



NATIONAL ELECTRICITY GRID CODE



REPUBLIC OF GHANA

October, 2009



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Part A: General Provisions

Section 1. PREAMBLE

Purpose and scope of the National Grid Code

Art 1.00 The National Electricity Grid Code of Ghana referred to in this document as the Grid Code, establishes the requirements, procedures, practices and standards that govern the development, operation, maintenance and use of the high voltage transmission system in Ghana. The purpose of the Grid Code is to ensure that the NITS provides fair, transparent, non-discriminatory, safe, reliable, secure and cost efficient delivery of electrical energy.

Art 1.01 This Grid Code is issued by the Energy Commission and it is based on the provisions of sections 24, 27 and 28 of the Energy Commission Act, 1997 (Act 541) that work together to ensure the coordinated operation of the high voltage transmission system within Ghana.

Art 1.02 The Grid Code describes the responsibilities and obligations associated with all the functions involved in the supply, transmission and delivery of bulk electric power and energy over the NITS including the functions of the ETU, a NITS Asset Owner, a Wholesale Supplier, a Distribution Company and a Bulk Customer.

Scope of the NITS

Art 1.03 In accordance with the Act, the Energy Commission has determined that the NITS shall comprise **“all electricity plant and equipment within the borders of Ghana that function or are operated at any voltage higher than 36 kV as well as any associated feeder or supply equipment that are for shared or common use”**.

Art 1.04 Accordingly the operational boundary of the NITS includes

- (a) the high voltage terminal of a step-up transformer at a generating station,
- (b) all transmission lines, and
- (c) substation equipment up to either the step-down transformer of a single-user sub-station or the last shared-use feeder equipment.

For the avoidance of doubt the term NITS incorporates all equipment which form part of the national interconnected transmission system irrespective of ownership or whether it is dedicated to the service of an entity.

Structure of the Grid Code

Art 1.05 The provisions of the Grid Code have been crafted from a functional rather than an organizational perspective, so that they will remain relevant and applicable as the power industry is progressively reformed.

Art 1.06 The following provisions of Act 541 define the three legal instruments required for the regulation of the NITS:

(a) Section 24 – Conditions of Transmission Licence;

(b) Section 27 – Standards of Performance for Public Utilities; and

(c) Section 28 – Technical and Operational Rules of Practice.

Art 1.07 The Parts of the Grid Code are generally organized according to the legal instruments by which they are to be implemented.

Art 1.08 Part A of the Grid Code covers those provisions that are common to all the three legal instruments. This Part, the General Provisions, contains a definition of roles, responsibilities, terminology, exemptions and transitional measures as well as arrangements for the governance and management of the Grid Code.

Art 1.09 Part B of the Grid Code defines the Conditions of Transmission Licence. This Part contains the sub-codes that deal with planning responsibility, connection arrangements, rights and the requirements for transparency and non-discrimination.

Art 1.10 Part C, the Rules of Practice, details the arrangements for system operations, scheduling and safety.

Art 1.11 Part D, the Standards of Performance, states the indicators and benchmarks for quality and reliability of supply. It also contains the sub-code for metering which describes the applicable standards and installation arrangements for metering.

Art 1.12 Part E, the Definitions, provides meanings and definitions for special words and technical terms used in the text to bring out the meanings in the context that they have been used in the Grid Code

Art 1.13 Part F, the Technical Schedules, contains detailed technical information relevant for the implementation of the Grid Code to guide the operation of the NITS.

Art 1.14 Despite the separation, the different Parts of the Grid Code are intended to be consistent and complementary for the satisfactory delivery of transmission services.

Art 1.15 Nothing in this Grid Code precludes the application of evolving technologies and processes as they become available.

Section 2. ABBREVIATIONS

AFLC	Automatic Frequency Load Control
AFLS	Automatic Frequency Load Shedding
AGC	Automatic Generation Control
AVR	Automatic Voltage Regulation
BC	Bulk Customer
BST	Bulk Supply Tariff
COC	Compliance and Oversight Committee
CT	Current Transformer
ECOWAS	Economic Community of West African States
ECG	Electricity Company of Ghana
EMS.....	Energy Management System
EPA	Environmental Protection Agency
ETC.....	Electricity Technical Committee
ETU	Electricity Transmission Utility
GoG	Government of Ghana
GPS	Global Positioning System
GWh	Gigawatt-hour or one billion (10 ⁹) watt-hours of energy

National Electricity Grid Code

IEC	International Electro-technical Committee
ISO.....	Independent System Operator
ITU	International Telecommunication Union
kVar.....	KiloVar, or one thousand volt-amperes of reactive power
kW	Kilowatt or one thousand watts of active electric power
kWh	Kilowatt-hour or one thousand watt-hours of electrical energy
MOU	Memorandum of Understanding
MVar	Megavar, one million volt-amperes of reactive electric power
MW	Megawatt, one million watts of active electric power
NED	Northern Electricity Department of the VRA
NEP	National Electrification Programme
NTTS	National Interconnected Transmission System
PURC	Public Utilities Regulatory Commission
SCADA.....	Supervisory Control And Data Acquisition
TICo	Takoradi International Company
VAR	Volt Amperes Reactive
VRA	Volta River Authority
WAPP	West Africa Power Pool

Section 3. RULES AND RESPONSIBILITIES OF MAIN ACTORS

Background

Art 3.00 The open-access transmission service that is envisaged for the NITS in Ghana requires extensive coordination of the roles and responsibilities of the several actors to successfully deliver the required service.

Roles of main actors

Art 3.01 The ETU is the exclusive and independent operator of all transmission assets irrespective of ownership and shall play the central role in respect of activities related to the NITS. The ETU shall operate the system to offer fair, transparent and non-discriminatory services of prescribed standards and quality to all qualified entities.

Art 3.02 The ETC of the Energy Commission shall have the mandate to oversee the activities and decisions of the ETU towards ensuring the attainment of the objectives of the NITS.

Art 3.03 A NITS Asset Owner shall design, construct, own and maintain the transmission assets which will be used in providing transmission services.

Art 3.04 A Wholesale Supplier shall construct, maintain and operate power plants in accordance with the instructions of the ETU to provide supply through the NITS to consumers.

Art 3.05 A Distribution Company or Bulk Customer who wishes to receive power from the NITS shall design, construct and operate its network connected to the NITS in accordance with prescribed standards and in accordance with the instructions of the ETU.

Art 3.06 A Grid Participant who may wish to interconnect the NITS to the electricity networks of neighbouring countries in the WAPP shall do so in accordance with the provisions of this Grid Code, the ECOWAS Energy Protocol and the WAPP Operation Manual.

Compliance with laws and industry standards

Art 3.07 The ETU and all Grid Participants shall comply with all relevant laws, the requirements of the Grid Code, permits, Prudent Utility Practice and applicable international standards.

Responsibilities of the ETU

Art 3.08 The ETU shall operate the NITS to provide services in accordance with the Performance and Reliability Standards of the Grid Code. The ETU's responsibilities in this regard shall include:

- (a) the operation of all NITS equipment, installations and facilities in accordance with the operation instructions and guidelines for the respective equipment or in accordance with Prudent Utility Practices;
- (b) the provision of open, fair and non-discriminatory access and connection to the NITS for all licensed or permitted Grid Participants, in accordance with the regulations and provisions of the Grid Code;
- (c) the performance of all the planning functions related to the NITS;
- (d) making the necessary recommendations for transmission expansion projects to adequately meet the forecast requirements for demand growth, potential generation additions and customer reliability standards;
- (e) the scheduling of sufficient generation capacity to meet forecast demand in accordance with merit order principles and carrying out real-time operations, dispatching and controlling the output of generating units to ensure reliable and economic operation of the NITS;
- (f) the control and operation of the NITS to ensure security of the network within its technical limits and in accordance with the provisions of the Grid Code;
- (g) undertaking outage planning and coordinating maintenance activities of all equipment and facilities that will or are likely to impact on the reliability of the NITS;
- (h) the planning, development, supply, installation, commissioning and maintenance of adequate central SCADA/EMS system together with any necessary associated backup systems, telecommunication systems and the coordination of their expansion and upgrade;
- (i) the planning, development, installation and maintenance of Remote Terminal Units at transmission substations and generating stations and the coordination of their upgrade;
- (j) investigation and review of each major power system operational incident and the issuance of the relevant reports;
- (k) provision, installation, operation and maintenance of the main revenue metering system of the NITS;
- (l) administering power supply and power purchase agreements;

- (m) the real-time monitoring and recording of electric power and energy balance and the performance of the accounting and billing function for NITS supply and services;
- (n) the coordination of operations and liaising with WAPP interconnected utilities and the WAPP General Secretariat to carry out studies and analyses to ensure reliable operation of the WAPP;
- (o) the development of the System Operational Manual and Safety Rules for coordinated and safe operation of the NITS; and
- (p) supervising and ensuring adherence to Safety Rules by all Grid Participants.

Art 3.09 The ETU shall collect information and statistics, publish reports and disseminate information relating to the performance of the NITS.

Art 3.10 The ETU shall operate the NITS efficiently in accordance with the Grid Code.

Art 3.11 The ETU shall liaise with other bodies within Ghana that have regulatory functions with respect to the power industry in order to ensure consistent and effective development and application of the Grid Code.

Responsibilities of a NITS Asset Owner

Art 3.12 Each NITS Asset Owner shall be responsible for:

- (a) concluding with the ETU an Asset Vesting Agreement that delegates all authority to the ETU for granting and controlling of connections to the Asset Owner's facilities in the interest of facilitating open, fair and non-discriminatory access to the transmission assets by other Grid Participants;
- (b) the design, installation and maintenance of its transmission equipment to meet system performance and reliability requirements;
- (c) the design, installation and maintenance of its protection system to ensure timely disconnection of faulted facilities and equipment;
- (d) execution of the operating instructions of the ETU with respect to system operational limits and performance standards;

- (e) ensuring cooperation with the ETU and other Grid Participants in the discharge of system security responsibilities; and
- (f) the provision of accurate and timely data and information to the ETU.

Responsibilities of Wholesale Supplier

Art 3.13 Each Wholesale Supplier shall carry out its responsibilities in accordance with the provisions of the Grid Code, particularly the Rules of Practice segment.

Art 3.14 A Wholesale Supplier shall be responsible for:

- (a) the design, installation, commissioning and maintenance of its plant and equipment to meet the requirements of the Connection Sub-code and other relevant regulations;
- (b) compliance at all times with applicable requirements and conditions of connection for generating units in accordance with the Connection Agreement with the ETU and in consultation with any relevant NITS Asset Owner, where necessary;
- (c) providing the ETU with information on available capacities and operating constraints of its generating units to facilitate dispatch under all power system operating states;
- (d) the development of maintenance plans for its equipment and the provision of necessary information to the ETU for outage planning and maintenance coordination;
- (e) the operation of its plant and equipment in accordance with the dispatch instructions of the ETU to meet system performance and reliability requirements and in a manner that is consistent with the reliable operation of the NITS; and
- (f) the provision of accurate and timely data, information and reports to the ETU.

Responsibilities of Distribution Company or Bulk Customer

Art 3.15 A Distribution Company or Bulk Customer shall be responsible for:

- (a) the operation of its distribution network or facilities connected to the NITS to ensure safe and reliable operation in accordance to the requisite performance and reliability standards;
- (b) the execution of the operating instructions and directives of the ETU in a manner that is consistent with the reliable operation of the NITS;

- (c) ensuring that its network and operations do not degrade the performance of the NITS and take the necessary measures to promptly remedy any degradation; and
- (d) the procurement and deployment of adequate reactive power compensation and all other devices to meet its obligations under the Grid Code.

Responsibilities of the ETC

Art 3.16 The responsibilities of the ETC are to:

- (a) supervise the ETU in the implementation of all its functions and oversee all operations, activities and transactions on the NITS with the goal of ascertaining compliance with the Grid Code;
- (b) ensure the effective and consistent application of the rules and standards in the Grid Code;
- (c) approve “Non-compliance Listing” and associated Compliance Plans compiled by the ETU in accordance with Article 4.02;
- (d) issue guidance on the interpretation and implementation of the Grid Code;
- (e) establish procedures for dispute resolution concerning the provisions of the Grid Code and the use of the NITS;
- (f) consider changes to the Grid Code in order to achieve sector objectives and goals; and
- (g) perform any other function conferred on it by the Grid Code.

Other Responsibilities of a Grid Participant

Art 3.17 Every Grid Participant that intends to establish and connect to the NITS any new or modified equipment or network that it owns, operates or controls shall liaise with the ETU and the NITS Asset Owner, and obtain the required approval from the Commission.

Section 4. TRANSITIONAL PROVISIONS AND EXEMPTIONS

Background

Art 4.00 The provisions of the Grid Code require facilities to be equipped in accordance with the relevant standards and the Connection Agreement prior to their connection to the NITS. Services are also to be provided by the Grid Participants to meet the relevant performance standards. These service and reliability standards depend upon equipment configurations that incorporate system redundancies for effective operations. It is recognized that some of the facilities currently in operation do not meet all the required criteria and need to be accommodated in the initial period. Furthermore, the management systems and the human resources of the ETU need to be developed over a period of time. Transitional arrangements and exemptions are therefore needed in a number of instances.

Purpose and scope

Art 4.01 This section of the Grid Code makes recommendations for a transition period. These recommendations include temporary reliefs, relaxation of standards and capacity building in response to changes in roles, obligations and responsibilities. It provides the rationale and suggests the duration of any reliefs, relaxations or exemptions.

