/nonfarm supply required, subject to Chapter 6 (Connections).</td>
</tr>
<tr>
<td>Location map</td>
<td>Upgrades: name of existing point of supply to be upgraded and supply voltage</td>
</tr>
<tr>
<td></td>
<td>New connections: provide a 1:50 000 or other agreed scale location map, with the location of the facility clearly marked. In addition, co-ordinates of the Connection Point to be specified</td>
</tr>
</tbody>
</table>
### 20.4 OPERATIONAL INFORMATION

#### 20.4.1 Pre-commissioning Studies

a. *Users* shall meet all system planning information requirements before the commissioning test date. (This will include confirming any estimated values assumed for planning purposes or, where practical, replacing them with validated actual values and with updated estimates for the future.)

b. The *TNSP and/or Kenya National TSO* shall perform pre-commissioning studies prior to sanctioning the final connection of new or modified plant to the *KNTS*, using data supplied by *Users* in accordance with Section 20.3, to verify that all control systems are correctly tuned and planning criteria have been satisfied.

c. The *TNSP and/or Kenya National TSO* may request adjustments prior to commissioning should tuning adjustments be found to be necessary. The asset owner shall ensure that all system planning information records are maintained for reference for the duration of the operational life of the plant. Information shall be made available within a reasonable time on request from the *TNSP and/or Kenya National TSO* upon notification of such a request.
20.4.2 Commissioning and Notification

a. All Users shall ensure that exciter, turbine governor, Flexible AC Transmission System (FACTS) and High Voltage Direct Current (HVDC) control system settings are implemented and are as finally recorded by the Kenya National TSO prior to commissioning.

b. Users shall give the Kenya National TSO notice of the time at which the commissioning tests will be carried out. The Kenya National TSO and the User shall agree on the timeous provision of operational data items.

c. Records of commissioning shall be maintained for reference by the asset owner for the operational life of the plant and shall be made available, within a reasonable time, to the Kenya National TSO upon notification of such request.

d. The asset owner shall, before the equipment is returned to service, communicate to the TNSP and/or Kenya National TSO changes made to commissioned equipment during an Outage. The TNSP and/or Kenya National TSO shall keep commissioning records of operational data for the operational life of the plant connected to the KNTS.

e. Users shall also provide notification on:
   1. Planned and actual operational start-up dates for any permanently added, removed or significantly altered transmission segments;
   2. Planned and actual start-up testing and operational start-up dates for any permanently added, removed or significantly altered generation units.

20.4.3 General Data Acquisition Information Requirements

The Kenya National TSO shall have adequate observability to ensure reliable and safe operation of the KNTS. Users are to comply with reasonable requests from the Kenya National TSO that are intended to ensure adequate observability. The Kenya National TSO will ensure confidential treatment of data, as discussed in Section 3.15.

a. Users and TNSPs shall agree on the formats to be used for the measurements and indications to be supplied to the Kenya National TSO. Where required signals become unavailable or do not comply with applicable standards for reasons within the control of the provider of the information, such User shall report and restore or correct the signals and/or indications as soon as reasonable.

b. The Kenya National TSO shall notify the User, where the Kenya National TSO, acting reasonably and in consultation with the User, determines that additional measurements and/or indications in relation to a User’s plant and equipment are needed to meet a KNTS requirement. The costs related to the User’s modifications for the additional measurements and/or indications shall be for the account of the providing User.

c. On receipt of such notification from the Kenya National TSO the User shall promptly ensure that such measurements and/or indications are made available at the unit’s communications gateway equipment.

d. The data formats to be used and the fields of information to be supplied to the Kenya National TSO by the various Users shall be agreed among the parties.
e. The TNSP shall provide periodic feedback to Users regarding the transmission power flows, bus voltages, and status of equipment and systems installed in the substations where they are connected to the KNTS. The feedback shall include results from tests, condition monitoring, inspections, audits, failure trends and calibration. The frequency of the feedback shall be determined in the operating agreement, but will not exceed one year.

f. Plant status reports provided by the TNSP will also include Contingency plans where applicable.

g. The Kenya National TSO needs to inform Users where in the network out-of-step relays are installed, and how the relays are expected to operate. Furthermore, the characteristics of such an islanded network shall be provided, based on the most probable local network configuration at such a time.

h. The cost of the installation of the Data Terminal Equipment (DTE) will be paid for by the User.

i. The User shall decide on the location of the data terminal equipment.

j. The User will be responsible for the maintenance of communications links between the Generating Plant gateway and the data terminal equipment.

k. The Kenya National TSO shall be responsible for the maintenance, upkeep, and communications charges of the DTE.

l. Users shall exchange SCADA data that shall include: (1) breaker statuses including Generating Plant breaker status; (2) analogue measurements (flows and voltages); (3) Generating Plant MW and Mvar; (4) load MW and Mvar; (5) balancing area net interchange, operating reserve, and instantaneous demand.

m. Parties shall provide detailed EMS model data to the TSO once a year in a mutually agreed-upon electronic format with updates as new data becomes available as current and up-to-date representation of the EMS models become important for reliability coordination and market operations.

n. Users shall comply with all governing confidentiality agreements relating to information exchange.

20.4.4 Unit Scheduling

20.4.4.1 Schedules

a. The Kenya National TSO shall arrange for the provision of sufficient energy and Ancillary Services to maintain system reliability.

b. Dispatchable Resources shall declare to the Kenya National TSO their hourly unit available capacity or hourly load (in case of Customers participating as demand side resources) for the next day by 1400 Hr each day.

c. The Kenya National TSO shall provide final day-ahead power and Ancillary Service schedules to Dispatchable Resources not later than 1600 Hr.

d. On the day, the Kenya National TSO shall, at least ten (10) minutes before the hour, notify Dispatchable Resources of deviations in power and Ancillary Service schedules, subject to unit constraints.
e. In the event that Dispatchable Resource availability changes, the Dispatchable Resource shall notify the Kenya National TSO promptly.

f. All information exchange requirements for Ancillary Services that are contracted annually shall be included in the contract between the parties.

g. If the Dispatchable Resource provides a schedule more than a day in advance and provides no update to the previously provided schedule by 1400 Hr on the day-ahead, the Kenya National TSO shall use the most recently provided schedule.

h. At the discretion of the Kenya National TSO, the Dispatchable Resource will submit a daily energy schedule, which the Kenya National TSO will use to determine the hourly power and Ancillary Service schedule of the User, subject to the unit and/or hydrological constraints.

i. Renewable Power Plants should provide forecasts as specified in Section 7.2.11.

20.4.4.2 File Transfers

The applicable User and the Kenya National TSO shall agree on the format of the file used for data transfer. The data shall be made available in a common, electronically protected directory. All file transfer data shall be fetched by the Kenya National TSO.

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
<th>Trigger Event</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatch schedule</td>
<td>The combined 24-hour day-ahead energy and Ancillary Services schedules. Hourly day-ahead contracts for different market categories that identify the unit with the next 24 hourly values for it.</td>
<td>Generation dispatch schedule</td>
<td>Daily</td>
</tr>
<tr>
<td>Dispatch cost curve</td>
<td>Daily cost curve with incremental costs and corresponding volumes</td>
<td>Generation dispatch schedule</td>
<td>Daily</td>
</tr>
</tbody>
</table>

20.4.5 Inter Control Centre Communication

a. Users shall provide the Kenya National TSO on request with network information that is considered reasonable for the security and integrity of the KNTS. The Kenya National TSO shall communicate network information as requested to the User, as required for safe and reliable operation. The information exchange shall be electronic and/or paper-based, and within the time frame agreed upon between the Users.

b. The Users shall optimise redundant control centre facilities where required for the safe operation and control of the KNTS.
20.4.6 Communication Facilities Requirements

a. The minimum communication facilities for voice and data that are to be installed and maintained between the Kenya National TSO and Users shall comply with the applicable IEC standards for system control and data acquisition (SCADA) and communications equipment.

b. The communication facilities standards shall be set and documented by the Kenya National TSO, acting reasonably, in advance of design. Any changes to communication facility standards impacting on User equipment shall be designed in consultation with Users and shall be informed by a reasonable business motivation.

20.4.6.1 Telecontrol

a. The User’s plant shall support data acquisition to and from the plant gateway. The Kenya National TSO shall be able to monitor the state of the KNTS via telemetry from the gateway connected to the User’s plant.

b. The signals and indications required by the Kenya National TSO shall be agreed between the Kenya National TSO and the User, together with such other information as the Kenya National TSO may from time to time reasonably require by notice to the User.

c. Users shall interface via the standard digital interfaces, as specified by the Kenya National TSO. Interface cabinets shall be installed in the User’s plant and equipment room if required. The provision and maintenance of the wiring and signalling from the User’s plant and equipment to the interface cable shall be the responsibility of the User.

d. Users shall comply with such telecontrol requirements as may be applicable to the primary control centre and, as reasonably required, to the emergency control centre of the Kenya National TSO. Any changes to telecontrol requirements impacting on User equipment shall be designed in consultation with Users and shall be informed by a reasonable business motivation.

20.4.6.2 Telephone/facsimile

a. Each User shall be responsible for the provision and maintenance of no fewer than one telephone and one facsimile unit on separate lines that shall be reserved for operational purposes only, and shall be continuously attended to and answered without undue delay.

b. The Kenya National TSO shall use a voice recorder for historical recording of all operational voice communication with Users. These records shall be available for at least three (3) months. The Kenya National TSO shall make the voice records of an identified incident in dispute available within a reasonable time period after such a request from a User and/or the Regulatory Authority.