Configuration of equipment and installations

Art 4.02 “Non-compliance Listing” of all assets and connected facilities indicating the specific technical characteristics which do not comply with the Grid Code shall be prepared by all Asset Owners and Grid Participants, and compiled by the ETU within three months of the coming into force of the Grid Code.

Art 4.03 A transitional period for compliance shall commence after the compilation of the Non-compliance Listings by the ETU and approval by the ETC.

Art 4.04 NITS Facilities: All equipment and facilities that are in operation within the NITS at the time of coming into effect of this Grid Code shall be accepted and operated as part of the NITS during a transitional period which shall not exceed thirty months, provided that, the deficiency has been identified and included in the “Non-compliance Listing”. Each equipment and facility not included in the Non-compliance Listing shall be deemed to be fully compliant.

Art 4.05 Generation Facilities: All generation equipment and facilities that are in operation within the Ghana Grid at the time of coming into force of this Grid Code shall, despite any deficiency or non-compliance with the Grid Code, continue to operate during a transitional period which shall not exceed thirty-six months, provided that the deficiency has been identified and included in the “Non-compliance

Listing”. Each equipment and facility not included in the Non-compliance Listing shall be deemed to be fully compliant.

Art 4.06 Off-taker Facilities: All user facilities that are connected to and inject or receive power from the NITS at the time of coming into force of this Grid Code shall, despite any deficiency or non-compliance with the Grid Code, continue to operate during a transitional period which shall not exceed thirty months, provided that the deficiency has been identified and included in the “Non-compliance Listing”. Each equipment and facility not included in the Non-compliance Listing shall be deemed to be fully compliant.

Art 4.07 Every Grid Participant, in consultation with the ETU, shall prepare “Compliance Plans” for the upgrade of their respective affected off-taker facilities, and the ETU shall prepare “Compliance Plans” for the upgrade of each affected NITS Node or NITS facility to make them fully compliant within a reasonable period and, in any case, not exceeding the transition period allowed for that category.

Art 4.08 The ETU shall present all such Compliance Plans to the ETC for acceptance and approval within a period of nine months after the coming into force of the Grid Code and thereupon confirm to the respective NITS Asset Owners and Grid Participants their obligations and accepted time-frame to remedy the identified non-compliance and/or deficiencies.

Art 4.09 The non-compliance and/or deficiencies identified for each listed asset or node shall for all other purposes of the Grid Code be deemed to be fully compliant during the transition period.

Art 4.10 During such part of the transitional period as has been accepted by the ETC for implementation of remedial action on that non-compliant asset or node, no Grid Participant may be disconnected or denied service on the basis of that deficiency or non-compliance which has been identified and included in the “Non-compliance Listing”.

Service performance standard during transition period

Art 4.11 Prior to the completion of the upgrade of any NITS node or facility that was declared to be non-compliant, the performance benchmarks for only those services affected by the recorded deficiency shall not be applicable.

Management systems

Art 4.12 The application of the procedures prescribed in this Grid Code for generation dispatch may be deferred with the consent of the ETC until the associated commercial arrangements and corresponding energy accounting, billing and settlement instruments of the Wholesale Electricity Market are finalised.

Art 4.13 Enforcement of the procedures for maintenance and outage planning may be deferred by up to nine months with the consent of the ETC to enable Grid Participants and the ETU complete administrative arrangements for introduction of the procedures.

Capacity building (Human Resource Development)

Art 4.14 The ETU shall employ, train, suitably equip and maintain an adequate workforce that is qualified and competent in transmission planning, dispatch economics, maintenance scheduling and performance monitoring as well as commissioning and testing of grid components to enable it perform its functions.

Existing contracts

Art 4.15 Each contract in respect of transmission services entered into by the VRA and existing at the commencement of this Grid Code shall continue in force unless the contract is revoked or amended by agreement.

Art 4.16 The ETU shall have responsibility for transmission services required under an existing contract when the Grid Code comes into effect.

Art 4.17 The PURC shall determine the charges payable to the ETU for the transmission services rendered by the ETU.

Art 4.18 The Grid Code shall apply to all such existing contracts insofar as the Grid Code does not impair the obligations arising from the existing contract.

Art 4.19 The ETU shall endeavour to negotiate for new or amended contracts which shall conform to all the provisions of the Grid Code in order to attain uniform and non-discriminatory implementation of this Grid Code.

Art 4.20 The ETU shall not enter into a new contract or extend any existing contract that is not in accordance with the Grid Code.

Section 5. MANAGEMENT AND GOVERNANCE OF GRID CODE AND NITS

Scope

Art 5.00 This section defines the arrangements for the management and governance of the provision of NITS services and for the implementation of the Grid Code.

Conduct of ETU

Art 5.01 The ETU which has been given the exclusive mandate to operate the NITS shall be responsible for the good governance and management of the NITS in accordance with the Grid Code and guided at all times by generally accepted best practices for an “ISO”.

Art 5.02 The ETU shall not accept any advice, directions or instructions that may have the effect of subverting the fundamental principles of fairness, transparency, non-discrimination and open access in the governance and management of the NITS.

Art 5.03 The ETU, as the ISO of the NITS, shall neither act nor be considered as a Grid Participant in the NITS.

Art 5.04 The activities of the ETU shall be open for review by any interested Grid Participant.

Art 5.05 The ETU shall be accountable to the ETC of the Energy Commission for the performance of the NITS and compliance with the letter, spirit and intent of the Grid Code.

Art 5.06 A Grid Participant shall be a legal entity having a valid Connection Agreement with the ETU for the purposes of :

- (a) constructing, owning and providing NITS infrastructure or ancillary services;
- (b) injecting, wheeling, or off-taking power for its own use or for retail; or,
- (c) exchanging power either with the electricity networks of neighbouring countries or within the WAPP.

ETC

Art 5.07 The primary purpose of the ETC with regard to the operation of the NITS shall be to ascertain compliance with the Grid Code and to advise the agencies responsible for operating and regulating the NITS accordingly. The ETC shall also be a forum for ensuring effective collaboration and harmony among Grid Participants.

Mandate of ETC

Art 5.08 The ETC shall oversee all technical operations, activities and transactions of Grid Participants on the NITS and also supervise the performance of all the functions of the ETU towards ensuring the fulfilment of its role as an ISO as required under the Grid Code.

Art 5.09 The ETC shall have the mandate to

- (a) review and assess on a regular basis the following:
 - i) performance of the ETU and the NITS,
 - ii) compliance with rules and regulations by ETU and Grid Participants,
 - iii) fairness and non-discrimination in all operational activities;
- (b) consider, investigate, assess and advise the ETU, the PURC or the Energy Commission as appropriate on the following issues:
 - i) possible unacceptable behaviour of Grid Participants or Users,
 - ii) proposals for the revision of the Grid Code, procedures, practices, rules or regulations covering the NITS,
 - iii) NITS development strategies and plans,
 - iv) NITS Standards of Performance and penalties, and
 - v) any NITS related complaints;
- (c) audit, approve or affirm as relevant the following:
 - i) Non-compliance Listing, Compliance Plans and remedial programs, and
 - ii) data archiving systems of Grid Participants and the ETU; and
- (d) establish procedures for the resolution of disputes among Grid Participants.

Composition, officers and tenure of COC

Art 5.10 There shall be a COC appointed by the Board of the Energy Commission to assist the ETC in the discharge of its oversight responsibility with respect to the NITS.

Art 5.11 The COC shall comprise the following persons knowledgeable in the electricity supply industry:

- (a) three representatives of Grid Participants, one each from the categories of Wholesale Suppliers, Distribution Companies and Bulk Customers;
- (b) the Chief Executive Officer of the ETU;
- (c) one representative of the PURC;
- (d) one representative of the Energy Commission; and
- (e) three independent and unaffiliated persons with technical expertise in generation, transmission and distribution operations who shall be appointed in consultation with the PURC.

Art 5.12 Members of the COC, except the Chief Executive of the ETU, shall hold office for a two-year term subject to re-appointment or re-nomination.

Art 5.13 The Board of the Energy Commission shall appoint a chairperson from amongst the members of COC.

Art 5.14 The Chief Executive Officer of the ETU shall be the Secretary to the COC.

Art 5.15 The ETU shall house the COC Secretariat and provide all administrative and secretarial personnel, logistics and support.

Art 5.16 The Chairperson shall chair all meetings of the COC and the Secretary shall be responsible for preparing and keeping accurate records of all meetings.

Meetings of COC

Art 5.17 The COC shall meet at least once every quarter.

Art 5.18 The ETU shall prepare every quarter and submit for the review of the COC, the performance report of the NITS. The quarterly performance report shall be submitted to the COC and the ETC within 14 days after the end of the quarter. In addition to the review of the NITS performance report, the COC may consider other outstanding matters provided these matters have been placed on the agenda .

Art 5.19 At each meeting only matters on the approved agenda shall be discussed or considered and decisions shall be only made by the approval or rejection of the written resolutions that accompanied the agenda and were distributed prior to the meeting. Neither a written resolution that was not previously circulated with the agenda nor a verbal resolution shall be considered or passed as a decision of the meeting.

Art 5.20 Unless otherwise persuaded, the agenda for each meeting shall include all items requested by a Grid Participant to be on the agenda and in respect of which the Grid Participant has submitted a written memorandum.

Art 5.21 The Secretary shall prepare the agenda for each meeting in consultation with the Chairperson and convene meetings on the dates and the times agreed with the Chairperson.

Art 5.22 There shall be a written memorandum for each item on the agenda else the agenda item shall be struck-off by the Chairperson without further consideration of the matter.

Art 5.23 The Chairperson of the COC shall submit to the ETC quarterly reports on the activities of the COC within six weeks after the end of the quarter.

Revision of Grid Code

Art 5.24 Proposals for the revision of any provision of the Grid Code may be made by any Grid Participant or the ETU, the “Proposer”.

Art 5.25 All proposals for Grid Code revisions shall be in writing and shall be sent to the Energy Commission with a copy to the ETU.

Art 5.26 The Energy Commission shall receive, register and acknowledge all submissions and pass on the proposals to the Secretariat of the ETC located at the Energy Commission.

Art 5.27 The Secretariat of the ETC shall notify all Grid Participants and the ETU of all such proposals and make copies accessible to them either over the internet or through other appropriate means.

Art 5.28 The ETU shall within three months of its receipt of a revision proposal, provide the ETC and the “Proposer” with its views, comments and advice on each proposal.

Art 5.29 The ETC shall consider each revision proposal at the next regular meeting and make recommendations which shall be forwarded to the Energy Commission.

Art 5.30 The Energy Commission shall consider the submissions of the “Proposer”, the ETU and the ETC and advise all the parties of its decision with full and written justifications.

Complaints and disputes

Art 5.31 Any Grid Participant may lodge a complaint in writing with the ETC Secretariat where it believes that the rules, regulations or procedures of the Grid Code are not operating fairly.

- Art 5.32 A Grid Participant may also lodge a complaint where it believes that the ETU or a Grid Participant is not acting in accordance with the Grid Code.
- Art 5.33 The ETC Secretariat shall receive, register and acknowledge all complaints.
- Art 5.34 The ETC Secretariat shall promptly notify the relevant parties to the complaint, the ETU and the ETC of the receipt of such a complaint and make copies of the complaint accessible to them either over the internet or through other appropriate means.
- Art 5.35 All affected parties shall, within three months of their receipt of a complaint, provide the complainant, the ETU and the ETC with their views, comments and responses to the complaint.
- Art 5.36 The ETC shall consider each complaint at the next regular meeting and in accordance with its procedures for dispute resolution make recommendations to the parties for the amicable resolution of the complaint or dispute.

Part B: Conditions of Transmission Licence

Section 6. TRANSPARENCY & NON-DISCRIMINATION REQUIREMENTS

Background, purpose and scope

Art 6.00 This section defines the requirements and actions which will inter alia provide transparent, open and non-discriminatory access to the NITS for use by Wholesale Suppliers, Distribution Companies, Bulk Customers and any other duly licensed or permitted entity for whom open-access is to be provided.

Publication of procedures

Art 6.01 The ETU shall develop and publish in detail all the requirements, qualifications and administrative procedures to be fulfilled or followed by those seeking to be provided services by the ETU.

Art 6.02 The requirements shall include all technical standards for connection equipment, communication, operating parameters and performance benchmarks for service provision.

Art 6.03 The qualifications shall include all legal, financial and technical qualifications to be fulfilled.

Art 6.04 The administrative procedures shall include all administrative, financial, technical and any other procedures to be followed prior to the commissioning of the connection as well as the obligations of the Grid Participant for the continued operation of the connection.

Art 6.05 The ETU shall make readily available to the public copies of the Grid Code and all related publications upon the payment of a published fee.

Equal application of the Grid Code

Art 6.06 This Grid Code shall be equally and uniformly applied to all entities. All conditions and situations that are similar shall also receive consistent and equitable treatment.

Transparency criteria

Art 6.07 The ETU shall conduct all its affairs as an ISO that follows well publicised rules, regulations and procedures that are known to all interested parties such that all its actions are predictable and in accordance with the Grid Code.

Art 6.08 There shall be transparency in all ETU decisions, procedures, application of rules, regulations and charges of the ETU regarding participation in the development of the NITS, connections to the NITS, utilisation of NITS' services, allocation of resources and costs of service provision.