20.4.6.3 Electronic Mail

The Users shall provide the Kenya National TSO with the electronic mailing address of the contact person as defined in this Information Exchange Chapter and vice versa. The provider of this service shall be selected to meet the real-time operational requirements of the Kenya National TSO.
20.4.7 SCADA and Communication Infrastructure at Points of Supply

20.4.7.1 Access and Security

a. The Kenya National TSO shall agree with Users the procedures governing security and access to the Users’ SCADA, computer and communications equipment. The procedures shall allow for adequate access to the equipment and information by the Kenya National TSO or its nominated representative for purposes of maintenance, repair, testing and the taking of readings.

b. Each User shall designate a person with delegated authority to perform the duties of information owner in respect of the granting of access to information covered in this chapter to third-parties, and shall disclose that person’s name and contact details to the Regulatory Authority. A Party may, at its sole discretion, designate more than one person to perform these duties.

20.4.7.2 Time Standards

All information exchange shall be GPS satellite time signal referenced. The Kenya National TSO shall ensure broadcasting of the standard time to relevant telecommunications devices in order to maintain time coherence.

20.4.7.3 Integrity of Installation

Where the Electrical Plant does not belong to the TNSP and/or Kenya National TSO, the TNSP and/or Kenya National TSO shall enter into an agreement with the User for the provision of reliable and secure facilities for the housing and operation of TNSP and/or Kenya National TSO equipment. This includes access to, at no charge to the TNSP and/or Kenya National TSO, an uninterruptible power supply with an eight (8) hour standby capacity.

20.4.8 Data Storage and Archiving

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

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

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

d. The information owner shall store the information in a manner that will allow for such information to be retrieved on request and shall ensure that the contents remain unaltered from its original state. The information shall be retained for a period of at least five (5) years (unless otherwise specified in the KNTGC) commencing from the date the information was created.

e. Parties shall ensure reasonable security against unauthorised access, use and loss of information (i.e. have a backup strategy) for the systems that contain the information.

f. Parties shall store Outage planning information electronically for at least five (5) years. Other system planning information shall be retained for the life of the plant or equipment concerned, whichever is the longer.
g. The Kenya National TSO shall archive operational information, in a historical repository sized for three (3) years’ data. This data includes:
   1. KNTS time-tagged status information, change of state alarms, and event messages
   2. Hourly scheduling and energy accounting information
   3. Operator entered data and actions.

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

20.5 POST-DISPATCH INFORMATION

20.5.1 System and Generating Plant Information

The Kenya National TSO shall provide applicable Users the following information:

a. Hourly system total MW loading
b. Hourly individual Generating Plant MW sent out
c. Hourly system constraints and constrained generation
d. Hourly international tie-line power flow
e. Predetermined system load flow data

20.5.1.1 Additional Unit Post-dispatch Information

a. The Kenya National TSO shall provide the following operational information regarding unit dispatch:
   1. Unit high limit, MW
   2. Unit low limit, MW
   3. Unit Automatic Generation Control (AGC) mode
   4. Unit AGC status, Automatic/Off/Manual
   5. Unit set-point, MW
   6. AGC pulse
   7. Unit sent out, MW
   8. Unit auxiliary, MW
   9. Unit contract, MW
  10. Unit spinning, MW
  11. 32-bit flag on AGC setting, 32 bits

b. The Kenya National TSO shall provide operational information regarding overall dispatch performance:
   1. Area Control Error (ACE), MW
   2. Average ACE previous hour, MW
   3. System frequency, HZ
   4. Frequency distribution current hour, HZ
5. Frequency distribution previous hour, HZ
6. System total generation, MW
7. Control area total actual interchange, MW
8. Control area total scheduled interchange, MW
9. System operating reserve, MW
10. System sent out, MW
11. System spinning reserve, MW
12. *Automatic Generation Control (AGC)* regulating up, MW
13. AGC regulating down, MW
14. AGC regulating up assist, MW
15. AGC regulating down assist, MW
16. AGC regulating up emergency, MW
17. AGC regulating down emergency, MW
18. AGC mode
19. AGC status, On/Off
20. *Area Control Error* output, MW
21. System transmission losses, MW
22. Uganda tie-lines, MW
23. *AGC* performance indicators

### 20.5.1.2 Hourly Demand Metering Data

*Kenya National TSO* shall provide *Users* with hourly-metered data pertaining to their installations.

### 20.5.2 File Transfers

a. The format of the files used for data transfer shall be negotiated and defined by the supplier and receiver of the information. The file transfer media shall be negotiated and defined by both parties involved.

b. The parties shall keep the agreed number of files for backup purposes so as to enable the recovery of information in the case of communication failures.

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
<th>Trigger Event</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGC pulses</td>
<td>The total pulses sent to a unit by the <em>AGC</em> system to move the set-point up or down</td>
<td>Ongoing, file created at end of hour</td>
<td>Hourly</td>
</tr>
<tr>
<td>System near real-time data</td>
<td>Historical near real-time system data files on readings as required for post-dispatch</td>
<td>Communication failure</td>
<td>To be agreed</td>
</tr>
<tr>
<td>Unit near real-time data</td>
<td>Historical near real-time unit data files on readings as required for post-dispatch</td>
<td>Communication failure</td>
<td>To be agreed</td>
</tr>
</tbody>
</table>
20.5.3 Performance Data

20.5.3.1 Generating Plant Performance Data

a. *Generation Licensees* shall provide the *Kenya National TSO* monthly with performance indicators for each unit at each *Generating Plant* including those indicators listed below, and others as agreed between the *Kenya National TSO* and the *Generation Licensees*.

1. Capacity factor
2. Equivalent availability factor
3. Equivalent forced *Outage* rate
4. Equivalent planned *Outage* hours
5. Start-up time
6. Successful start-up ratio

b. *Generation Licensees* shall report significant events, such as catastrophic failures, to the *Regulatory Authority* within one (1) week of occurrence of such event.

20.5.3.2 Distribution Licensee and End-use User Performance

a. The performance measurement of all *Distribution Licensees* and *End-use Users* shall be supplied to the *Kenya National TSO*.

b. The *Parties* shall negotiate and agree on the details of acceptable levels of performance for *Distribution Licensee* or *End-use User* networks. Acceptable network performance principles shall include

1. Performance comparable with benchmarks for similar networks
2. Performance within the design or original equipment manufacturer (OEM) specifications of the *User* and transmission equipment
3. Performance at the *Connection Point* that complies with the *TNSP* operating procedures
4. Performance consistent with the outcomes of the investment criteria
5. Performance that does not negatively impact on agreed levels of performance with other *Users*.

c. If the *Distribution Licensee* or *End-use User* network performance falls below acceptable levels and affects the quality of supply to other *Users* or causes damage (direct or indirect) to the *TNSP* equipment, the process for dispute resolution as described in Section 3.11 shall be followed.

d. The *Regulatory Authority* shall determine criteria for the contracting of acceptable levels of performance.

e. If *Distribution Licensees* or *End-use Users* are aware that their network performance could be unacceptable as described above, they shall take reasonable steps at their own cost to overcome the shortcomings, e.g. by improving their line maintenance practices, improving protection and breaker operating times, if necessary replacing the said equipment, installing additional network breakers, changing operating procedures, installing fault-limiting devices if the number of faults cannot be reduced, etc. These changes to their networks should be effected in consultation with the *TNSP* and the *Kenya National TSO* regarding both the technical scope and the time frame.
f. Where Quality of Service (QOS) standards are not met, the parties shall co-operate and agree in accordance with Regulatory Authority power quality directives in determining the root causes and plans of action.

g. Distribution Licensees shall report periodic testing of under-frequency and under-voltage load shedding relays in the following format:

Table 20-4: Periodic Testing

<table>
<thead>
<tr>
<th>Distribution Licensee:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substation:</td>
<td></td>
</tr>
<tr>
<td>Fed from transmission substation (directly or indirectly):</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activating Frequency / Voltage</th>
<th>Timer Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>As tested</td>
<td>As tested</td>
</tr>
</tbody>
</table>

| Stage 1                      |               |
| Stage 2                      |               |
| Stage 3                      |               |
| Stage 4                      |               |

<table>
<thead>
<tr>
<th>Feeders Selected (required)</th>
<th>Feeders Selected (as tested)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td></td>
</tr>
<tr>
<td>Stage 4</td>
<td></td>
</tr>
</tbody>
</table>

20.5.3.3 TNSP and Kenya National TSO Performance

a. The TNSPs and the Kenya National TSO shall make the following KNTS performance indicators available monthly to the Regulatory Authority and Users:
Table 20-5: Performance Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Month</th>
<th>Year to date</th>
<th>12 Month Moving Index</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>System minutes lost</td>
<td></td>
<td></td>
<td></td>
<td>Minutes</td>
</tr>
<tr>
<td>Number of interruptions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of statutory voltage transgressions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandatory under-frequency load shedding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User voluntary load shedding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAIDI (System Average Interruption Duration Index)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAIFI (System Average Interruption Frequency Index)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAIDI (Customer Average Interruption Duration Index)</td>
<td></td>
<td></td>
<td></td>
<td>Time</td>
</tr>
<tr>
<td>KN TS losses</td>
<td></td>
<td></td>
<td></td>
<td>%</td>
</tr>
</tbody>
</table>

b. *TNSPs* shall provide *Users* with all performance indicators at each point of supply.

20.5.3.4 System Operational Performance Information

a. The following *KN TS* operational information shall be published by the *Kenya National TSO* to all *Users*:

1. Daily:
   i. The hourly actual demands of the previous day (MW)
   ii. The reserve amounts over the morning and evening peaks of the previous day (MW)

2. Monthly:
   i. MW generated, imports, exports, available for distribution/sale and transmission losses.
   ii. Generation Plant availability
   iii. Regulating reserve Hours deficit over total hours
iv. Number of frequency excursions > 50.05 or < 49.5

v. For each abnormal network condition the action taken by the *Kenya National TSO* to restore normal operations.

vi. Network constraints (details to be defined by the *Regulatory Authority*)

3. Annually:

   i. Annual peak (MW), date and hour

   ii. Annual minimum (MW), date and hour

b. The *TNSP* shall make available all information collected via recorders installed at substations, to the *Kenya National TSO* for analyses. The *Kenya National TSO* shall make this information available to affected *Users* on request.
Cyber Security is the protection required to ensure confidentiality, integrity, and availability of the electronic communication system. With the two-way flow of electricity and information, the management and protection of the electrical communication system that includes information technology and telecommunication infrastructure, has become critical to the electric utility industry.

21.1 INTRODUCTION

With the increase in dependence on modern communication technology (e.g., wireless, cloud computing, etc.), power systems are vulnerable to cyber-attacks and hackers. In Kenya, the growth in the field of information, communication, and technology (ICT) makes it imperative to develop a sound Cyber Security strategy that will ensure confidentiality, integrity, and availability of public and private sector information across Kenya’s ICT infrastructure.

Kenya has initiated the effort to define its Cyber Security strategy as demonstrated in its National Cyber Security Master Plan draft that has been awaiting implementation. Kenya’s strategy for Cyber Security includes:

a. Enhancing the Cyber Security posture to facilitate the country’s growth, safety, and prosperity.

b. Fostering Cyber Security awareness and developing Kenya’s workforce to ultimately build national capability.

c. Facilitating information sharing and collaboration among relevant stakeholders while staying information focused.

d. Defining the national Cyber Security vision, goals, and objectives and coordinating Cyber Security initiatives at the national level. in line with Kenya’s Cyber Security strategy, goals, and objectives.

Following the guidelines and best practices as described by the US Department of Energy, National Institute of Standard and Technology (NIST – under US Department of Commerce), and National Rural Electric Cooperative Association (NRECA, from US), and some observations of Cyber Security best practices in India and Europe, this document provides guidance for developing Cyber Security controls that would help meet the potential security challenges for Kenya’s power grid modernisation.

This chapter addresses: (a) development of information security management controls and procedures; (b) development of Cyber Security systems with identity; (c) access management systems; and (d) building defence against threats through training, awareness and monitoring.

21.2 OBJECTIVES

The key objectives defined here have been adopted from Kenya’s Cyber Security Master Plan draft as per Section 21.1 in this chapter.
a. Protect Critical Information Infrastructure  
b. Awareness and Training: Inform and educate  
c. Communications and Outreach: Elevate Cyber Security awareness for government, private sector, and the Kenyan public  
d. Develop a comprehensive governance framework to leverage resources, reduce conflict and duplication of effort, and work toward Kenya’s long-term Cyber Security goals  
e. Develop and Coordinate Implementation of the National Cyber security Strategy and Master Plan  

21.3 **SCOPE**  
The following issues are considered and detailed in the scope of Cyber Security in this document:  
a. People and policy  
b. Operational issues  
c. Insecure software development life cycle (SDLC) risks  
d. Physical security  
e. Third-party relationship  
f. Network security  
g. Platform security  
h. Application security  

21.3.1 **People and Policy**  
Policies and procedures are the final protective or mitigating control against security breaches, and hence shall be examined closely to ensure its consistency with both the inherent business objectives and secure operations. Policies and procedures shall be well documented to ensure there is no deficiency that can lead to any security risks for the organisation.  

21.3.1.1 **Security Policy**  
Security policies shall be well structured in a practical, flexible, and easy to understand manner. Implementation and enforcement of the policies (e.g., through audits and disciplinary actions for noncompliance) shall be monitored periodically. Adequate flexibility shall be in place so improvements and modifications shall be made easily as needed. Policies must be reviewed and approved by the designated authorities within the organisation.  

21.3.1.2 **Security Policy Elements**  
The security policies must address the following elements:
a. **Policy Management**: this shall address purpose, scope, and applicability, roles and responsibilities; implementation and enforcement procedures; exceptions, and policy reviews; approvals, and change management;

b. **Personnel and Training**: personnel risk assessment, security awareness program, and Cyber Security training shall all be under the umbrella of this key element.

c. **Critical Asset Management**: methodology for identifying critical cyber assets; inventory and classification of cyber assets, information protection and data privacy; cyber vulnerability assessment, access control, monitoring, and logging; disposal or redeployment of assets; maintenance and change control of the asset inventory and classifications;

d. **Electronic Security Perimeter (ESP)**: critical assets within the perimeter; cyber vulnerability assessment; access control/monitoring and logging, Configuration, maintenance, and testing; documentation maintenance to support compliance

### 21.3.1.3 Security Related Roles and Responsibilities

Roles of people responsible for maintaining security shall be defined and documented. These roles shall include:

a. The governing body for the security policy (e.g., an oversight board comprising representatives of stakeholder groups).

b. A designated information security manager who maintains the policy and provides guidance for implementation, training, and enforcement.

c. Department managers who “own” the critical cyber assets and are responsible for implementing the security policies and procedures to protect those assets.

d. Personnel with authorised access to critical assets who must review, provide feedback on, and comply with security policies.

### 21.3.1.4 Privacy Policy

Insufficient privacy policies can lead to unwanted exposure of employee or Customer/client personal information, resulting in both business and security risks. A privacy policy, that documents the necessity of protecting private/personal information to help ensure that data is not exposed or shared unnecessarily, shall be established.

### 21.3.1.5 Policy Exception

Reasons such as an overriding business need, a delay in vendor deliverables, new regulatory or statutory requirements, and temporary configuration issues may necessitate policy exceptions. The exception process must ensure that these circumstances are addressed in a manner to make all stakeholders aware of the event, the risks, and the timeline for eliminating the exception.

### 21.3.1.6 Personnel and Training

Training is required for everyone in the organisation to get a clear understanding of the importance of Cyber Security. All employees shall acquire a level of security awareness training (with roles and
responsibilities clearly defined), the degree of which shall vary based on the technical responsibilities and/or the critical assets one is responsible for.

Workshops shall be arranged periodically to provide training in such areas as Cyber Security for Critical Infrastructure, Threats and Attacks, Cyber Security Framework and Communications, Network and Information Security, Building Cyber Attack Resilience, Cyber Security Audit and Assessment, and Cyber Security Assessment Project. Such workshops shall be aimed at providing exposure to the local utilities (Generation, Transmission, and Distribution), local Academia and R&D organisations as well as industry experts from overseas sharing with the best practices knowledge and experience.

21.3.1.7 Due Diligence in Hiring

Due diligence in the hiring and personnel review process is crucial. It is important to define and document a risk assessment program for personnel with authorised cyber access or authorised unescorted physical access to critical cyber assets. The program must comply with applicable laws and existing collective bargaining agreements. The risk assessment must include, at a minimum, identity verification and criminal check. This information must be updated periodically at a frequency as determined by the local regulatory authorities. Similar checks must be enforced for the employees of third-party vendors.

21.3.1.8 Access Privileges

System access and information shall be granted only on an as-needed basis. System access needs to be managed, monitored, and enforced based on the individual’s access requirements and the level of impact that uncontrolled access could have on the organisation. In general, each employee shall be granted the lowest levels of access to cyber assets and other privileges needed to do his or her job efficiently. A list of all personnel with authorised cyber access or authorised unescorted physical access to critical cyber assets shall be maintained. This list that contains each person’s specific electronic and physical access rights to such assets shall be reviewed quarterly and updated within seven (7) days of any change in a list member’s access rights.

21.3.1.9 Identity Validation, Background Checks

Identity validation/background checks shall be implemented based on an individual's area of responsibility, the physical facilities/hardware/systems, and the type of information authorised to access. The more sensitive information available to an individual, the deeper and more detailed the identity validation and background check process needs to be.

21.3.2 Operational Security

Operational mistakes can break security policies. Although operational mistakes cannot be completely avoided, it is possible to reduce the risk of a mistake. Operational security acts as a deterrent against mistakes and deliberate misconfigurations. The ability to detect a mistake and trace it back to its source could also deter insiders from making malicious misconfigurations or to help quickly detect operator mistakes. The operational security shall deal with the responsibilities
and authorisation, as well as disciplinary actions in case of breaches. Industry compliance regulations require certain operational security measures. Network operators should check which regulation applies and verify that the required measures are in place.

It is often possible to provide additional security measures that are not fully dependent on operational mistakes. However, before implementing additional security measures a formal risk assessment needs to be performed to balance the cost of the additional measures with the cost of the risk incurred due to operational weaknesses. A Cyber Security program must be comprehensive—it is only as strong as its weakest link. Failure to develop appropriate controls in any category provides openings for attackers. This guide includes sections that describe common risks and mitigations in each category.