Art 6.09 To ensure transparency regarding access, use and operation of the NITS only fees and charges that have previously been published by the ETU may be levied on applicants or Grid Participants and the

dispatch of generating plants shall follow strictly the procedures prescribed in the Scheduling and Dispatch Sub-Code.

Art 6.10 The primary function of the ETC is ensuring transparency, consistency and fairness for all Grid Participants, in which regard, the ETC may demand and consider justifications and explanations for the ETU's actions and decisions and may direct the review or revision of any ETU action or decision.

Art 6.11 In furtherance of the transparency objective, the following rules shall apply to the performance of the functions of the ETC:

- (a) the agenda for meetings of the ETC shall reflect the priorities of all the stakeholders and shall be announced and made public well in advance;
- (b) the dates and places of meetings shall be announced;
- (c) any interested Grid Participant shall be allowed to be physically present at any meeting (except when discussing individuals or appointments) to observe the proceedings where decisions are taken; and
- (d) the minutes of meetings and documentation shall be published within 10 working days.

Delegation and Outsourcing of functions

Art 6.12 The ETU may delegate or contract the functions associated with performance monitoring and merit-order dispatch to independent companies or persons provided they are not likely to have a "conflict of interest" towards entrenching a non-discriminatory, fair and competitive environment.

Art 6.13 The ETU shall only delegate or contract independent parties for the performance of any of those other functions that could influence the nature of open access and competition within the NITS.

Art 6.14 The ETU may contract or delegate to a Grid Participant any technical function that does not influence the outcome of the competitive environment.

Exercise of discretion by the ETU and other officials

Art 6.15 The ETU or any other person shall not make a decision that is inconsistent with the Grid Code in respect of the usage or provision of services from the NITS.

Art 6.16 The ETU may use its discretion and good judgment in making decisions on any matter on which this Grid Code does not contain complete or adequate stipulations. The exercise of any discretionary

powers or judgment shall however be fully justified by providing in writing at the same time that such decision is issued, corresponding principled arguments and rationale for the decision.

Art 6.17 The principles and rationale for any discretion exercised or judgement issued by the ETU shall be published and made available to any person upon request.

Art 6.18 Any person who believes that a discretionary decision taken by the ETU is either inconsistent with the principles of the NITS, discriminatory or not sufficiently transparent shall request for a review by the ETC.

Art 6.19 The ETC shall hear the arguments and either approve or recommend a reconsideration of the decision.

Art 6.20 A discretionary decision or judgment once approved by the ETC shall be considered as a precedent which shall be applied uniformly and equally to all similar situations unless explicitly reversed and/or revised in writing.

Charges for NITS services

Art 6.21 Charges for the use of the NITS or the services of the ETU shall not exceed those approved by the PURC and published in the Gazette or national dailies.

Section 7. PLANNING SUB-CODE

Background, purpose and scope

Art 7.00 The Planning Sub-Code specifies the planning responsibility for grid developments and the policy, organisational procedures, standards or criteria to be applied. Grid development includes the construction or refurbishment of power lines, transformers, substation equipment, reactive compensating devices, auxiliaries and control systems.

Art 7.01 The objective of the Planning Sub-code is to ensure that:

- (a) the configuration of new transmission infrastructure is optimised and in accordance with projected long-term needs;
- (b) the development of infrastructure and facilities is well coordinated in terms of technical arrangement and characteristics;
- (c) system congestion is adequately anticipated and reinforcement schemes are designed to overcome constraints to electrical power transfer and overall power system performance; and,
- (d) all Grid Participants will provide from time to time, the planning data required.

Art 7.02 The Planning Sub-Code therefore specifies the information to be supplied by Grid Participants to facilitate the evaluation of the impact of the connection of new facilities, identification of congestion and the planning of expansion or development of the transmission network regarding its adequacy to meet the needs of users.

Grid planning responsibility

Art 7.03 The ETU shall discharge all functions relating to the planning and coordination of grid developments. The ETU shall arrange for the performance of studies and all other activities needed to formulate and present a ten-year plan of transmission development, the Grid Development Plan, and shall keep such plan updated regularly to take care of revisions in actual and forecast demand, sources of supply and transmission transfer capacity.

Art 7.04 The planning activities leading to the Grid Development Plan shall be undertaken sufficiently in advance so that all prudent and required steps for coordination, design, construction and commissioning of the needed facilities are performed without disturbing the delivery of power over the NITS and so that all stakeholders have an opportunity to contribute to all the steps.

Art 7.05 The planning process shall also provide sufficient time for the preparation of designs and proposals so that all interested persons have an adequate non-discriminatory opportunity to participate in any invitation to build or supply the facilities.

Grid Development Plan

Art 7.06 The Grid Development Plan shall be a document describing the future modifications, expansion and development of the NITS. It shall indicate the new components that have to be built, their main technical characteristics, their location within the NITS as well as the terms and conditions for their commissioning. It shall also indicate the expected technical performance of the NITS.

Art 7.07 The draft Grid Development Plan shall be submitted to the ETC for approval prior to any commitments being made for its implementation.

Grid planning criteria

Art 7.08 The planning criteria for the grid shall be based on a network security philosophy that has been agreed with the Energy Commission as well as the guidelines below.

Art 7.09 The NITS shall be capable of withstanding the following contingency outages without contravening NITS Performance Standards:

- (a) outage of any single transmission plant or equipment or line segment; and
- (b) outage of any one generating unit or power in-feed from any cross-border or regional interconnection such as WAPP.

Art 7.10 Any of the events defined in Art 7.09 shall not cause:

- (a) loss of supply;
- (b) unacceptable high or low voltage outside the specified limits;
- (c) unacceptable overloading of transmission elements;
- (d) prolonged operation with system frequency outside the specified performance and reliability limits; and,
- (e) system instability.

Grid Planning Studies

Art 7.11 The grid planning studies shall be conducted to ensure the safety, reliability, security and stability during operation of the NITS, all as stipulated in the Reliability and Performance Standards.

Art 7.12 Grid planning studies shall also be conducted whenever necessary to assess the impact of any proposed addition or change of equipment in the NITS or in a Grid Participant's facility that is connected or is to be connected to the NITS.

Art 7.13 The purpose of such studies shall be to identify the technical specifications or corrective measures needed to eliminate any potential non-compliance with the Grid Code that may result from such changes or additions.

Art 7.14 The standard studies to be performed shall include the following:

- (a) Load Flow studies to evaluate the behaviour of the NITS for existing and proposed NITS facilities under minimum and maximum loads;
- (b) Short Circuit studies to evaluate the effect on equipment of the NITS due to the connection of new generating plants, lines and other facilities which are likely to result in increased fault duties on the equipment;
- (c) Voltage Stability Analysis to determine if the grid is vulnerable to voltage collapse; and
- (d) Steady State Stability Analysis to determine if the NITS is vulnerable to stability problems.

Art 7.15 Additional analyses, such as for reliability, transient stability or electromagnetic transient studies which may be required, shall be performed when determined by the ETU to be necessary.

Grid Planning Data

Art 7.16 All Grid Participants shall provide the ETU with Standard Planning Data as specified in the Technical Schedule TS-O by the 1st day of July of each calendar year.

Art 7.17 The Standard Planning Data generally shall include the prime technical characteristics of generation and transmission facilities as well as historic and forecast data on energy and capacity demand for each connection point or NITS node.

Art 7.18 In addition to Standard Planning Data, Detailed Planning Data as specified in the Technical Schedule TS-P or other specific details shall also be provided by any Grid Participant within thirty days of being requested by the ETU.

Section 8. CONNECTION SUB-CODE

Background, purpose and scope

Art 8.00 In order to maintain stable and secure operation of the NITS to provide the expected standard of service for the benefit of all Grid Participants, certain minimum technical, design and operational criteria are to be met by all Grid Participants seeking connection to the NITS.

Art 8.01 The Connection Sub-code aims to ensure that the basic rules and conditions for connection and access to the NITS or to a Grid Participant's system or facility are clear, transparent, fair and non-discriminatory. It is also to provide Grid Participants with an assurance of service provision whilst also ensuring secure and reliable operation of the NITS and all other facilities.

Art 8.02 This section of the Grid Code:

- (a) provides the framework, rules and guidelines for connection to the NITS to facilitate the harmonious and coordinated development of the NITS ;
- (b) details the principles and rules governing access to NITS services;
- (c) establishes the process to be followed by a Grid Participant to set up or modify a connection to the NITS;
- (d) specifies the technical, design and operational criteria at the Grid Participant's connection point; and
- (e) defines the data exchange requirements between the Grid Participant and the ETU.

Principles

Art 8.03 This Sub-code is based on the following principles relating to connection to the NITS:

- (a) provided they satisfy all requirements in this Sub-Code, all Wholesale Suppliers, Distribution Companies and permitted Bulk Customers shall have the opportunity to connect to the NITS and have fair and equitable access to the services provided by the ETU;
- (b) the terms and conditions under which connection to the NITS and provision of service is to be granted shall be set out in a commercial agreement designated as the Connection Agreement entered into between the ETU and the Grid Participant;

- (c) the operations under this Sub-code should result in the achievement of
 - i) long term benefits to Grid Participants in terms of costs and reliability of the NITS, and
 - ii) open communication and information flows between the ETU and Grid Participants while ensuring the security of confidential information belonging to Grid Participants;
- (d) no facilities shall be connected without a minimum arrangement for communications, metering and protective relaying being in place.

Art 8.04 The ETU shall not assume any responsibility for the protection of a Grid Participant's plant or equipment or any other portion of the Grid Participant's electrical equipment. A Grid Participant shall be responsible for protecting its equipment in such a manner that faults or other disturbances in the NITS do not cause damage to the Grid Participant's equipment.

Obligations and Responsibilities

Art 8.05 A Grid Participant shall construct, operate and maintain all equipment that are part of its facility in accordance with

- (a) the requirements of the Grid Code;
- (b) Prudent Utility Practice; and
- (c) applicable national and international laws, protocols and standards.

Obligation of the ETU

Art 8.06 The ETU has an obligation to:

- (a) coordinate the design aspects of equipment proposed to be connected to the NITS with those of other Grid Participants in order to achieve the performance and reliability requirements of the Grid;
- (b) evaluate in collaboration with the NITS Asset Owner requests for connections or amended connections to the NITS;
- (c) enter into a Connection Agreement for a connection to the NITS with any applicant who meets the specified requirements;

- (d) advise a Grid Participant or any other person who may be affected about any expected service interruption so that the Grid Participant may make alternative arrangements during such interruption; and
- (e) make recommendations to NITS Asset Owners and Grid Participants regarding the reinforcement or expansion of their facilities to meet reliability requirements.

Obligation of NITS Asset Owner

Art 8.07 A NITS Asset Owner has an obligation to:

- (a) enter into an Asset Vesting Agreement with the ETU that will grant the ETU operational control of all Connection Points relating to the NITS including the coordination of the design, installation, maintenance and implementation of system expansion plans relating to any part of the NITS;
- (b) process requests forwarded to it by the ETU for connection to its equipment or to modify a connection to its equipment;
- (c) comply with the power system performance and quality of supply standards as described in Technical Schedule TS-L and the Connection Agreement between Grid Participants and the ETU;
- (d) ensure that to the extent that a Connection Point relates to its part of the NITS, every arrangement for connection with a Grid Participant or any other arrangement involving a Connection Agreement complies with all the relevant sections of the Grid Code;
- (e) arrange for and participate in the planning and development of the NITS;
- (f) permit and participate in inspection and testing of facilities in accordance with the provisions of the Grid Code;
- (g) permit and participate in commissioning of facilities and equipment which is to be connected to its network, in accordance with the Grid Code;
- (h) ensure that modelling data in respect of its assets and which are provided for planning, design and operational purposes are current, complete, consistent and accurate, and that whenever and wherever warranted by the ETU, the NITS Asset Owner shall perform tests to verify data accuracy;

- (i) provide to the ETU and other relevant Grid Participants in respect of its assets all technical characteristics, drawings, specifications and other details available to it and reasonably required for diagnosing problems or modelling the performance of the NITS;
- (j) provide to the ETU drawings and other technical details of any Connection Points with other Grid Participants;
- (k) organise and perform under the coordination of the ETU all maintenance activities for all of its assets which form part of the NITS for optimum service availability and reliability such that electricity may be transmitted efficiently and continuously up to the agreed capability;
- (l) employ its best efforts to restore equipment and service as soon as practicable following any interruption at a Connection Point; and
- (m) comply with applicable regulatory provisions and all relevant provisions of the Grid Code.

Obligation of Wholesale Supplier

Art 8.08 A Wholesale Supplier has an obligation to:

- (a) submit to the ETU an application in respect of a new or an altered equipment owned, operated or controlled by it and which it desires to connect to the NITS;
- (b) comply with the requirements of the ETU and the relevant NITS Asset Owner in respect of design requirements of equipment proposed to be connected to the NITS;
- (c) have in force a valid Connection Agreement with the ETU prior to the facility being connected to the NITS;
- (d) at all times, comply with applicable requirements and conditions of connection for generating units and in accordance with any Connection Agreement with the ETU;
- (e) provide generating unit technical characteristics, data and Availability Declaration information to the ETU in accordance with the relevant provisions of the Grid Code;
- (f) permit and arrange participation in the inspection, testing or commissioning of facilities and equipment to be connected to the NITS;
- (g) operate its facilities and equipment in accordance with the instructions of the ETU; and

- (h) give prior notice of any intended voluntary disconnection in accordance with the provisions of this Sub-code.