21.3.2.1 Risk Assessment and Mitigation

Security risks are fundamentally caused by people/policies/process/technology. An important part of the risk management process is to determine the severity of each risk as a function of its impact and likelihood. It is also important to understand the extent to which existing security controls completely or partially mitigate each risk. It is then possible to enumerate the gaps in protection and make an informed risk-based decision on next steps.

Although a risk management strategy strives for risk prevention where practical, it also must balance the costs and benefits of security controls.

21.3.2.2 Access Control, Monitoring, and Logging

Access control that includes both technical and procedural control (e.g., logs, user account review, account management, restricting use of shared accounts, password use), enforces the authentication and accountability of all user activities. Access control requires not granting users access to network resources, before they are authenticated and authorised using their own individual (i.e., non-shared) credentials. Remote access to networks shall be limited to an absolute minimum. When required, technologies like Virtual Private Networks (VPNs, IPSec) shall be used to create a secure tunnel after properly authenticating the connecting Party using their individual credentials. In addition to user name and password, also use an RSA ID-like device to provide an additional factor of authentication. Access control shall be implemented for critical cyber assets by restricting authorised users and transactions. A designated security team shall be in charge of access control and system logs. Access control shall be enhanced through perimeter security (e.g., security personnel, surveillance cameras and fences) wherever possible. Use an access control model whose default setting is to deny access, thereby requiring explicit permission changes to enable access. Similarly, for all access points enable only the ports and services required for approved operations and monitoring. Remote interactive access to a point within the perimeter typically must be accompanied by strong procedural or technical controls to enforce authentication of the authorised users. The Network access level that is needed for each individual or role at the organisation shall be documented and only the required level of access shall be granted to these individuals or roles. All exceptions shall be noted.
All cyber assets, where technically feasible, shall include automated tools or organisational process
controls to monitor Cyber Security-related system events. All automated mechanisms or processes shall
be documented. The monitoring function shall log each detected Cyber Security incident and issue an
alert. All such events shall be reviewed and logged. Logs shall be maintained for at least ninety (90) days.

21.3.2.3 Disposal or Redeployment of Assets

Formal methods, processes, and procedures for disposal or redeployment of cyber assets that are
within an ESP shall be documented and implemented in order to prevent any accidental release of
sensitive and confidential information. This shall include, at a minimum, destroying or erasing the
data storage media and maintaining records of asset disposition.

21.3.2.4 Change Control

Managing change is essential to maintaining a robust ongoing security posture. The state of the
hardware, operating system must be monitored. Change control mechanism shall ensure that new
cyber assets and significant changes to existing cyber assets shall not adversely impact existing
Cyber Security controls or the overall security posture of the system. Change management
processes shall also ensure an uninterrupted operation of the system. All changes shall be logged
and executed in a controlled way. The logs must be evaluated and checked for potential
misconfigurations. The logs shall also be used to demonstrate a deliberate breach of the operational
security policy.

21.3.2.5 Patch Management Process

A patch management process must be in place to ensure that software and firmware are kept
current to remediate against known vulnerabilities, or that a proper risk analysis and mitigation
process is in place when patches cannot be promptly installed. Evaluation, installation, testing, and
tracking process of Cyber Security patches, cumulative service packs, and version upgrades shall be
implemented and documented.

21.3.2.6 Vulnerability Assessments

Cyber vulnerability is a gap or weakness in a system’s security controls that a threat can exploit.
Vulnerability assessments are necessary for generating awareness of threats, attacks, vulnerabilities,
and ensuring the effectiveness of existing controls. They also establish baselines that future
assessments can use to determine the need and effectiveness of planned improvement. A cyber
threat is any entity or circumstance that has the potential to harm an information system along with
its mission and goals.

Cyber vulnerability assessment of the access points to each ESP shall be done at least once a year to
examine ways in which the security perimeter can be breached and existing security controls
bypassed to compromise confidentiality, integrity, or availability of critical cyber assets.
21.3.2.7 Configuration Management and Maintenance

Improperly configured software/systems/devices added to existing software/systems/devices can lead to insecure configurations and increased risk of vulnerability. Configuration management processes must be in place to ensure that system configurations are governed appropriately in order to maximise overall system reliability.

A designated network team shall execute the configuration actions. Typical actions such as: (a) adding vulnerable hardware; (b) introducing tampered device to the system; (c) failure to document changes made to the network configuration; (d) not having a sign-off approval in the configuration management process; and (e) changing network configuration that reduces security profile shall be in the realm of responsibilities of the network team.

21.3.2.8 Incident Management and Handling

An incident such as a breach of security or reliability protections can potentially cause loss of confidentiality, integrity, or availability of data, maintenance, and sustainment of any software or hardware product or operations. System reliability depends on the ability of participant organisations to quickly detect, report, and respond to incidents. Problems detected and correctly handled in a timely manner can prevent them from spreading to other entities. Knowledge gained from detecting and responding to computer security incidents provides insight into real risks and threats to the integrity, confidentiality, and availability of software and hardware products.

A robust incident-handling capability requires planning, documented procedures, and ongoing training and rehearsal for all personnel who might be required to report, analyse, or respond to incidents. This capability begins with a clear policy statement of incident-handling requirements.

21.3.2.9 Contingency Planning

Contingency planning shall include policy, plans, and procedures for disaster recovery and continuity of operations. Policy and plans must include preparation and training for responding to an emergency along with detailed procedures for executing defined strategies.

A disaster recovery plan applies to a major disruption to service that deny access to the primary facility infrastructure for an extended period of time. It includes the preparation (e.g., off-site storage of system backups), emergency facilities, and procedures for restoring critical cyber assets and infrastructure at an alternate site after an emergency.

A business continuity plan focuses on sustaining an organisation’s mission and business functions during and after a disruption. A business continuity plan shall be written for mission/business functions within a single business unit or it may address the entire organisation’s processes.

Continuity and recovery plans also define interim measures that increase the speed with which organisations resume service after disruptions. These plans must be tailored to each system. Creating specific measures requires a detailed understanding of specific scenarios.

Kenya National Transmission Grid Code
Some of the key items that need to be addressed in the contingency plan are:

a. Server backup and recovery;
b. Data backup and recovery;
c. Network backup and recovery; and
d. Employee backup

21.3.2.10 Software Development Life Cycle (SDLC)

The software development shall have the objective to design, implement, configure, and support software systems to enable:

a. Continuous operation even under most attacks by either restricting the exploitation of faults or other weakness in the software by the attacker, or tolerating the errors and failures that result from such exploits;
b. Isolation and containment of damage caused by any failures from attack-triggered faults that the software was unable to resist or tolerate, and
c. Recovery from fault conditions as quickly as possible

Information gathered from incident handling shall be used at the beginning of the SDLC to help define better security requirements in products and provide a better understanding of the threat environment within which these products must operate. Knowledge gained from containing and mitigating computer security risks and threats shall also help identify auditing and recovery requirements for systems and software. Such requirements include: (a) building alerts when files and components that should not be changing are modified, (b) establishing policy and configuration setting capabilities to identify and control specific software and hardware components that should not be changed during normal operations, and (c) providing functionality for logging unauthorised changes or malicious attacks in a manner that would preserve evidence in a forensically sound manner.

Collection and sharing of information shall be smooth and successful if there is a well-defined and structured relationship between the software system developers and incident management staff.

Practices in SDLC shall include:

a. Developing abuse cases to help refine requirements and build business cases
b. Performing business risk analysis
c. Implementing test planning (e.g., security functionality and risk-driven testing)
d. Performing code review
e. Performing penetration testing
f. Deploying and operating applications in a secure environment
21.3.3 Physical Security

Physical security is the protection of personnel, hardware, programs, networks, and data from physical circumstances and events that could cause serious losses or damage to an enterprise, agency, or institution. This includes protection from fire, natural disasters, burglary, theft, vandalism, and terrorism. A physical security plan, sponsored by senior management in the organisation, must be documented, implemented, and maintained. The plan shall address the following among other things:

a. The protection of all cyber assets within an identified physical security perimeter or by way of alternate measures if a completely enclosed border is not feasible.

b. The identification of all physical access points past the physical security perimeter and measures to control entry at those access points to make network links harder to compromise.

c. Processes, tools, and procedures to monitor physical access to the perimeter(s).

d. Appropriate use of physical access controls.

e. Review of access authorisation requests and revocation of access authorisation.

f. A visitor control program for personnel without authorised unescorted access to a physical security perimeter.

g. Physical protection from unauthorised access and a location within an identified physical security perimeter for cyber assets that authorise or log access or monitor access to a physical or electronic security perimeter.

h. Documentation and implementation of operational and procedural control to manage physical access at all access points at all times.

i. Ensuring that all ports and services not required for normal and emergency operations are disabled.

j. Use of antivirus and malicious software prevention tools, where technically feasible.

k. Enforcement of restrictions on who can perform maintenance and repair, emergency procedures, and remote configuration and maintenance.

Physical security shall be implemented in the following levels:

a. Multiple locks, fencing, walls, fireproof safes, and water sprinklers shall be placed in the way of potential attackers and sites shall be hardened against accidents and environmental disasters.

b. Surveillance and notification systems (such as lighting, heat sensors, smoke detectors, intrusion detectors, alarms, and camera) shall be put in place as an alert.