Obligation of Distribution Company and Bulk Customer

Art 8.09 A Distribution Company or Bulk Customer has an obligation to:

- (a) submit to the ETU an application in respect of any new or altered equipment or network that it owns, operates or controls and which he desires to connect to the NITS;
- (b) have in force a valid Connection Agreement with the ETU prior to its equipment or network being connected or re-connected to the NITS;
- (c) comply with the requirements of the ETU and the relevant NITS Asset Owner in respect of the design and technical standards of equipment or networks proposed to be connected to the NITS;
- (d) ensure that all facilities which are owned, operated or controlled by it and are associated with a Connection Point at all times comply with applicable requirements and conditions of connection for Grid Participants and in accordance with the Connection Agreement with the ETU;
- (e) provide to the ETU information on energy and power demand forecasts as specified in the relevant sections of the Grid Code;
- (f) permit and participate in inspection and testing of facilities and equipment in accordance with the provisions of the Grid Code;
- (g) permit and arrange for the witnessing and participation of the ETU and the relevant NITS Asset Owner in the commissioning or re-commissioning of facilities and equipment which are to be connected to the NITS, if the ETU and Asset Owner so wish;
- (h) operate its facilities and equipment, at all times, in accordance with the instructions of the ETU; and
- (i) provide prior notice of any intended voluntary disconnection in accordance with the provisions of this Sub-code.

Telecommunications Requirements for monitoring and control

Art 8.10 A telecommunication system shall be established so that the ETU and Grid Participants can communicate with one another, as well as exchange data signals for monitoring and controlling NITS equipment at all times.

Art 8.11 The ETU shall provide NITS Asset Owners with the requirements for the complete telecommunication equipment that is required for monitoring and control within the NITS.

Art 8.12 A NITS Asset Owner shall provide the complete telecommunication equipment prescribed by the ETU for monitoring and control of all Connection Points within the NITS.

SCADA System for monitoring and control

Art 8.13 The ETU shall procure, install and setup Remote Terminal Units and other telemetry equipment for monitoring real-time information and controlling equipment which form part of the NITS or are at a Connection Point.

Art 8.14 The Remote Terminal Unit shall be compatible with the Master Station protocol and in accordance with the defined requirements and specifications.

Art 8.15 The Grid Participant shall also provide, if necessary, other related equipment and interfaces for interconnection with the SCADA system of the ETU.

Requirements for new NITS connection

Art 8.16 A Grid Participant seeking a new connection to the NITS shall, prior to the installation, erection or construction of the connection to the NITS,

- (a) apply for connection to the NITS in accordance with Articles 8.29 and 8.30;
- (b) submit to the ETU a Connection Proposal in accordance with Article 8.31; and
- (c) sign a Connection MOU with the ETU.

Art 8.17 The applicant shall negotiate and execute a Connection Agreement with the ETU before the completion of the installation, erection or construction of the connection to the NITS.

Art 8.18 The ETU shall lodge with the Energy Commission, the PURC and any other regulatory authority, copies of

- (a) the Connection MOU and any subsequent revisions to the Connection MOU within thirty days after its conclusion, and

(b) the Connection Agreement within thirty days after its conclusion.

Requirements for modification of existing NITS connection

Art 8.19 A Grid Participant seeking a modification of an existing connection to the NITS shall, prior to commencement of modification works of the existing connection to the NITS,

(a) apply for the modification of an existing connection in accordance with Articles 8.29 and 8.30,

(b) submit to the ETU a Connection Modification Proposal in accordance with Article 8.31, and

(c) sign a Connection Modification MOU with the ETU.

Art 8.20 The applicant shall negotiate and execute an Amended Connection Agreement with the ETU before completion of the modification works.

Art 8.21 The ETU shall lodge with the Energy Commission, the PURC and any other regulatory authority, copies of

(a) the Connection Modification MOU and any subsequent revisions to the Connection Modification MOU within thirty days after its conclusion, and

(b) the Amended Connection Agreement within thirty days after its conclusion.

Grid Impact Studies

Art 8.22 The ETU shall specify the technical studies required to be carried out to evaluate the impact of a proposed Grid Participant development on the NITS.

Art 8.23 The ETU shall develop the required technical studies for evaluating the impact on the Grid of any proposed new connection or modification to an existing connection.

Art 8.24 A Grid Participant may indicate whether it wishes the ETU to undertake additional technical studies and shall bear the cost of any additional technical studies it requires of the ETU.

Art 8.25 A Grid Participant applying for a connection or a modification of an existing connection to the NITS shall take all necessary steps to ensure that the proposed development will not result in the degradation of the NITS.

Art 8.26 The ETU may disapprove an application for connection or a modification to an existing connection if the Grid Impact Studies show that the proposed development will result in unacceptable degradation of the NITS.

Art 8.27 To enable the ETU carry out the necessary detailed Grid Impact Studies, a Grid Participant may be required to provide the data as specified in the relevant sections of the Planning and Connection Sub-Codes and any additional data that may be specified by the ETU.

Application for new connection or modification

Art 8.28 The ETU shall publish the procedures for the processing of applications for a new connection or modification of an existing connection to the NITS. The ETU and all entities seeking a NITS connection shall adhere to the published procedures.

Art 8.29 A person seeking a new connection or a modification of an existing connection to the NITS may upon submitting the information contained in the published procedures by the ETU, obtain from the ETU the appropriate application form, the Grid Development Plan and/or the layout and block schematic diagrams of the NITS Node to enable the applicant prepare an adequate relevant proposal.

Art 8.30 The Applicant shall submit to the ETU the completed application form for a new connection or modification of an existing connection to the NITS and pay the published application fee to the ETU.

Art 8.31 A completed application form shall include the following information:

- (a) a description of the proposed new connection or modification to an existing connection, which shall comprise the Connection Proposal or Connection Modification Proposal at the Connection Point;
- (b) the relevant Standard Planning Data in accordance with the requirements of the Planning Code; and
- (c) the expected completion date of the proposed connection.

Processing of application for a new connection or modification

Art 8.32 The ETU shall evaluate the application and inform the applicant whether the proposed Grid Participant's development is acceptable or not within sixty days from the date of submission of the completed application.

Art 8.33 If the application is acceptable, the ETU shall approve the Connection Proposal or the Connection Modification Proposal and sign a Connection MOU or a Connection Modification MOU, as the case may be, with the Applicant.

Art 8.34 If the application is not acceptable, the ETU shall notify the applicant stating why the application is not acceptable. The ETU shall include in its notification suggestions on how the application could be improved and made acceptable.

Art 8.35 The applicant may revise and resubmit the application as it deems appropriate and the ETU shall reconsider the resubmission.

Art 8.36 If the ETU and the applicant cannot reach agreement on the proposed connection or modification to an existing connection, any of the Parties may bring the matter to the attention of the EC for resolution.

Art 8.37 If a Connection MOU or Connection Modification MOU is signed, the Applicant shall, within thirty days from signing or a mutually agreed longer period, submit to the ETU the Detailed Planning Data pertaining to the Connection Proposal or the Connection Modification Proposal as specified in the Planning Sub- Code.

Art 8.38 The applicant may at anytime thereafter commence construction of the facility subject to having deposited copies of the Connection MOU or the Connection Modification MOU with the Energy Commission, the PURC and any other relevant regulatory authority.

Art 8.39 The applicant and the ETU shall negotiate and execute a Connection Agreement or Amended Connection Agreement, as the case may be, before the completion of construction. The Connection Agreement or the Amended Connection Agreement shall however only come into force after the satisfactory construction and commissioning of the facility and the issuance by the ETU of a Certificate of Approval to Connect.

Data Registration

Stages of data registration

Art 8.40 The data relating to a Connection Point and a Grid Participant development that are submitted by a Grid Participant applying for a new Connection or an Amended Connection shall be registered in three stages and classified accordingly as:

- (a) Preliminary Project Planning Data;
- (b) Committed Project Planning Data; and
- (c) Connected Project Planning Data.

Art 8.41 The data that are submitted at the time of application shall be considered as Preliminary Project Planning Data. These shall contain the Standard Planning Data and the Detailed Planning Data specified in the Planning Sub-Code.

Art 8.42 Once a Connection MOU or Connection Modification MOU is signed, the Preliminary Project Planning Data as may have been amended during the consideration of the relevant Proposal shall become the Committed Project Planning Data, and shall be utilised in the evaluation of other similar applications and in the preparation of the Grid Development Plan.

Art 8.43 The Committed Project Planning Data shall be updated, conformed and replaced with validated actual values of parameters and information about the facility at the time of commissioning and shall be transformed to become the Connected Project Planning Data.

Art 8.44 The Connected Project Planning Data shall be registered to replace the Committed Project Planning Data that had hitherto been utilised in the evaluation of other applications for a new connection or modification of existing connection and in the preparation of the Grid Development Plan.

Data forms

Art 8.45 The applicant, in consultation with the ETU, shall complete and submit the forms for all data requirements in fulfilment of either a Connection MOU or Connection Modification MOU, as the case may be.

Submittals prior to the Commissioning Date

Art 8.46 Pursuant to the terms, conditions and schedules specified in the Connection Agreement the following shall be submitted by the applicant prior to the commissioning date:

- (a) specifications for major equipment not included in the Standard Planning Data and Detailed Planning Data;
- (b) for distribution network connections and connections for other equipment or networks that will not form part of the NITS, details of switching, protection and control arrangements, equipment and settings for connection to a Distribution Company, a Bulk Customer or any other Grid Participant who will be extracting power;
- (c) for assets that will form part of the NITS, electrical diagrams and drawings of the applicant's equipment at the NITS Node;
- (d) information that will enable the ETU to prepare the Connection Point drawings;

- (e) copies of all Safety Rules and local safety instructions applicable to the applicant's equipment and a list of Safety Coordinators;
- (f) a list of the names and telephone numbers of authorized representatives, including confirmation that they are fully authorized to make binding decisions on behalf of the applicant, in relation to operations of the NITS;
- (g) proposed maintenance program; and
- (h) Tests and Commissioning Procedures for the facility.

Commissioning

Procedure for Commissioning of equipment and connection to the NITS

Art 8.47 Upon completion of construction, erection or installation of the proposed facility, commissioning of the applicant's development, including work at the Connection Point, the equipment at the Connection Point or the Grid Participant development shall be subjected to the required Test and Commissioning Procedures.

Art 8.48 The procedure for any tests which may require, result in or involve a temporary connection to the NITS shall be jointly agreed, scheduled and performed by the applicant or Grid Participant and the ETU.

Art 8.49 Where the tests are considered to be successful and the installation ready for operation, the applicant or Grid Participant shall submit to the ETU, a statement of readiness to connect, which shall include the test results and the commissioning report.

Art 8.50 The ETU may within fourteen days after the receipt of the statement of readiness to connect, perform at its sole discretion, any tests it deems necessary so as to accept or decline the statement of readiness to connect.

Art 8.51 Upon acceptance of the statement of readiness to connect received from an applicant or Grid Participant, the ETU shall issue a Certificate of Approval to Connect and arrange to connect the facility at the convenience of the applicant or the Grid Participant as may be appropriate.

Art 8.52 The physical connection to the NITS shall be made only after the Certificate of Approval to Connect has been issued by the ETU.

Requirement to inspect and test equipment during commissioning

Art 8.53 Any new or replacement equipment to form part of or to be connected to the NITS shall be inspected and tested by the ETU to demonstrate that it complies with relevant Standards, the provisions

of the Grid Code and any relevant Connection Agreement prior to or within an agreed time after being connected to the NITS, and the relevant NITS Asset Owner is entitled to witness such inspections and tests.

Art 8.54 Valid test certificates shall be produced on the demand of affected Grid Participants or within an agreed time thereafter, showing that the equipment has passed the tests and complies with the required standards before connection to a network.

Coordination during commissioning

Art 8.55 A Grid Participant seeking to connect a facility to the NITS shall cooperate with other Grid Participants and the ETU to develop procedures that will ensure that the commissioning of the connection and connected facility is carried out in a manner that:

- (a) does not adversely affect other Grid Participants or affect power system security or quality of supply; and
- (b) minimizes the threat of damage to any other Grid Participant's equipment.

Art 8.56 Not less than four months prior to the proposed commencement of commissioning of a new or replacement equipment (other than replacement by identical equipment) that could reasonably be expected to alter performance of the power system, the Grid Participant shall submit to the ETU sufficient design information including proposed parameter settings to allow critical assessment and analytical modelling of the effect of the new or replacement equipment on the performance of the power system (if, in the opinion of the ETU, this is required).

Art 8.57 The ETU shall consult with other relevant Grid Participants as appropriate and within twenty working days of receipt of the design information notify the Grid Participants of any comments on the proposed parameter settings for the new or replacement equipment.

Art 8.58 The ETU and the affected Grid Participants shall consult and agree on the parameter settings.

Commissioning program

Art 8.59 Not less than three months prior to the proposed commencement of commissioning by a Grid Participant of any new or replacement equipment that could reasonably be expected to alter performance of the power system, the Grid Participant shall advise the relevant NITS Asset Owner and the ETU in writing of the commissioning program including test procedures and proposed test equipment to be used in the commissioning.

Art 8.60 The relevant NITS Asset Owner and the ETU shall, within fifteen working days of receipt of such advice notify the Grid Participant either that it agrees with the proposed commissioning program

and test procedures or that it requires changes in the interest of power system security, safety or quality of supply.

Art 8.61 If the NITS Asset Owner or the ETU require changes, then the parties shall co-operate to reach agreement and finalize the commissioning program within a reasonable period.

Art 8.62 A Grid Participant shall not commence commissioning until the commissioning program has been finalized.

Art 8.63 The relevant NITS Asset Owner and the ETU shall not unreasonably delay finalizing a commissioning program.

Commissioning Tests

Art 8.64 The ETU may, at its sole discretion, witness commissioning tests relating to new or replacement equipment that could reasonably be expected to alter performance of the power system or the accurate metering of energy.

Art 8.65 The NITS Asset Owner and the ETU shall, within a reasonable period of receiving advice of commissioning tests, notify the Grid Participant whose new or replacement equipment is to be tested whether or not it wishes to witness or observe the commissioning tests and finds the proposed commissioning times to be suitable.

Art 8.66 A Grid Participant whose new or replacement equipment is tested under this provision shall submit to the relevant NITS Asset Owner and the ETU the commissioning test results demonstrating that a new or replacement equipment complies with the provisions of the Grid Code or the relevant Connection Agreement or both to the satisfaction of the relevant NITS Asset Owner and the ETU.

Art 8.67 If the commissioning tests conducted in relation to a new or replacement item of equipment demonstrates non-compliance with one or more requirements of the Grid Code or the relevant Connection Agreement then the Grid Participant whose new or replacement equipment was tested shall promptly meet with the ETU to agree on a process aimed at the achievement of compliance of the relevant equipment with the provisions of the Grid Code.

Art 8.68 The ETU may independently or at the request of a Grid Participant direct that the commissioning and subsequent connection of the particular equipment must not proceed if the relevant equipment does not meet the technical requirements and applicable standards.

Electrical Diagram Requirements

Art 8.69 Each Grid Participant shall prepare and submit to the ETU an Electrical Diagram for the equipment at the Connection Point, in accordance with the requirements of the Connection Agreement or Amended Connection Agreement.

Art 8.70 The Electrical Diagrams shall provide an accurate record of the layout and circuit connections, ratings, identification of equipment and related apparatus and devices at the Connection Point.

Art 8.71 The ETU shall provide each Grid Participant with an Electrical Diagram for all the equipment on the NITS side of the Connection Point, in accordance with the requirements of the Connection Agreement or Amended Connection Agreement.

Art 8.72 The ETU shall prepare and distribute the composite Electrical Diagram for the entire Connection Point.

Art 8.73 The ETU shall specify the format to be followed in the preparation of the Electrical Diagrams for any Connection Point.

Art 8.74 All Symbols used in Electrical Diagrams shall be in accordance with IEC 60617 Standards as updated.

Preparation of Electrical Diagram

Art 8.75 All the equipment at the Connection Point shall, wherever possible, be shown in one Electrical Diagram. When more than one Electrical Diagram is necessary, duplication of identical information shall be minimized.

Art 8.76 The Electrical Diagrams shall represent, as closely as possible, the physical arrangement of the equipment and their electrical connections.

Art 8.77 The title block of the Electrical Diagram shall include the names of authorized persons together with provisions for the details of revisions, dates and signatures.

Changes to Electrical Diagrams

Art 8.78 The ETU and other affected Grid Participants shall be provided with a revised Electrical Diagram by the relevant Asset Owner or Grid Participant, at least one month prior to the proposed addition to or change of equipment connected to or forming part of any NITS Node.

Art 8.79 If the modification involves the replacement of existing equipment, the revised Electrical Drawing shall be provided to the ETU in accordance with the requirements of the Amended Connection Agreement.

Art 8.80 The revised Electrical Diagram shall incorporate the new equipment to be added, the existing equipment to be replaced or the change in Equipment Identification.

Validity of Electrical Diagrams

Art 8.81 The Composite Electrical Diagram prepared by the ETU in accordance with the provisions of this Sub-code shall be the Electrical Diagram to be used for all operation and planning activities associated with the Connection Point.

Art 8.82 If a dispute involving the accuracy of the Composite Electrical Diagram arises, a meeting between the ETU and the Grid Participant or any other relevant parties shall be held as soon as possible, to resolve the dispute.

Inspection and testing

Right of entry and inspection

Art 8.83 If a Grid Participant who is party to a Connection Agreement reasonably believes that another Grid Participant is not complying with a technical provision of the Grid Code and as a consequence, the first Grid Participant is suffering or is likely to suffer an adverse effect, then the first Grid Participant may, with the prior consent of the ETU, inform the offending Grid Participant of the intention to enter the relevant facility for the sole purpose of passively observing the situation in order to assess compliance with the technical obligations under the Grid Code.

Art 8.84 A Grid Participant who wishes to inspect any NITS facility that it does not own shall give the ETU and the Asset Owner at least two working days notice of its intention to carry out an inspection. The notice shall contain the following information:

- (a) the name of the representative who will be conducting the inspection on behalf of the Grid Participant;
- (b) the time the inspection will commence and the expected time the inspection will be concluded;
and
- (c) the nature of the suspected non-compliance with the Grid Code;
- (d) and the reasons for desiring an inspection.

Art 8.85 A Grid Participant may not carry out an inspection under this Section on more than two occasions in any month, except for the purpose of verifying the performance of corrective action claimed to have

been carried out in respect of non-conformance observed and documented on a previous inspection or for the purpose of investigating an operating incident.

Art 8.86 At any time when the representative of a Grid Participant is conducting an inspection that representative shall:

- (a) not interfere with the operation of the facility except to the extent reasonably necessary and approved by the Asset Owner and the ETU (such approval not to be unreasonably withheld or delayed); and
- (b) observe all safety precautions, site access and clearance protocols of the facility, provided that these are not to be used to delay or deny the granting of access for inspection.

Art 8.87 Any representative of a Grid Participant conducting an inspection under this Section must be appropriately qualified to perform the relevant inspection.

Art 8.88 The costs of inspections under this Section shall be borne by the Grid Participant requesting the inspection.

Art 8.89 The ETU or any of its authorized representatives may, at any time and without notice, inspect a facility of a Grid Participant and the operation and maintenance of that facility in order to:

- (a) assess compliance by the relevant Grid Participant with its operational obligations under the Grid Code or an ancillary services agreement;
- (b) investigate any possible past or potential threat to power system security; or
- (c) conduct any periodic familiarization or training exercise associated with the operational requirements of the NITS.

Art 8.90 A Grid Participant who undertakes an inspection under this section shall within seven days of first entry submit to the ETU and the Asset Owner a report that provides the findings and results of the inspection carried out.

Right of testing

Art 8.91 A Grid Participant who has reasonable grounds to believe that equipment or facilities owned by itself or by others may not comply with the Code or the Connection Agreement may request testing of the relevant equipment by giving notice in writing to the ETU.

Art 8.92 The ETU shall notify the relevant Asset Owner and may conduct either by itself or by contract or otherwise arrange for the relevant test(s) to be conducted at a time suitable to the ETU and the Asset Owner, if the Asset Owner's involvement is necessary.

Art 8.93 The costs of such tests shall be borne by the Grid Participant that requested the test, unless the equipment is determined by the tests to be non-compliant with the relevant Connection Agreement or the Grid Code, in which case all reasonable costs of such tests shall be borne by the Owner of that facility.

Art 8.94 Tests shall be conducted using test procedures agreed between the relevant parties, which agreement shall not be unreasonably withheld or delayed.

Art 8.95 Tests shall be carried out only by persons with the relevant skills and experience.

Art 8.96 A Grid Participant shall give the ETU adequate prior notice of the intention to conduct a test in respect of equipment within the Grid Participant's facility.

Art 8.97 The Grid Participant who requests a test under this Section may appoint a representative to witness the test and the representative so appointed shall be provided with all the necessary information, schedules and procedures to enable that representative follow the stages of the test as it is being conducted.

Art 8.98 An accredited testing officer or expert who conducts a test shall submit a report to the Grid Participant who requested the relevant test, the ETU, the Asset Owner and to any other Grid Participant who is likely to be affected by the results of the test within a reasonable period after the completion of the test, but in any case not exceeding two weeks except for stated reasons.

Art 8.99 The ETU may, at the request of a Grid Participant and subject to the other provisions of this Sub-code regarding entry and inspection instruct an Asset Owner to arrange and attach a test or monitoring equipment to its plant.

Art 8.100 In carrying out a monitoring directive, the performance of the monitored plant or equipment shall not be constrained in any way.

Art 8.101 Notwithstanding any provisions in this section, the ETU may undertake equipment testing at any time it deems necessary.

Compliance with connection requirements by a Wholesale Supplier

Art 8.102 Each Wholesale Supplier shall, prior to the commencement date of supply to a Grid Participant with which it has a Power Purchase Agreement, provide evidence to the Grid Participant that

- (a) it has a valid Connection Agreement with the ETU, and
- (b) each of its generating units complies with the technical requirements of Schedule TS-L, the relevant Power Purchase Agreement and the Connection Agreement.

Art 8.103 Each Wholesale Supplier shall negotiate in good faith with the relevant Grid Participant and the ETU to agree on a compliance monitoring method and program for each of its generating units in order to confirm ongoing compliance with the applicable requirements of this Grid Code and the relevant Connection Agreement.

Art 8.104 If a performance test or monitoring of in-service performance demonstrates that a generating unit is not complying with one or more technical requirements then the Wholesale Supplier shall:

- (a) promptly notify the relevant Grid Participant and the ETU of that fact;
- (b) promptly advise the Grid Participant and the ETU of the remedial steps it proposes to take and the timetable for such remedial work;
- (c) diligently undertake such remedial work and report at monthly or any other reasonable intervals to the Grid Participant and the ETU on progress of implementing the remedial action; and
- (d) conduct further tests and monitoring on completion of the remedial work to confirm compliance with the relevant technical requirement.

Art 8.105 If a Grid Participant or the ETU reasonably believes that a generating unit is not complying with one or more technical requirements of the Grid Code and the relevant Connection Agreement, the ETU may instruct the Wholesale Supplier to conduct tests to demonstrate that the relevant generating unit complies with those technical requirements.

Art 8.106 Where the tests provide evidence that the relevant generating unit continues to comply with the technical requirement(s) the Grid Participant or the ETU (as appropriate) shall reimburse the Wholesale Supplier for the reasonable expenses incurred as a direct result of conducting the tests.

Art 8.107 If the ETU or a Grid Participant either

- (a) is not satisfied that a generating unit does comply with one or more technical requirements,
- or

(b) does not have evidence demonstrating that a generating unit complies with the technical requirements, or

(c) holds the reasonable opinion that there is or could be a threat to the power system security,

the ETU may independently or upon the advice of the Grid Participant, direct the relevant Wholesale Supplier to operate the relevant generating unit at a particular generator output or in a particular mode until the Wholesale Supplier submits evidence reasonably satisfactory to the ETU or the Grid Participant that the generating unit is complying with the relevant technical requirement.

Art 8.108 Each Wholesale Supplier shall maintain records for five years for each of its generating units and power stations setting out details of the results of all technical performance and monitoring tests conducted under the provisions of the Grid Code and make these records available to the relevant Grid Participant and the ETU on request.

Routine testing of protection equipment by Grid Participants

Art 8.109 A Grid Participant shall cooperate with the ETU by testing for the proper operation of equipment forming part of a protection system for the Connection.

Art 8.110 A Grid Participant shall conduct protection system tests as follows:

(a) prior to the plant at the relevant Connection Point being placed in service; and

(b) at intervals specified in the Connection Agreement or in accordance with a plan agreed between the ETU and the Grid Participant.

Art 8.111 A Grid Participant shall bear its own costs of conducting tests under this Section

Tests by Grid Participants of own plant requiring changes to normal operation

Art 8.112 A Grid Participant proposing to conduct a test on equipment which requires a change to the normal operation of that equipment, shall give notice in writing to the ETU at least five days before the planned date for the test, except in an emergency.

Art 8.113 The notice to be provided shall include:

(a) the nature of the proposed test;

(b) the estimated start and finish time for the proposed test;

(c) the identity of the equipment to be tested;

- (d) the power system conditions required for the conduct of the proposed test
- (e) details of any potential adverse consequences of the proposed test on the equipment to be tested;
- (f) details of any potential adverse consequences of the proposed test on the power system and NITS facilities; and
- (g) the name of the person responsible for the coordination of the proposed test on behalf of the Grid Participant.

Art 8.114 The ETU shall review the proposed test to determine whether it could :

- (a) adversely affect the normal operation of the power system;
- (b) pose a threat to power system security;
- (c) require the power system to be operated in a particular mode which differs from the mode in which the power system is normally operated; or
- (d) affect the normal metering of energy at a NITS Node.

Art 8.115 If the ETU determines that the proposed test does fulfil one of the conditions specified above then the Grid Participant and the relevant Asset Owner must seek the ETU's approval prior to undertaking the test, which approval shall not be unreasonably withheld or delayed.

Art 8.116 If in the ETU's reasonable opinion, a test could threaten public safety, damage or threaten to damage equipment or adversely affect the operation of the power system, the ETU may direct the proposed test procedure to be modified or that the test not be conducted at the time proposed or both.

Art 8.117 The ETU shall advise any other Grid Participant who might be adversely affected by a proposed test and take into consideration any reasonable requirements of those Grid Participants when approving the proposed test.

Art 8.118 A Grid Participant who conducts a test under this Section shall ensure that the person responsible for the coordination of the test promptly advises the ETU when the test is complete.