21.3.3.1 Monitoring, Logging, and Retention

The organisation must document and implement the technical and procedural controls for monitoring physical security system at all access points at all times. Unauthorised access attempts must be reviewed immediately and handled in accordance with procedures. Logging will be
sufficient to uniquely identify individuals and the time of access. Physical access logs should be retained for at least ninety (90) calendar days.

 Routinely review network logs for anomalous / malicious behaviour via automated and manual techniques.

21.3.3.2 Maintenance and Testing

Each physical security system must be tested at least once every three (3) years to ensure it operates correctly. Testing and maintenance records must be maintained at least until the next testing cycle. Outage records must be retained for at least one (1) calendar year.

21.3.3.3 Third-party Relationship

Third-party vendors provide a wide variety of products and services. If these vendors are not exercising reasonable care in preparing for and responding to Cyber Security threats, incidents may occur that could have serious consequence. In order to mitigate such situations, the third-party vendor shall be required to have a signed contract for such Cyber Security protections as: (a) performing regular malware scans, (b) patching vulnerable systems in a timely manner, and (c) enforcing a strong password policy. Vendors shall provide notification of known vulnerabilities affecting vendor-supplied, application, and third-party software within a pre-negotiated period after public disclosure. Vendors shall verify and provide documentation that all services are patched to current status. Vendors shall provide a configurable account password management system that allows for selection of password length, frequency of change, setting of required password complexity, number of login attempts, inactive session logout, screen lock by application, and denial of repeated or recycled use of the same password.

In the case of pre-existing contracts and relationships, it is crucial first to perform a full audit of these previous contracts to determine whether Cyber Security gaps exist, and then to determine how best to fill any gaps through contract renegotiation with the vendor. Vendors shall provide details on their patch management and update process.

21.3.4 Network Security

Network Security is the protection of all data that leaves or enters the local computer or server from the network. Controlled by a network administrator, network security involves the authorisation of access to data in a network, and preventing and monitoring unauthorised access, misuse, modification, or denial of a computer network and network-accessible resources. Refer to Section 21.3.2.2, “Access Control, Monitoring, and Logging” for more on Network Security and access control. Intrusion Detection Systems (IDSs) shall be used to detect any anomalous behaviour on network. If anomalous behaviour is encountered, the potentially compromised nodes on the network must be isolated from the rest of the network.

All settings used on network hardware shall be set to their secure settings. Settings provided by each piece of hardware must be fully understood. Do not assume that default settings are secure.
21.3.4.1 Network Connection Control

User assigned devices shall be restricted to connection to specified network segments only, and shall be uniquely identified and approved for use. Care shall be taken in granting authorised connections to network segments where information of a higher security classification is stored, processed, and/or transmitted and the user of that device has not been granted access to information assets of that classification. Source of network time shall be accurate and that accurate time shall be reflected on all network nodes for all actions taken and events logged.

User devices shall be prohibited from cross-connecting (i.e., acting as a router) between any two networks. Unneeded network services shall be disabled.

21.3.4.2 Firewall

Firewalls play an important role in establishing the first line of defence against cyber threats. Combined with anti-spyware, anti-virus and anti-spam software, strong passwords and safe online practices, a firewall adds a layer of protection that helps enhance Cyber Security. Firewalls protect the computer and information from: (a) hackers breaking into the system; (b) viruses and worms that spread across the Internet; and (c) outgoing traffic from the host computer created by a virus infection.

Firewalls and virtual local area networks (VLANs) technologies shall be used to properly segment the network and to increase its compartmentalisation (e.g., machines with access to business services like e-mail should not be on the same network segment as SCADA machines). Firewall rules shall be routinely reviewed and tested to confirm expected behaviour.

Firewalls shall be configured in accordance with the organisation’s standards and policies, and deny any of the following traffic types:

a. Firewalls and other boundary security mechanisms that filter or act as a proxy for traffic from one network segment to another of a different security level.

b. Invalid source or destination address (e.g., broadcast addresses, RFC 1918 address spaces on interfaces connected to public networks, addresses not assigned by IANA on interfaces connected to public networks).

c. Those destined for the firewall itself, unless the firewall provides a specific service (e.g., application proxy, VPN).

d. Source routing information.

e. Directed broadcasts that are not for the subnet of the originator (these can be used to create broadcast storms in denial-of-service attacks against third-parties).

f. Destined for internal addresses or services that have not been approved for access from external sources.

Requests for allowing additional services through a firewall or other boundary protection mechanisms must be approved by the information security manager.
21.3.4.3 Flow of Electronic Communications

Client systems shall communicate with internal servers. The internal servers shall communicate with the external systems via an intermediate system. The flow of traffic shall be enforced through boundary protection mechanisms.

Ensure channel security of critical communication links with technologies like Transport Layer Security (TLS). Where possible, implement Public Key Infrastructure (PKI) to support two-way mutual certificate-based authentication between nodes on the network.

Ensure that only standard, approved, and properly reviewed communication protocols are used on the network.

21.3.4.4 Protecting Data in Transit

When any non-public classified data transits a network and the confidentiality and integrity of that data cannot be guaranteed because of the use of protocols which do not provide a mechanism for protecting the data payload, encryption shall be used to guard against disclosure and modification of the data.

Ensure availability, integrity, and confidentiality of data traversing the networks through use of digital fingerprints and signed hashes. If channel-level encryption is not possible, apply data-level encryption to protect the data traversing the network links. Time stamps to protect against replay attacks must be ensured. No actions should be taken based on the data coming from network nodes that may have been compromised.

Ensure that proper certificate and key management practices are in place. Remember that cryptography does not help if the encryption key is easy to compromise. Ensure that keys are changed periodically and that they are changed right away in the event of compromise.

21.3.4.5 Protecting Domain Name Service (DNS) Traffic

DNS provides a mechanism for resolving host names into Internet Protocol (IP) addresses in the internet. Due to its ability to map human memorable system names into computer network numerical addresses, its distributed nature, and its robustness, the DNS has evolved into a critical component of the Internet. Insecure underlying protocols and lack of authentication and integrity checking of the information within the DNS threaten the proper functionality of the DNS. The threats that surround the DNS are due in part to the lack of authenticity and integrity checking of the data held within the DNS and in part to other protocols that use host names as an access control mechanism. The DNS shall be deployed in a multitier architecture that protects internal systems from direct manipulation. Internal client resolvers shall direct their queries to internal DNS servers, which forward all queries for external resource records to DNS server(s). The flow of traffic shall be enforced through boundary protection mechanisms.
21.3.4.6 Network Routing Control /Use of Secure Routing Protocols or Static Routes

When exchanging routing information with external parties, secure routing protocols or static routes shall be used. If possible, network address translation shall be employed to prevent accidental leakage of internal routing information. Rules include:

a. Users and devices shall not be allowed to specify the routing of network traffic. Development, test, and production environments shall be separated.

b. Sufficient redundancy shall be ensured to exist in the network links so that rerouting traffic is possible if some links are compromised.

21.3.5 Platform Security Risks

Platform security risk focuses on the operating systems and other software making up the software stack on top of which an organisation’s custom applications run. Each accessible host on an organisation’s network is a potential target for attack. Adversaries will try to compromise these hosts via methods that cannot be mitigated through network security controls alone. It is imperative to ensure that the platform software running on the hosts is secure, including (but not limited to) operating system software, database software, Web server software, and application server software. Together these form a software stack on top of which an organisation’s custom applications run.

21.3.6 Application Security

In-house developed or custom-procured application software must be developed with security in mind from the get-go to help ensure that it does not contain any software security weaknesses that may be exploited by adversaries to compromise the system. The software development process therefore must be security aware.

21.3.7 Unique Security Requirements and Controls

This section describes unique security best practices and controls needed for the grid modernisation and/or smart grid applications.

21.3.7.1 Advanced Metering Infrastructure (AMI)

The AMI network consists of various software & hardware components, and networks for communication. These include: (a) “head end” operating on the utility network; (b) wide area network (WAN) that provides communications from the utility head end out to the field; (c) field access or collection points on the edge of the WAN providing connections and/or consolidation for metering data access, and (d) mesh network known as a local area network (LAN) or neighbourhood area network (NAN) providing sub-networks of Meters, extending the reach to a larger Meter population. Home area networks (HAN) are also used to provide interfaces into the home to support customer awareness of energy consumption and to extend support for demand response functionality.

The security requirement for AMI begins with establishing fidelity of the meter data. Since smart Meters in the field are readily available, with few if any physical security controls, an attacker gaining physical access to the smart meter may “patch” their firmware, thereby compromising the
smart meter. From this point on, any data supplied by the smart meter to the SCADA can no longer be trusted. If the attacker can repeat the same tactic on a broader scale, it may be possible for the hacker to generate incorrect actions for the SCADA system based on meter readings from compromised Meters. Detection of a compromised meter through remote attestation and other state-of-the-art techniques is therefore of utmost importance.