Art 8.119 If the ETU approves of a proposed test, the ETU shall use its best endeavours to ensure that power system conditions reasonably required for that test are provided as close as is reasonably practicable to the proposed start time of the test and continue for the proposed duration of the test.

Art 8.120 Within a reasonable period after any such test has been conducted, the Grid Participant who has conducted a test must provide the ETU with a report in relation to that test, including full test results where appropriate or requested by the ETU.

Tests of Generating Units

Art 8.121 The ETU may, at intervals of not less than twelve months, require the testing of any generating unit connected to the NITS in order to assess the performance of the relevant generating unit or determine analytic parameters for modelling purposes and the ETU is entitled to witness such tests.

Art 8.122 Adequate notice of not less than fifteen days shall be given by the ETU before the proposed date of a test as indicated above.

Art 8.123 The ETU shall ensure that the tests are conducted at a time which will minimize the departure from the commitment and dispatch schedule that are due to take place at that time.

Art 8.124 A Wholesale Supplier shall provide any reasonable assistance requested by the ETU in relation to the conduct of the tests.

Art 8.125 Tests conducted under this Section shall be conducted in accordance with test procedures agreed between the ETU and the relevant Wholesale Supplier and a Wholesale Supplier shall not unreasonably withhold its agreement to test procedures proposed for this purpose.

Art 8.126 A Wholesale Supplier shall bear its own costs associated with tests conducted under this Section and no compensation shall be payable for financial losses incurred as a result of these tests or associated activities.

Power System Tests

Art 8.127 The ETU shall coordinate tests to verify the proper functioning and performance of the NITS and associated equipment. Such tests may be conducted whenever:

- (a) an existing facility of the NITS is upgraded or substantially modified;
- (b) a new facility of the NITS is commissioned;
- (c) a new generating unit of a Wholesale Supplier or equipment of a Distribution Company or Bulk Customer is commissioned that is expected to substantially alter the power transfer capability of the transmission network; and
- (d) settings or changes are made to any power system stabilizers.

- Art 8.128 The ETU shall develop a program and coordination arrangements for the tests including criteria for continuation with the tests and operational procedures.
- Art 8.129 Operational conditions for each test shall be arranged by the ETU and the test procedures shall be coordinated by an officer nominated by the ETU who has the authority to stop the test or any part of it or vary the procedure within pre-approved guidelines if that officer considers any of these actions to be reasonably necessary.
- Art 8.130 Each Grid Participant shall cooperate with the NITS Asset Owner(s) and the ETU when required during the planning, preparation and conduct of tests on the NITS to assess the technical performance of the transmission network and, if necessary, conduct coordinated activities to prepare for power system-wide testing or individual on-site tests of a Grid Participant's facility or plant, including the disconnection of a generating unit.
- Art 8.131 The ETU may direct changes in operation of generating units during power system tests if this is deemed necessary to achieve operational conditions on the NITS which are reasonably required to achieve valid test results.
- Art 8.132 The ETU shall plan the timing of tests so that the variation from schedule dispatch that would occur is minimized and the duration of the tests is as short as possible and consistent with test requirements and power system security.

Disconnection and Reconnection

Voluntary Disconnection

- Art 8.133 Unless otherwise agreed and specified in a Connection Agreement, a Grid Participant shall give six months prior notice in writing to the ETU of its intention to permanently disconnect a facility from a NITS Node.
- Art 8.134 Subject to the terms of the relevant Connection Agreement, a Grid Participant is entitled to request voluntary permanent disconnection or decommissioning of its equipment from the NITS, in which case appropriate operating procedures necessary to ensure that the disconnection will not threaten power system security must be implemented in accordance with the provisions of the Grid Code.
- Art 8.135 The Grid Participant shall pay all costs directly attributable to the voluntary disconnection and decommissioning.

Decommissioning Procedures

Art 8.136 In the event that a Grid Participant's facility is to be permanently disconnected from the NITS, the ETU, the relevant Asset Owner and the Grid Participant shall, prior to such disconnection occurring, coordinate and follow an agreed procedure for the disconnection.

Art 8.137 The Asset Owner shall notify the ETU and any other Grid Participant with whom the ETU has a Connection Agreement if it believes, in its reasonable opinion, that the terms and conditions of such a Connection Agreement will be affected by the procedures for disconnection or proposed procedures agreed with any other Grid Participant. The parties shall negotiate any amendments to the procedures for disconnection or any amendments to the Connection Agreement that may be required.

Involuntary Disconnection

Art 8.138 The ETU or a NITS Asset Owner may without the prior consent of any affected Grid Participant, disconnect a Grid Participant's facilities from the Grid under any of the following conditions:

- (a) during an emergency in accordance with the provisions of the Grid Code;
- (b) in accordance with applicable laws, order of the law courts; or
- (c) in accordance with the provisions of the Grid Participant's Connection Agreement.

Art 8.139 In all cases of disconnection by the ETU during an emergency, the ETU shall undertake a review and thereafter provide a report to the Grid Participant and the NITS COC advising of the circumstances requiring such action.

Art 8.140 In carrying out its obligations above where there is more than one Grid Participant involved, the ETU shall, to the extent practicable,

- (a) implement an equitable sharing of the reconnection of facilities up to the power transfer capability of the network, and,
- (b) in performing these obligations, both the ETU and the relevant Asset Owner shall, to the extent practicable, give priority to reconnection of sensitive loads.

Art 8.141 All disconnections of a Grid Participant's facilities other than those required during an emergency, shall be undertaken in an orderly manner and include a request to the relevant Grid Participant to reduce the power transfer level at the proposed point of disconnection to zero prior to disconnection at the appointed time.

Disconnection to implement regulatory order

Art 8.142 The ETU or a NITS Asset Owner may, pursuant to a directive given by a regulatory or legal authority in accordance with the laws of Ghana or following the withdrawal of the Grid Participant's licence or permit in accordance with the licensing regulations or permitting guidelines, disconnect a Grid Participant's facilities from the NITS without the Grid Participants prior consent.

Obligation to reconnect

Art 8.143 The ETU shall reconnect a Grid Participant's facility to the NITS as soon as practicable if

- (a) it is reasonably satisfied that there no longer exists an emergency due to which the Grid Participant's facility was disconnected under this Section of the Grid Code;
- (b) it is reasonably satisfied that there no longer exists a reason for the disconnection under applicable laws or the Grid Participant's Connection Agreement; or
- (c) any of the following conditions are met:
 - i) a Code breach giving rise to disconnection has been remedied,
 - ii) where the breach is not capable of remedy, compensation has been agreed and paid by the Grid Participant to the affected parties or, failing agreement, the amount of compensation payable has been determined in accordance with the dispute resolution procedure of the ETC and that amount has been paid,
 - iii) where the breach is not capable of remedy and the amount of compensation has not been agreed or determined, assurances for the payment of reasonable compensation have been given to the satisfaction of the ETU, the Asset Owner and the affected parties, or
 - iv) the Grid Participant has taken all necessary steps to prevent the re-occurrence of the breach and has delivered binding undertakings to the ETU or the NITS Asset Owner that the breach will not re-occur.

Part C: Rules of Practice

Section 9. OPERATIONS SUB-CODE

Background, purpose and scope

Art 9.00 This section of the Grid Code, the Operations Sub-code, contains the provisions and regulations covering all relevant aspects of power system operation. The Operations Sub-Code governs the day-to-day control, management and short-term planning functions needed to ensure the satisfactory performance of the NITS.

Art 9.01 The purpose of this Operations Sub-Code is to define the general arrangements, obligations of Grid Participants, policies, criteria and procedures needed to ensure the coordinated operation of the NITS in a manner consistent with the security of supply and reliability requirements as set out in Technical Schedule TS-L taking into account any expected or real constraints on the generation and transmission systems.

Art 9.02 This sub-code shall apply to all Grid Participants and their agents.

Art 9.03 All entities to whom this Sub-code applies shall adopt Prudent Utility Practice at all times to ensure reliable and satisfactory operation of the NITS.

Operational planning and management

Art 9.04 The ETU shall have responsibility for the Operational planning and management functions within the NITS which shall comprise

- (a) all tasks concerned with scheduling and controlling the operation of the generating units and the transmission equipment to ensure adequate operating margins,
- (b) development of procedures for maintaining system integrity during emergencies and
- (c) coordination of maintenance outages with NITS Asset Owners, Wholesale Suppliers, Distribution Companies and Bulk Customers.

Art 9.05 The purpose of Operational planning shall be to ensure that short-term and medium-term events such as maintenance and repair work on equipment and apparatus, constructional activities in the transmission system and schedules registered with the ETU are handled efficiently by taking them into consideration in the planning of daily operational activities.

Operations Planning Criteria

General principles

- Art 9.06 Operational planning for the NITS shall be based on operations criteria that are designed to maintain the reliability and continuity of electricity supply within the NITS at least cost.
- Art 9.07 In performing the operational planning function the ETU shall take into account the maintenance cycle of plant and equipment and prepare annual, monthly, weekly and daily operational plans to achieve the required objectives.
- Art 9.08 The ETU shall at all times have a set of current plans, which are based on evaluated options and implement these plans to ensure that NITS reliability is maintained.
- Art 9.09 The ETU shall measure, record and account for all power and energy flowing or interchanged over the NITS and shall install and operate devices of acceptable accuracy at each input and output node or feeder of the NITS for the purposes stated in Articles 9.10 - 9.18.

Generation Management

- Art 9.10 The ETU shall operate sufficient generation capacity under automatic control to meet its obligation to continuously balance power demand and supply in real-time in accordance with the stipulated reliability and quality of service standards.

Voltage Management

- Art 9.11 The ETU, in operating the transmission system, shall schedule generating plant reactive power outputs and procure reactive compensation as necessary to maintain the voltages at all NITS nodes and substations within established limits, as stipulated in Technical Schedule TS-L.
- Art 9.12 Each generating plant shall be capable of continuous operation within the stipulated power factor range to support voltages under normal and contingency conditions.

Time and Frequency Management

- Art 9.13 The ETU shall control and operate all relevant NITS equipment and devices to maintain system frequency within the stipulated performance and reliability limits.
- Art 9.14 Each Wholesale Supplier, wherever possible, shall contribute to frequency regulation in order to achieve the required balance.
- Art 9.15 Operating limits for frequency deviation and time error shall be established with NITS reliability as first priority.

Art 9.16 Each Wholesale Supplier shall participate in time error correction procedures and the ETU shall coordinate the time error correction procedures.

Interchange Management

Art 9.17 Each Wholesale Supplier shall, through daily schedule verification and the use of reliable metering equipment, accurately measure, control and account for all energy and power interchanges.

Art 9.18 Recognizing generation and load patterns, each generating plant shall be active in preventing inadvertent interchange accumulation.

Operating reserves criteria

Art 9.19 The ETU shall schedule for operation at all times adequate generation resources to provide a level of operating reserves, sufficient to allow adequate cover for:

- (a) errors in demand forecasting, regulating requirements and system load diversity;
- (b) deviations in generation and transmission equipment unavailability; and
- (c) variations in internal grid needs taking into account such factors as number and size of generating units, system equipment usage, forced outages and maintenance schedules, all in order to meet applicable standards for system reliability and security.

Types of reserves

Art 9.20 Operating Reserves are that generation capability above firm system demand that are required to meet the standards of an adequately responsive system for regulation, load forecasting error, mismatch between generation and demand, equipment forced outages and scheduled outages. Operating reserves consist of spinning reserves and non-spinning reserves.

Art 9.21 Spinning reserves consist of the unloaded generation capacity, which is synchronized and ready to automatically serve additional demand without human intervention in order to arrest a drop of system frequency due to an instantaneous mismatch between generation and demand. It shall include and consist primarily of the additional output from currently operating generating plant that is realizable in real time and can be provided steadily for at least one hour.

Art 9.22 A Non-spinning reserve is that generating capacity not operating or synchronised to the system but which is available to serve demand within thirty minutes of being requested so to do. Specifically, a Non-spinning reserve shall comprise the steady output available from a generating unit that can be synchronized to the NITS and loaded up within the specified period to respond to an unexpected demand increase or loss of generation or transmission capacity.

Determination and allocation of operating reserves

Art 9.23 The ETU shall determine and have adequate operating reserves available at all times in order to ensure the security and reliability of power supply within the NITS.

Art 9.24 The Spinning Reserve at any time shall be large enough to enable the grid withstand any one of the following events:

- (a) the loss of the generating unit currently producing the highest amount of power within the NITS, or
- (b) the loss of generation capacity that could result from any single transmission equipment failure, fault or other contingency, or
- (c) the loss of any power in-feed from an interconnected system, whichever is the largest.

Art 9.25 The ETU shall allocate and distribute the required Spinning Reserves among the generating units operating within the NITS such that the grid is able to withstand any single contingency.

Art 9.26 The ETU shall determine the amount of Non-spinning Reserve that is required within the NITS and allocate and distribute this requirement among any available generating units provided the generating unit has not been already identified as part of the spinning reserves and can be synchronized and put on line within the stipulated time of thirty minutes.

Art 9.27 The security of supply from the NITS especially under certain contingency conditions, depends on the reliable and prompt start-up of Non-spinning Reserves whenever required. Accordingly, a generating unit designated or allocated as part of the Non-spinning Reserves shall ensure its readiness to start-up and generate its full allocated power within the stipulated period. A generating unit that fails to meet this obligation shall be in breach of the Grid Code and shall be liable for penalties as provided for under the Electricity Market Rules.

System voltage and reactive power criteria

Art 9.28 Operational planning of the grid shall assume that the reactive power requirements at all NITS nodes, feeders and substations are such that the power factor at these points is between 0.90 lagging and unity.

Art 9.29 Operations planning of the grid shall also assume that all generating units connected to the NITS are capable of continuous operation at a power factor of 0.85 lagging and 0.95 leading at rated active power output.

Art 9.30 Operations planning for the NITS shall ensure that voltages are maintained within the stipulated range, provided loads and generating plants abide by the above requirements.

Co-ordination of reactive power compensation

Art 9.31 On the basis of the expected power flows, the ETU shall predict the voltage profile of the NITS and the reactive power generation and reactive reserve capacity requirements for each section of the system and from each generating unit in order to ensure satisfactory voltage levels.

Art 9.32 The ETU shall instruct the use of voltage control devices and also despatch the reactive power output of generating units to meet the requirements as economically as possible.

Basic reactive power compensation

Art 9.33 Distribution Companies, Bulk Customers and any other NITS off-taker shall install devices in their respective networks that provide sufficient reactive power compensation to maintain their operations within the stipulated average power factor of not lower than 0.9 lagging.

Art 9.34 All generation units shall be designed to be capable of continuous operation or in-feeding power at a power factor between 0.95 leading and 0.85 lagging as a normal requirement.

Art 9.35 Generation plants shall in addition have reactive reserve capacity (i.e. operate with power factor at 0.90 leading for up to thirty minutes) and operate within the generator capability chart for temporary sustenance of system voltage under contingency conditions.

Art 9.36 The ETU shall co-ordinate with each generation plant the setting of generating unit operating points and the use of voltage control equipment to maintain transmission voltages as specified in Technical Schedule TS-L.

Art 9.37 All generation plants shall promptly comply with any despatch instruction from the ETU to operate at any power factor within the required limits as a normal requirement and the provision of such reactive power by any generating plant shall be without compensation.

Art 9.38 Failure of a generation plant to provide the normal operational requirement for voltage control upon the instructions of the ETU shall constitute a breach of the Grid Code for which penalties may be assessed and applied in accordance with Technical Schedule TS-C.

Art 9.39 Provided user loads and generating plants have complied with the normal reactive power compensation requirements above, it shall be the responsibility of the ETU to provide whatever additional reactive power compensation that is required to maintain system voltages within the stipulated range.

Such reactive power compensation generally referred to as the “*Basic Reactive Power Compensation*” shall be to the account of the ETU as part of the general cost of operating the NITS.

Supplementary reactive power compensation

Art 9.40 Where a Distribution Company, Bulk Customer or any other NITS off-taker fails to maintain its reactive power requirements or power factor within the stipulated range, the ETU may procure or provide supplementary reactive compensation in order to ensure that the NITS voltage standards are achieved. Such users shall be liable to pay compensation to the ETU in addition to penalties at rates set out in Technical Schedule TS-C or the Electricity Market Rules which are commensurate with either the level of their reactive power needs that are in excess of their limits or the level of supplementary reactive compensation deemed to have been procured by the ETU due to their failure.

Art 9.41 The ETU shall schedule, provide, procure and/or despatch supplementary reactive power compensation as necessary to maintain system voltage within limits during normal operations as well as during grid contingency conditions.

Art 9.42 The normal provision of reactive power requirements by any generating plant shall be without compensation but dispatch instructions for operation beyond the standard requirement shall attract compensation payments from the ETU as provided under the Electricity Market Rules.

Compliance of generating plants with instructions

Art 9.43 A generating plant shall comply with the instructions of the ETU and operate accordingly to provide reactive power compensation and maintain voltage levels.

Art 9.44 Generating plants shall inform the ETU of any difficulties in meeting the agreed voltage levels or in providing the reactive power compensation requirements. The generating plants shall in addition ensure that automatic voltage regulators and other such devices are continuously in service and inform the ETU accordingly whenever a generating unit is operating without its automatic voltage regulator or any such devices.

Art 9.45 The inability or unwillingness of a generating plant to comply with the valid instructions of the ETU (i.e. to operate at any point within the stipulated limits) shall constitute a breach of the Grid Code for which penalties may be assessed and applied.

Transmission operations planning

Art 9.46 For the purposes of real-time control of the power system, the ETU shall regularly perform transmission operational planning studies.

Art 9.47 The transmission operational planning studies shall be made on a coordinated basis to determine:

- (a) the configuration and operating characteristics of facilities necessary for satisfactory operation of the NITS; and
- (b) the operating limitations for normal operation when all transmission components are in service and also under abnormal or emergency conditions.

Art 9.48 Transmission operational planning shall be in accordance with and satisfy the N-1 contingency criteria.

Art 9.49 Periodic studies shall be undertaken to determine the Emergency Transfer Capability of interconnection transmission lines.

Power system operating states

Normal State

Art 9.50 The NITS shall be considered to be in a Normal State when all the following conditions are satisfied :

- (a) the operating reserves as specified in the Operating Manual are sufficient;
- (b) the system frequency is within the limits of 49.8Hz and 50.2Hz;
- (c) voltages at all NITS buses are within the limits of $\pm 5\%$ of the nominal value;
- (d) the loading levels of all transmission circuits and substation equipment are below 85% of their continuous ratings;
- (e) all interconnection transmission lines having or likely to have an impact on the operation of the NITS are being operated within their ratings; and
- (f) the NITS configuration is such that any potential fault current can be interrupted and the faulted equipment can be isolated from the NITS and the NITS shall remain secure against an N-1 contingency event.

Alert State

Art 9.51 The NITS shall be considered to be in an Alert State when any one of the following conditions exist:

- (a) the system operating reserve is less than the required margin;

- (b) the system frequency is outside the limits for the Normal State, but within 49.0Hz to 51.0Hz;
- (c) the N-1 contingency criterion is violated;
- (d) the voltage at any NITS bus is outside the limits of $\pm 5\%$ of the nominal value but within the limits of $\pm 10\%$ of the nominal value;
- (e) there is critical loading or imminent overloading of transmission lines or substation equipment;
- (f) a weather disturbance has entered the ETU area of responsibility, which may affect operations of the NITS; or
- (g) a social unrest or public order problem exists, which may pose a threat to NITS operations.

Art 9.52 The ETU shall declare the power system to be in an Alert State when any of the above conditions exist on the NITS and all Grid Participants shall coordinate their actions to restore the NITS to the Normal State.

Art 9.53 Once an Alert State has been declared, the ETU may take such action as it determines appropriate, including:

- (a) cancelling all planned maintenance or other work affecting the security of the NITS;
- (b) cancelling and denying requests for or deferring approved outages;
- (c) directing that parts of the NITS be returned to service, as required; and
- (d) operating at security limits appropriate for an Alert State.

Emergency State

Art 9.54 The NITS shall be considered to be in an Emergency State when a multiple contingency system condition has occurred without resulting in a total system collapse, in addition to the existence of any one of the following conditions exists:

- (a) there is a generation deficiency; or
- (b) NITS transmission voltages are outside the limits of $\pm 10\%$ of the nominal value; or

- (c) the loading level of any transmission circuit or substation equipment is above 110% of its continuous rating.

Art 9.55 The ETU shall declare the power system to be in an Emergency State when any of the above conditions specified for an Emergency State exists on the NITS or when the ETU determines that there exists a situation which has an adverse effect on electricity supply or which poses a significant threat to system security.

Art 9.56 During an Emergency State, all Grid Participants shall coordinate their actions to restore the NITS to the Normal State.

Art 9.57 Once an Emergency State has been declared, the ETU shall operate within the security limits appropriate for an Emergency State which shall include taking such necessary action as the following:

- (a) cancelling all maintenance or other planned work affecting the security of the NITS;
- (b) cancelling, denying requests for or deferring approved planned outages;
- (c) directing that transmission or generation facilities be returned to service; and
- (d) operating to security limits appropriate for an Emergency State.

Extreme State

Art 9.58 The NITS shall be considered to be in an Extreme State when corrective measures taken by the ETU during an Emergency State have failed to maintain the security of the NITS and has resulted in either cascading trips, islanding and/or system collapse.

Restorative State

Art 9.59 The NITS shall be considered to be in Restorative State when generating units, transmission lines, substation equipment and loads are being energized and synchronized to restore the Grid to its Normal State.

Power system operation criteria

Art 9.60 The NITS shall be operated so that it remains in the Normal State.

Art 9.61 The NITS shall be operated and maintained to meet the operating limits and benchmarks stipulated in Technical Schedule TS-L including other Reliability and Performance Standards under the Grid Code

Art 9.62 The Security and Reliability of the NITS shall be determined based on a Single Contingency criterion which is that the NITS shall continue to operate in the Normal State following the loss of any one generating unit, a transmission line or a transformer.

Art 9.63 The system frequency shall be controlled by the spinning reserve during the Normal State and by the timely use of non-spinning reserve and demand management practices during the Alert State and the Emergency State.

Art 9.64 The NITS shall be operated at adequate security levels to reduce vulnerability to transient instability, dynamic instability and voltage instability problems.

Art 9.65 Adequate spinning reserve and non-spinning reserve shall be available to stabilize the NITS and facilitate the restoration to the Normal State following a disturbance leading to loss of generating capacity.

Art 9.66 Following a contingency event or a significant change in power system conditions, it is possible that the power system may no longer be in a condition which could be considered secure on the occurrence of a further contingency event. The ETU shall take all reasonable actions to adjust the operating conditions with a view to returning the power system to the Normal operating state as soon as it is practical to do so.

Art 9.67 The ETU shall ensure that adequate load shedding facilities that could be initiated automatically by frequency conditions are available and in service to facilitate the restoration of the power system to a Normal State following significant contingency events.

Art 9.68 All Grid Participants shall be required to provide and maintain all required facilities consistent with Prudent Utility Practice and to operate equipment in a manner so as to:

- (a) assist in preventing or controlling instability within the power system;
- (b) assist in the maintenance of, or restoration of the NITS to a Normal State of operation;
and
- (c) prevent uncontrolled separation of the power system, transmission break-up, or cascading outages, following any power system incident.

Power system frequency control

Art 9.69 The ETU shall use its reasonable endeavours to control the power system frequency and ensure that the power system frequency performance standards defined in the Technical Schedule TS-F of the Grid Code are achieved.

Art 9.70 To assist in the effective control of power system frequency by the ETU,

- (a) The authority to control and direct the output of generating units shall rest with the ETU;
- (b) Generating plants, however, are required to provide any necessary protective devices or systems to protect their plant and associated facilities against abnormal and extreme frequency excursions on the power system;
- (c) The ETU shall arrange to have available and specifically allocate generating plant as found appropriate that can be automatically controlled through AGC or directed by the ETU to ensure that normal load variations do not result in frequency deviations outside the defined limits for normal operation;
- (d) The ETU shall procure adequate ancillary services to cater for the impact of potential power system disruptions on the power system frequency arising from the most critical single contingency event; and
- (e) The ETU shall ensure that adequate facilities are available at all times and are under its direction to allow for the managed recovery of the NITS to its Normal State whenever required.

Power system voltage control

Art 9.71 The ETU shall use all reasonable endeavours to control power system voltages and ensure that the defined power system voltage standards of the Grid Code are achieved.

Art 9.72 To assist in the effective control of power system voltages:

- (a) The ETU shall ensure that sufficient resources are available throughout the NITS to meet applicable performance standards for reactive power support and voltage control;
- (b) The necessary procedures shall be as established by the ETU in the relevant System Operational Manuals;
- (c) The ETU, in consultation with Grid Participants, shall assess and determine the limits of the operation of the power system associated with the avoidance of voltage failure or collapse under credible contingency event scenarios, which determination shall include a review of the dynamic stability of the power system;

- (d) The voltage limits of the power system shall be translated by the ETU into key location operational voltage target settings, transmission line capacity limits, reactive power production or absorption capacity or other appropriate limits;
- (e) The ETU shall direct providers of reactive power support and voltage control service to take any actions necessary to maintain stable voltage levels in accordance with relevant provisions of Connection Agreements, applicable performance standards and contractual arrangements for ancillary services in order to prevent the collapse of voltages on the NITS;
- (f) If voltages are outside acceptable limits, and the means of voltage control are exhausted, the ETU shall take all other reasonable actions, including directing changes to demand, selective load shedding, additional generation or reduction in transmission line flows but only to the extent necessary to restore the voltages to within the relevant limits and all Grid Participants shall comply with any such directions;
- (g) Sufficient data acquisition equipment with suitable indicators shall be available to the ETU and generating plants to monitor system voltage levels, load-tap-change settings, reactive power flow and status of reactive power supply resources; and
- (h) The ETU shall arrange, coordinate and supervise the conduct of appropriate tests to assess the availability and adequacy of the provision of reactive power to control and maintain power system voltages under Normal, Alert and Emergency States.

Protection co-ordination

Art 9.73 Relaying at Connection Points shall be of primary concern to the ETU because the satisfactory operation of the NITS, especially under abnormal conditions, is dependent upon the relay equipment and relay schemes in effect..

Art 9.74 A Grid Participant shall design, implement, coordinate and maintain its protection system to ensure the desired speed, sensitivity and selectivity in clearing faults on the Grid Participant's side of the Connection Point.

Art 9.75 The NITS shall have adequate and coordinated primary and backup protection at all times to limit the magnitude of Grid disturbances when a fault or equipment failure occurs.