It is important to note that an attacker need not gain physical access to many Meters. Since Meters are networked together, gaining access to one smart meter, downloading its firmware, reverse engineering the firmware to look for software vulnerabilities (e.g., buffer overflow), and then creating a root kit that can exploit that vulnerability to modify the functionality of the smart meter is all an attacker needs to do. A worm can then be used to propagate that root kit from one smart meter to another via a network that connects them. An attacker may then have a botnet of compromised smart meters that he or she can activate at any time to achieve the attack goal (e.g., cause a blackout).

a. The following actions shall be taken in order to help mitigate this vulnerability: Verify with the software/hardware vendors (with embedded software) with proof of evidence (e.g., third-party assessment) that their software is secure and free of security weaknesses.

b. Perform remote attestation of smart meters to ensure that the firmware has not been modified.

c. Make use of communication protocol security extensions (e.g., MultiSpeak® security extensions) to ascertain the integrity, including the origin integrity, of smart meter data.

d. Establish and maintain secure configuration management processes (e.g., when servicing field devices or updating their firmware).

e. Ensure that all software (developed internally or procured from a third-party) is developed using security-aware SDLC.

f. Apply a qualified third-party security penetration test to all hardware and software components prior to live deployment.

g. Ensure that the software running on the smart meter is free of software weaknesses, especially if they are remotely exploitable. Otherwise, an attacker may be able to take control of a user’s smart meter to begin manipulating the climate in the user’s home. When done on a large scale, this may result in blackouts.

h. Implement physical security controls and detection mechanisms when tampering occurs.

i. Ensure that a reliable source of network time is maintained.

j. Disable the remote disconnect feature that allows electricity to be remotely shut down using a smart meter.

To safeguard end user privacy, smart meter information shall be decoupled from Customer information. Meter identification shall be done through a generic number instead of a specific household address, GPS location, etc.
21.3.7.2 Meter Data Management System (MDMS)

Data imported into MDMS must be thoroughly validated for syntax and semantic for both privacy and data security issues. The following actions must be ensured:

a. Data received by MDMS does not come from a compromised Meter.

b. Data received by MDMS undergoes validation, estimation, and editing (VEE) protocols to ensure data integrity and completeness.

c. Appropriate exception handling mechanism is available in place for compromised data.

d. MDMS has been designed and implemented using security-aware SDLC.

e. MDMS system has passed a security penetration test by a qualified third-party.

f. Denial-of-service attempts (from compromised meters) are handled gracefully by MDMS.

21.3.7.3 Communication System

Communication system security has been covered under Network Security in Section 21.3.4 of this chapter. Following is a list of actions important for the communication system security:

a. Ensure data integrity

b. Ensure origin integrity.

c. Use proven communications protocols with built-in security capabilities.

d. Ensure confidentiality of data where appropriate.

e. Ensure proper network segmentation.

f. Have a third-party perform network security penetration testing.

g. Implement sufficient redundancy.

h. Protect from man-in-the-middle attacks.

i. Protect from replay attacks.

j. Use proven encryption techniques.

k. Use robust key management techniques.

21.3.7.4 Supervisory Control and Data Acquisition (SCADA)

SCADA system is a part of a utility’s critical infrastructure and requires protection from a variety of threats that exist in cyber space. The following actions shall be taken to ensure Cyber Security of SCADA networks:

a. Appoint a senior security manager with a clear mandate.

b. Establish policies to minimise the likelihood of inadvertent disclosure of sensitive information regarding SCADA system design, operations, or security controls by organisational staff.

c. Conduct personnel security awareness training.
d. Clearly define Cyber Security roles, responsibilities, and authorities for managers, system administrators, and users.

e. Apply basic network and system IT security practices (e.g., regular security patches, run antivirus software, etc.).

f. Ensure that software running in the SCADA environment (e.g., either internal or external) has been built with security in mind and reviewed for security by a qualified third-party.

g. Enforce the principle of least privilege when it comes to granting user access to SCADA resources.

h. Conduct physical security surveys and assess all remote sites connected to the SCADA network to evaluate their security.

i. Disconnect unnecessary connections to the SCADA networks.

j. Document network architecture and identify systems that serve critical functions or contain sensitive information that need additional level of protection.

k. Establish a rigorous ongoing risk management process.

l. Conduct routine self-assessments.

m. Establish system backups and disaster recovery plans.

n. Test business continuity and disaster recovery plans.

o. Establish SCADA “Red Teams” to identify and evaluate possible attack scenarios.

p. Implement internal and external intrusion detection systems and establish 24-hours-a-day incident monitoring.

q. Perform technical audits of SCADA devices, networks, and any other connected networks to identify security concerns.

r. Perform monitoring and logging, and ensure that people are held accountable for their actions.

s. Avoid taking critical control decisions without human confirmation.

t. Avoid taking critical control decisions based on too few data points.

u. Avoid taking critical control decisions based on data points from compromised field devices or based on data that has been tampered with.

v. Ensure proper network segmentation in the SCADA environment.

w. Ensure sufficient fault tolerance and redundancy in the SCADA environment.

x. Use individual (rather than shared) user login accounts with strong passwords.

y. Ensure that all hardware authentication settings have been changed from their default values.

21.3.7.5 In-Home Display (IHD)

IHD provides Customers with information on energy consumption. The security of this device is critical from the customer’s perspective in both preventing others from sneaking as well as preventing someone from using that device to manipulate household appliances. An attacker may
be able take control of a user’s IHD to begin manipulating the climate in the user’s home. When done on a large scale, this may result in blackouts due to overloads. Attacks could be launched wirelessly through AMI network, communication channel, or the internet.

Additionally, if utilities and third-parties bundle internet access as a potential marketing hook, the device will also be subject to potential malware when a Customer surfs the internet. It is therefore imperative to have a mechanism for frequent security patches. The following actions shall be taken to ensure security of IHD:

a. Ensure that the software running on IHDs is free of software weaknesses
b. Ensure the integrity of data shown on the user’s IHD.
c. Ensure the integrity of data sent from the user’s IHD to the control centre.
d. Ensure the anonymity and privacy of data (where appropriate) pertaining to electricity usage patterns such that it cannot be tied back to the customer.
e. Perform remote attestation of IHDs to alert the control centre when unauthorised firmware updates occur.
f. Request third-party security penetration testing of IHDs

<table>
<thead>
<tr>
<th>Risk</th>
<th>Impact</th>
<th>Mitigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of security training and awareness.</td>
<td>Insufficiently trained personnel may inadvertently provide the visibility, knowledge, and opportunity to execute a successful attack.</td>
<td>All employees must undergo security training when hired and at least once a year thereafter. The degree and nature of security training for personnel shall vary based on their job function.</td>
</tr>
<tr>
<td>Inadequate technology &amp; processes for identification/authentication</td>
<td>Online transaction and data/information privacy are vulnerable with identity fraud and theft</td>
<td>Identity proofing through appropriate background checks for all new hires must be done. Access to sensitive information and resources shall be given only after proper authentication and authorisation.</td>
</tr>
<tr>
<td>Inadequate security policy</td>
<td>Inadequate policies that do not drive operating requirements and procedures lead to vulnerabilities in Cyber Security.</td>
<td>Security policies must adequately cover all aspects of maintaining a secure environment.</td>
</tr>
<tr>
<td>Insufficient privacy policy</td>
<td>Undesirable exposure of employee/Customer/client personal information could pose business and security risk.</td>
<td>Adequately defined privacy policies must cover all aspects of safeguarding access to private information.</td>
</tr>
<tr>
<td>Lack of management oversight for security.</td>
<td>Without sponsorship of senior management, it is not possible to successfully enforce a security program in the event of a policy compromised or abuse.</td>
<td>Assign a senior manager to be in charge of the overall security program who can make appropriate decisions in the event of the policies need to be modified.</td>
</tr>
<tr>
<td>Inconsistent action in revocation of employee access</td>
<td>Not revoking access of terminated employees could be a threat to Cyber Security that may lead to unauthorised access, and sabotage.</td>
<td>Employees shall have access to resources and systems only as needed to perform their job function for the duration as needed. All access for terminated employees shall be revoked before notifying them of termination.</td>
</tr>
<tr>
<td>Operational Risks</td>
<td>Potential Impact</td>
<td>Mitigation</td>
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<td>--------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
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<tr>
<td>Lack of patch management process.</td>
<td>Missing patches potential risks to the affected system.</td>
<td>Security patches shall be applied as appropriate, with automated alerts</td>
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<tr>
<td>Lax access control</td>
<td>Unauthorised users can obtain/modify/delete sensitive information</td>
<td>Periodically review the lists for each critical resource or system</td>
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<tr>
<td>Inadequate change and configuration management.</td>
<td>Improperly configured software/systems/devices lead to insecure configurations and</td>
<td>All hardware and software must be configured securely. When unclear, seek</td>
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<td>an increased risk of vulnerability.</td>
<td>further clarification from vendors as to secure settings and do not assume</td>
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<td></td>
<td></td>
<td>that shipped default settings are secure. Establish change management and</td>
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<td></td>
<td>approval processes for making changes to the configuration to ensure that the</td>
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<td></td>
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<td>security posture is not jeopardised.</td>
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<tr>
<td>Lack of periodic security audits.</td>
<td>Failure to perform periodic security audits may lead to unidentified security risks</td>
<td>Periodic security audits shall focus on assessing security</td>
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<td></td>
<td>and/or process gaps.</td>
<td>controls for (a) people and policy, (b) operations, (c) network, (d)</td>
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<td></td>
<td>platform, (e) application, (f) process, (g) physical security, and (h)</td>
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<td></td>
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<td>third-party relationships.</td>
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<tr>
<td>Inadequate continuity of operations and disaster recovery plan.</td>
<td>Causes longer- than-necessary recovery from a possible plant or operational outage</td>
<td>An associated cyber contingency plan and Cyber Security incident response plan</td>
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<td>shall be developed within the various plant/system disaster recovery plans in</td>
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<td>place. Disaster recovery plans shall highlight the need to determine if the</td>
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<td>disaster was created by or related to a Cyber Security incident. Steps shall</td>
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<td>be taken to validate, backup, and ensure devices being recovered are clean</td>
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<td>before installing the backups, incident reporting, etc.</td>
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<tr>
<td>Inadequate risk assessment process.</td>
<td>Inadequate understanding of the actual risk may lead to poor and ineffective</td>
<td>A documented risk assessment process that includes consideration of business</td>
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<tr>
<td></td>
<td>decisions</td>
<td>objectives, the impact to the organisation if vulnerabilities are exploited, and</td>
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<td>the determination by senior management of risk acceptance is necessary to</td>
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<td></td>
<td>ensure proper evaluation of risk.</td>
</tr>
<tr>
<td>Inadequate risk management process.</td>
<td>Could result in major risks being unaddressed</td>
<td>A systematic approach of risk management process shall use the results of the</td>
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<td>risk assessment to initiate timely and appropriate risk mitigation in a fashion</td>
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<td>commensurate with their likelihood and impact. An executive dashboard shall</td>
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<td>be developed to show all risks where mitigations are past due.</td>
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<tr>
<td>Insufficient incident response process.</td>
<td>Time-critical response actions may not be completed in a timely manner, leading</td>
<td>An incident response process is required to ensure proper</td>
</tr>
<tr>
<td></td>
<td>to the increased duration of risk exposure.</td>
<td>notification, response, and recovery in the event of an incident.</td>
</tr>
</tbody>
</table>
### Table 21-3: Third-Party Risks and Mitigation

<table>
<thead>
<tr>
<th>Risk</th>
<th>Impact</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to specify security requirements in RFPs.</td>
<td>Products/services will not meet security requirements of the system</td>
<td>Security requirements shall be reflected in the RFPs, and contract</td>
</tr>
<tr>
<td>Failure to request results of independent security testing of hardware and software prior to procurement.</td>
<td>Procurement may not meet standards of security requirements.</td>
<td>Hardware/software vendors must be required to have their products reviewed by third-party security experts and to share the reports.</td>
</tr>
<tr>
<td>Failure to request evidence from a third-party vendor of its risk management and security practices.</td>
<td>Products/services will have insufficient security measures</td>
<td>Vendor’s risk management and security practices shall be reviewed to ensure that they adhere to appropriate standards.</td>
</tr>
<tr>
<td>Failure to request information from a third-party on its secure SDLC process.</td>
<td>A SDLC process that does not follow security development practices will likely result in insecure software.</td>
<td>Software vendor shall demonstrate a secure software development process.</td>
</tr>
</tbody>
</table>

### Table 21-4: Network Risks and Mitigation

<table>
<thead>
<tr>
<th>Risk</th>
<th>Impact</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unneeded services running.</td>
<td>Every service that runs is a security risk, because intended use of the service may provide access to system assets, and the implementation may contain exploitable bugs.</td>
<td>Perform analysis to identify all services that are needed, and only have these enabled. Establish a process for obtaining permission to enable additional services. Conduct periodic reviews to ensure that the services are running as expected.</td>
</tr>
<tr>
<td>Insufficient log management.</td>
<td>(a) Failure to detect critical events; (b) Removal of forensic evidence; (c) Log wipes</td>
<td>Events from all devices should be logged to a central log management server. Alerts should be configured according to the criticality of the event or a correlation of certain events. For instance, when the tamper-detection mechanism on a device is triggered, an alert should be delivered to the appropriate personnel. When a remote power disconnect command is issued to x number of meters within a certain time, alerts should also be sent.</td>
</tr>
</tbody>
</table>

### Table 21-5: Platform Risks and Mitigation

<table>
<thead>
<tr>
<th>Risk</th>
<th>Impact</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient Authentication and authorisation process for all components</td>
<td>Denial of service (DoS)/distributed denial of service (DDoS) attacks may overwhelm a software system by overloading it with data requests ultimately causing platform shutdown and data/assets stolen</td>
<td>Enforce multi-layer authentication. Institute sound key management practices. Ensure secure key exchange. Ensure that the authentication process cannot be bypassed.</td>
</tr>
<tr>
<td>Monitoring for unusual activities not performed</td>
<td>System may be vulnerable to fraudulent activities</td>
<td>Ensure dedicated senior management to rigorously enforce policies and procedures</td>
</tr>
</tbody>
</table>
This chapter contains requirements specific to both the *EAPP IC* and the *KNTGC*. If in any instance there is a difference in requirements, the more stringent requirement shall hold.

### 22.1 EAPP IC REQUIREMENTS

#### 22.1.1 Introduction

The *System Operator* Training Chapter (SOTC) sets out the responsibilities and the minimum acceptable requirements for the development and implementation of *System Operator* Training and Authorisation programmes. The SOTC shall ensure that *System Operators* throughout *EAPP* and the *EAC* are provided with continuous and coordinated operational training in order to promote the reliability and security of the *EAPP Interconnected Transmission System*.

#### 22.1.2 Objective

The objectives of the *System Operator* Training Chapter are to establish mandatory continuing training and authorisation to improve and maintain *System Operator* capability and performance in their job tasks.

#### 22.1.3 Responsibility

*TSOs* shall establish and authorise the *System Operator* positions that will have the responsibility in their *Control Centres* for the safe and reliable operation of the *EAPP Interconnected Transmission System* and *National System*. *TSOs* shall also be responsible for the ongoing training of their *System Operators* in accordance with the SOTC. In a *TSO’s Control Centre* and in the *EAPP CC* at least one *System Operator*, authorised in accordance with the SOTC, shall be on duty at all times and shall be responsible for the operation of the *EAPP Interconnected Transmission System* and for complying with the *EAPP/EAC* Interconnection Code.

#### 22.1.4 Scope

Reliable operation of the *EAPP Interconnected Transmission System* requires highly trained and tested *System Operators* who are able to evaluate information on the current status of their *National System* and *EAPP Interconnected Transmission System*. They must evaluate possible risks to system reliability, and make near-instant decisions about actions necessary to protect the system in a safe and reliable manner under all conditions. When recruiting *System Operators*, each *TSO* shall ensure that they have basic qualifications and shall provide them with a continuous and coordinated training and authorisation. *System Operators* should be selected on the basis of their level of intellectual and reasoning ability and their capacity for working under stressful conditions. They should have good engineering, mathematical and problem-solving skills and communicate clearly both in writing and verbally. *System Operators* shall also have sufficient language skills to enable them to communicate with other *EAPP Control Centres* under operational conditions in both the English and French languages. *System Operators* must be able to deal with their peers in other...
Control Centres and also with regulators, Generation Licensees, and End-use Users. System Operators should be capable of supervising and training other operating personnel in their own National System.

22.1.5 Need for Training

System expansions, new technologies, and modifications of market and regulatory rules require changing functionalities in Control Centres. As the markets expand and the EAPP Interconnected Transmission System becomes more congested, operational reliability is crucial and requires more robust data acquisition, better analysis, and faster coordinated controls. To ensure smooth operation of the EAPP Interconnected Transmission System and National Systems under steady-state and disturbed conditions, a number of technical rules and recommendations also need to be followed. The functions and responsibilities set out above require qualified, skilled, and well-trained System Operators at the Control Centres to direct the operation of EAPP Interconnected Transmission System in a reliable and secure manner.

22.1.6 Authorisation of System Operators

System Operators in the EAPP Coordination Centre and in the TSO Control Centres shall be authorised in accordance with the SOTC. The training and authorisation of System Operators is the responsibility of EAPP in the case of the EAPP Coordination Centre and individual TSOs in the case of their Control Centres. There are two levels of authorisation:

a. Basic Authorisation: This level of authorisation is for new recruits to the System Operator function and requires the completion of the Initial Course and the passing of an examination. This authorisation will be valid for three (3) years.

b. Continuing Authorisation: This level of authorisation is for System Operators who are already performing the role. The Continuous Course to be followed involves the accumulation of credits. Sufficient credits must be obtained every three (3) years in order to maintain authorisation.

22.1.7 Training of System Operators

The training of System Operators consists of two courses. The content of the Initial Course is aimed at new recruits to the System Operator position and assumes a good knowledge of electrical engineering principles. It introduces the basics of system operation using the EAPP Interconnected Transmission System to illustrate the concepts and to instil knowledge on how the overall system operates at all times and under all conditions. The Initial Course is of six (6) month duration for trainees without experience in power system operation, including three (3) months for on-the-job and simulator training.

The Continuous Course is targeted at System Operators to enable them to maintain their proficiency and professional development throughout their career. The Continuous Course is required to be completed before expiry of the previous authorisation and will require the accumulation of a number of credits to be defined by the EAPP Steering Committee.
The training programme will introduce the basics of interconnected system operation and control practices including security analysis, stability studies, optimal power flow and system management. The deregulation processes adopted in EAPP Member Countries will be covered. Different restructuring models and technical problems in operation and control including congestion management, Ancillary Services, Automatic Generation Control, demand forecasting, power systems security and state estimation will be discussed.

The detailed course material shall be reviewed periodically to account for changing requirements and developments in Prudent Utility Practice. The EAPP Steering Committee shall establish a Committee of experts to review the training needs to ensure that the content of both courses is relevant and covers all aspects.

22.1.8 Initial Course

22.1.8.1 Theoretical Modules

The structure of the theoretical part of the Initial Course should provide a first level of competencies in the following main topics:

a. Types of overhead lines and underground cables with their components;

b. Different types of HV and EHV substations, HVDC converters, circuit breakers, isolator-ground switches, power transformers, measurement and protection transformers, tap changers, reactors, capacitors, phase shifting transformers, other electronic regulators (SVC, FACTS), telecommunication systems, protection relays;

c. Types of Generating Units and their operational characteristics e.g. response times.

22.1.8.2 Operation Modules

This will include all relevant national and international regulations and market rules as well as the knowledge and analysis of the necessary conditions for safe and reliable system operation. This category might include modules on the following aspects:

a. Network behaviour, network operation, power flows and system frequency;

b. Basics of system protection;

c. Voltage and Reactive Power control;

d. Balancing (Primary and Secondary Response and Tertiary Reserves), Automatic Generation Control;

e. EAPP Interconnection Code and National Grid Codes;

f. Other technical or operational policies of the TSO;

g. Emergency scenarios including manual and automatic remedial actions and system restoration philosophies;

h. Electricity Market operations;

i. Communication and reporting of system incidents.
22.1.8.3 Practical Modules

Trainees should receive training in the following topics:

a. Data collection and configuration of SCADA and EMS;

b. Models implemented for state estimation, system, Contingency analysis, Automatic Generation Control, and demand forecasting;

c. System Operator’s Man-Machine Interface;

d. Training on Power System Protection.

22.1.8.4 Simulator Training

System Simulator based training bridges the gap between theory and practice and is also used to enhance the skills of experienced System Operators. During the Initial Course trainees should use the Simulator to experience the following:

a. Simulation of system performance under SCADA real-time conditions;

b. Restoration of the system following a blackout;

c. Use of the Control Centre User Interface;

d. Decision making under stress conditions;

e. Operation under emergency conditions.

22.1.8.5 On Job Training

Training on shift in the Control Centre is a most important part of the Initial Course. The training should concentrate on the future position and responsibilities of the trainee and should cover all relevant operational aspects relevant to the position. On job training puts into practice all the topics of the Theory Modules and the trainees should be supervised by experienced System Operators.

22.1.9 Continuous Course

The Continuous Course is an ongoing training programme aimed at System Operators who have already been authorised. It focuses on advanced theoretical and practical aspects of system operation as well as on cross-border issues. Each TSO should implement a Continuous Course with two modules.

22.1.9.1 Theoretical Module

The Theoretical Module should provide advanced technical knowledge on the following main topics:

a. Analysis of past system disturbances and ‘near-misses’;

b. System operation including security analysis, optimal power flow, transient and dynamic stability and operation under emergency conditions;

c. New risks and conditions affecting system operation including new network elements or Generating Units;
d. Modifications to the *EAPP/EAC* Interconnection Code and National Grid Codes and other new technical and operational rules and procedures.

### 22.1.9.2 Simulator Training

Training on the System Simulator should be concerned with the ‘play back’ of system incidents and with the lessons to be learned from them. The training should also include ‘live’ interaction with *Control Centres of Neighbouring Systems* in the handling of cross-border incidents.

### 22.1.10 Combined Training

Cooperation and communication between *System Operators* in the National Control Centres and the *EAPP CC* is essential for the successful and coordinated operation of the *EAPP Interconnected Transmission System*. This cooperation shall be fostered by joint training programmes between TSOs. These programmes could include:

a. Exchange visits between *Control Centres* including periods on-shift;

b. Joint training workshops;

c. Common System Simulator training.

### 22.2 Kenya National Transmission Grid Code Requirements

#### 22.2.1 Operations Training Seminar

a. The *Kenya National TSO* will, at a minimum, annually host a training seminar. The purpose of the training seminar is to provide a forum for system wide problems to be effectively addressed. The training seminar should present information to maintain the consistency of operators across all of the *Kenya National TSO* Region.

b. The seminar provides a forum for *Users*. The *Kenya National TSO* shall meet and analyse common topics and issues as well as participate in formal training sessions that impact all *Users*.

#### 22.2.2 Severe Weather Drill

The *Kenya National TSO* shall conduct a severe weather drill each year. This drill will be used to test the scheduling and communication functions of the primary and/or backup centres and train operators in emergency procedures. The *Kenya National TSO* shall participate in the drill. The *Kenya National TSO* shall appoint a drill coordinator for developing and coordinating the annual severe weather drill. The *Kenya National TSO* shall appoint a Working Committee to review and critique the results of completed severe weather drills that will ensure effectiveness and recommend changes as necessary. The *Kenya National TSO* shall verify and report Entity participation to the appropriate authority.

#### 22.2.3 Training Practices

Each *Licensee* shall establish a clear requirement, define and develop a systematic approach in administering the training, and provide the necessary feedback as a measurement of curriculum
suitability and trainee progress. Each entity should recognise the importance of training and provide sufficient operator participation through adequate staffing and work-hour scheduling.

The **Regulatory Authority** shall certify the training practices established by each **Licensee**.

### 22.2.4 Operator Certification

The *Kenya National TSO* Certification shall verify that an individual has knowledge of fundamental topics in electrical power and power system operations in Kenya. The certification shall be achieved through self-study of the *Kenya National TSO* Training Manual, followed by successful completion of a written examination over the subject matter contained in the Manual.
## APPENDIX A DEROGATION REQUEST AND MITIGATION PLAN FORMS

### A.1 KENYA NATIONAL TRANSMISSION GRID CODE DEROGATION REQUEST FORM

<table>
<thead>
<tr>
<th>Name of Entity:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Name (CEO or delegated Officer):</td>
<td>Contact Phone:</td>
</tr>
<tr>
<td>Signature (CEO or delegated officer):</td>
<td></td>
</tr>
<tr>
<td>Type of Derogation Being Requested (Indicate One):</td>
<td>Exemption</td>
</tr>
<tr>
<td>If Mitigation: Proposed date by which mitigation plan will be filed:</td>
<td></td>
</tr>
<tr>
<td>Date by which the non-compliance will be remedied:</td>
<td></td>
</tr>
<tr>
<td>Date of Non-Compliance Discovery:</td>
<td></td>
</tr>
<tr>
<td>Date Non-Compliance Reported:</td>
<td></td>
</tr>
<tr>
<td>Code Section Title:</td>
<td>Code Section Number:</td>
</tr>
<tr>
<td>Described the nature and extent of the Non-Compliance (Attach)</td>
<td></td>
</tr>
<tr>
<td>Describe the cause of Non-Compliance (Attach)</td>
<td></td>
</tr>
<tr>
<td>Identification and Description of the system, facility, equipment, process, procedures or specific connection point in respect of which the Derogation is sought (Attach)</td>
<td></td>
</tr>
</tbody>
</table>
## A.2 Kenya National Transmission Grid Code Mitigation Plan Form

<table>
<thead>
<tr>
<th>Name of Entity:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Section Title:</td>
<td>Code Section Number:</td>
</tr>
</tbody>
</table>

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)
The standards listed in Table B-1 shall apply to all *Metering Equipment* in Kenya.

**Table B-1: Metering Standards Applied in Kenya**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO/IEC 17025</td>
<td>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)</td>
</tr>
<tr>
<td>IEC 60044 - 2 (replaced by IEC 61869 - 3)</td>
<td>Requirements for voltage transformers to be used with electrical measuring instruments and protective devices at frequencies from 15 Hz to 100 Hz.</td>
</tr>
<tr>
<td>IEC 60044 - 3 (replaced by IEC 61869 - 4)</td>
<td>Requirements for combined transformers</td>
</tr>
<tr>
<td>KS IEC 60044 -5 (replaced by IEC 61869-5)</td>
<td>Requirements for single-phase capacitive voltage transformers connected between line and ground for system voltages $U_m \geq 72.5$ kV at power frequencies from 15 Hz to 100 Hz. They are intended to supply a low voltage for measurement, control and protective functions</td>
</tr>
<tr>
<td>KS IEC 60044 -1 (replaced by IEC 61869-2)</td>
<td>Requirements for current transformers to be used with electrical measuring instruments and protective devices at frequencies from 15 Hz to 100 Hz.</td>
</tr>
<tr>
<td>IEC 61000 - 3-2: 2014</td>
<td>Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current $\leq 16$ A per phase)</td>
</tr>
<tr>
<td>IEC 62053-20:2003</td>
<td>Automatic Meter Reading</td>
</tr>
<tr>
<td>Standard</td>
<td>Type</td>
</tr>
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<td>------------------</td>
<td>----------------------------------------------------------------------</td>
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<td>(class 1.0)</td>
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<tr>
<td>IEC 62053-23:2003</td>
<td>Electricity Metering Equipment (a.c.) - Particular Requirements - Part 23: Static Meters for Reactive Energy (classes 2 and 3)</td>
</tr>
<tr>
<td>KS IEC 62054 - 21</td>
<td>Accuracy of the Real Time Clock</td>
</tr>
<tr>
<td>IEC 62056-21:2003</td>
<td>Electricity Metering, Data Exchange for Meter Reading, Tariff, and Load Control - Part 21: Direct Local Data Exchange</td>
</tr>
<tr>
<td>KS IEC 62059</td>
<td>Electricity Metering Equipment Dependability</td>
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<tr>
<td>Chapter</td>
<td>Comments</td>
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