Art 9.76 Where there is an outage of one protection system of a transmission element, the ETU shall determine, in consultation with the relevant NITS Asset Owner, the most appropriate action to take.

Art 9.77 Where there is an outage of both protection systems on a transmission element and the ETU determines this to be an unacceptable risk to power system security, the ETU may take the transmission element out of service as soon as possible and advise the relevant NITS Asset Owner immediately of the action undertaken.

Art 9.78 The ETU shall coordinate the necessary inspections and tests to ensure that the protection of the power system is adequate to avoid damage to power system plant and equipment.

Appointment of agents and authorised communications

Art 9.79 A Grid Participant may appoint an agent (called a “Grid Participant Agent”) to coordinate operations of one or more of that Grid Participant’s facilities on its behalf, but only with the prior written consent of the ETU.

Art 9.80 A Grid Participant that has appointed a Grid Participant Agent may replace that Grid Participant Agent but only with a prior written consent of the ETU.

Art 9.81 The ETU may only withhold its consent to the appointment of a Grid Participant Agent if it reasonably believes that the appointed agent is not suitably qualified or experienced to operate the relevant facility at the interface with a transmission network.

Art 9.82 The ETU may appoint a person to carry out operations on its behalf at the interface of the NITS with the Grid Participant’s facilities.

Art 9.83 The ETU and its representative (including authorised agents) may rely on any communications given

- (a) by a Grid Participant Agent as being given by the relevant Grid Participant; and
- (b) to a Grid Participant Agent as having been given to the relevant Grid Participant.

Art 9.84 For the purposes of this Grid Code,

- (a) the act or omission of a person appointed by a Grid Participant as an agent shall be deemed to be the act or omission of the relevant Grid Participant, and
- (b) communication between the respective appointees of the ETU and a Grid Participant shall be deemed to be authorised communication.

Demand management

Art 9.85 This section of the Operations Sub-Code applies to situations on the NITS where there is insufficient generation capacity available from generation facilities to satisfy expected demand, where operating problems that affect the ability to serve load exist, or where there is a breakdown on any part of the NITS.

Art 9.86 The section identifies actions that the ETU may take or may direct Grid Participants to take to assist in achieving reductions in demand to either avoid or alleviate such situations.

Automatic Frequency Load Shedding (AFLS)

Art 9.87 An AFLS scheme shall be implemented to maintain the frequency of the NITS and to restore it to normal, following frequency deviations outside of the limits established by the Grid Code.

Art 9.88 All Distribution Companies and Bulk Customers having expected peak demands at any connection point in excess of five MW shall provide AFLS facilities to enable automatic interruption of load.

Art 9.89 The AFLS scheme shall be implemented in accordance with the philosophy stipulated in Technical Schedule TS-A.

Art 9.90 The ETU, in consultation with Grid Participants, shall develop a Demand Management Guidelines Manual which shall include the basis for exclusions to demand management activities that are undertaken during under-frequency conditions. The manual shall be updated as and when necessary.

Art 9.91 Following load shedding to maintain the frequency of the NITS, the ETU shall within 60 minutes after the action report conditions on the power system to all affected Grid Participants.

Art 9.92 No Grid Participant shall restore load that has been shed until directions have been received from the ETU permitting it to do so and the Grid Participant shall commence the restoration of load immediately following receipt of such direction.

Art 9.93 Each Grid Participant shall, as soon as practicable, provide the ETU with an estimate of the demand reduction that has occurred as a result of an AFLS operation.

Demand management in an Emergency Operating State

Art 9.94 When an Emergency Operating State has been declared by the ETU, the actions available to the ETU to safeguard the security of the NITS may include issuing directions to a Grid Participant to take manual action to reduce demand for electricity.

Art 9.95 A Grid Participant that receives a directive from the ETU to reduce demand shall achieve the reduction in demand within five minutes of receipt of the directive and shall, as soon as practicable, notify the ETU that it has done so.

Art 9.96 The Grid Participant that has reduced its demand shall not restore it until directions have been received from the ETU permitting it to do so and the Grid Participant shall commence restoration immediately following receipt of such directions.

Art 9.97 Where demand reduction within a Grid Participant's network may not be adequate to relieve dangerous system conditions, the ETU may instruct block load-shedding or resort to tripping of feeders or transformers at bulk supply substations.

Ancillary services

Art 9.98 The ETU shall ensure the availability and adequacy of ancillary services to support the transmission of energy from generating sources to loads while maintaining, reliable operation of the transmission system in accordance with Prudent Utility Practice.

Art 9.99 The ETU shall operate to ensure that sufficient ancillary services are available to satisfy the performance and reliability standards of the Grid Code.

Art 9.100 The requirements for ancillary services shall be adjusted from time to time by the ETU to take into account factors including variations in power system conditions, real-time dispatch constraints, contingency events, the prevailing risk or vulnerability level of the NITS and the results of assessments of voltage and dynamic stability.

Art 9.101 The ETU shall determine the ancillary services requirements of the NITS using demand forecasts for the time frame for which the ancillary services are to be provided.

Art 9.102 Ancillary services shall include

- (a) Spinning reserves,
- (b) Non-spinning reserves,
- (c) Voltage and reactive power control and
- (d) Black start capability.

Standards for ancillary services

Spinning reserves

Art 9.103 Spinning reserves required to meet expected variations in system demand shall be provided by Wholesale Power Suppliers with synchronized generating units capable of governor control and equipped with AGC facilities to respond to control signals from the ETU Dispatch Centre.

Art 9.104 The ETU shall determine the total amount of AGC capacity required through studies that identify the amount of reserves and regulation required to meet system performance and reliability standards and by considering the likely variation in load over the period.

Art 9.105 A generating unit that provides AGC regulation service shall meet the following criteria:

- (a) the generating unit must be capable of responding to direct control signals from the ETU's Dispatch Centre in both an upward and downward direction;
- (b) the output of the generating unit must be capable of being monitored continuously by the ETU through observation of the generating unit's AGC status which shall be observable, indicating whether the generating unit is on AGC or not; and
- (c) the generating unit must be capable of delivering the full amount of regulating capacity contracted in both the upward and downward directions within the time limit defined by the ETU.

Non-spinning reserves

Art 9.106 Non-spinning reserves which are required to maintain power system security in the event of NITS or generation outages shall be provided from unsynchronized generating units capable of being started, synchronized and loaded within the time frame defined by the ETU.

Art 9.107 Non-spinning reserve shall be provided by contractually committing to the ETU a generating unit that provides a portion of capacity that is idle or unsynchronized and yet can be fully activated within thirty minutes and is capable of operating at the designated output level for at least one hour.

Art 9.108 The ETU shall determine the total amount of non-spinning reserve capacity required to meet system performance and reliability standards and the determination of this requirement shall be a function of the largest generating units and load blocks on the system, as well as the combined system demand.

Voltage and reactive power control

Art 9.109 Reactive power compensation which is required to maintain adequate system voltages and to prevent power system failure through voltage collapse shall be provided from generating units operating

outside the reactive power limits defined in this Grid Code and from Grid Participants with the capability to supply additional reactive power above their own requirements.

Art 9.110 The ETU shall conduct technical studies based on the quantities, characteristics and locations of forecast demand to determine the quantities and locations of reactive support required to maintain voltage levels and reactive margins within the required standards

Art 9.111 Reactive power compensation and voltage control service shall be provided by contractually committing to the ETU the ability to reserve and dispatch the reactive power output of a generating unit and reactive power compensation devices.

Art 9.112 Every generating unit shall provide a minimum amount of reactive power to the ETU, in accordance with the relevant Connection Agreements.

Black start capability

Art 9.113 Generating plants with Black Start capability are required to enable restoration of the power system to a Normal State following a complete or partial failure of the power system.

Art 9.114 The ETU shall prepare an emergency power system restoration plan and determine the quantities and locations of Black Start generating units that are required. The determination of Black Start requirements for the NITS shall be made based on contingency studies performed in the preparation of the emergency restoration plan which studies shall, at a minimum, take into account the following:

- (a) a range of reasonable initiating disturbances;
- (b) the magnitude, extent and likelihood of the outage, the assumed status of generation after the initiating disturbance and the system demand level at the time of the disturbance;
- (c) generating unit performance, including the probability that some resources used to provide Black Start may fail to start; and
- (d) the possibility that transmission system damage may prevent some of the resources used to provide Black Start from serving their intended loads.

Art 9.115 The ETU shall secure adequate Black Start capacity by contractually committing self-starting generating unit capacities which shall be used to restore service to the transmission system after a blackout.

Dispatch, monitoring and testing of ancillary services

Art 9.116 In the real time dispatch time frame, it will be necessary to regularly monitor and manage the provision of the various ancillary services. The instructions for these services shall be issued by the ETU, and sent to the relevant Grid Participant.

Art 9.117 Any information that is brought to the attention of the ETU, either by way of direct communication with an ancillary service provider, or through other data shall be logged.

Art 9.118 Monitoring of ancillary service performance by the ETU shall be by a combination of on-going monitoring, unannounced tests and detailed analysis of response to actual contingency events by Grid Participants.

Art 9.119 Where the ETU determines that a Grid Participant has not responded to its instruction or there is an apparent deficiency in terms of ancillary service performance, the Grid Participant shall in the first instance be contacted and the deficiency discussed. The ETU shall record any reasons offered for the deficiency or non-responsiveness.

Art 9.120 Where there is continuing non-responsiveness, deficiency or variation from dispatch expectations on the part of Grid Participants, the occurrence shall be logged for review by the COC and the Grid Participant advised to that effect. Logged details shall include specific information offered by the Grid Participant and all other evidence that is available.

Ancillary Services Agreement

Art 9.121 The ETU shall use reasonable endeavours to enter into agreements to provide sufficient ancillary services to meet the system performance requirements, taking into account those which are available or are provided under Connection Agreements.

Art 9.122 The ETU may direct a Grid Participant to provide ancillary services agreed to be provided under a Connection Agreement and a Grid Participant so directed shall use reasonable endeavours to comply with any such direction.

Art 9.123 Unless otherwise agreed between the parties, payment by the ETU under an Ancillary Services Agreement may contain but shall not be limited to:

- (a) components based on either or both of the contracted capabilities and a measure of the ancillary service actually provided;
- (b) a component reflective of demonstrable opportunity cost (i.e. lost revenue or opportunity) incurred by the Grid Participant in providing the ancillary service; and

- (c) a component to provide the Grid Participant with a fair return in respect of any additional direct costs associated with providing the ancillary service.

Art 9.124 A Grid Participant shall not unreasonably refuse to provide ancillary services.

Art 9.125 The ETU shall, through the System Operational Manual, develop methods and procedures to determine, control and monitor the performance of Grid Participants who provide ancillary services.

Art 9.126 The ETU shall randomly monitor and check each provider of ancillary service for compliance, in accordance with the requirements of the system.

Art 9.127 When justifiable in terms of power system security, the ETU may direct any Grid Participant to provide an ancillary service where the Grid Participant's plant is capable of doing so.

Art 9.128 The ETU shall offer compensation to a Grid Participant in respect of the ancillary services provided where:

- (a) the ETU directs a Grid Participant to provide ancillary services and the Grid Participant provides the ancillary services; and
- (b) there is no Ancillary Services Agreement in place with that Grid Participant in respect of the required ancillary service;

Art 9.129 If compensation offered for provision of ancillary services is not accepted by the Grid Participant and the level of compensation cannot be agreed, the Grid Participant may seek a determination of a reasonable level of compensation in accordance with the dispute resolution procedures of the Grid Code.

Power system restoration

Art 9.130 A partial or total system collapse represents one of the most serious fault situations that may occur on the NITS. Due to the significance of such an incident and the urgency in restoring supply to all customers, it is imperative that all Grid Participants maintain a high level of awareness and understanding in respect of power system restoration.

Art 9.131 Following a system collapse, the ETU shall coordinate power system restoration in an orderly and secure manner.

Restoration Plan

Art 9.132 The ETU shall develop and maintain a plan, the NITS Restoration Plan, for restoring the power system following a major contingency event or emergency as required by the applicable reliability standards and considered prudent by the ETU.

Art 9.133 The NITS Restoration Plan shall cover elements as the ETU determines necessary to implement effective restoration of the power system including:

- (a) plans for managing major disturbances on the power system that result in partial or total system collapse;
- (b) plans for the testing and verification of emergency preparedness facilities and procedures;
and
- (c) description of the roles of the ETU and various participants in the power system restoration plan.

Art 9.134 The objective of the NITS Restoration Plan shall be to ensure that in the event of a partial or total collapse normal supply is restored to all customers as quickly and as safely as practicable in accordance with Prudent Utility Practice.

Art 9.135 The NITS Restoration Plan and associated procedures shall be developed in consultation with all Grid Participants, and shall be reviewed and/or updated at least annually, whenever changes are made in the power system configuration or more frequently if required.

Art 9.136 Where an outside source of power is necessary for start-up, necessary switching procedures shall be determined and reviewed periodically with dispatchers and the operating personnel;

Art 9.137 It shall be the responsibility of each Grid Participant to ensure that any of its personnel who may reasonably be expected to be involved in power system restoration are familiar with, and are adequately trained and experienced in the procedures to be carried out and shall have sufficient authority to be able to implement the plan and comply with any instructions issued by the ETU.

Art 9.138 The ETU and all relevant Grid Participants shall verify the restoration procedure by actual testing or by simulation.

Restoration Process

Art 9.139 The ETU shall issue instructions for generating plants with Black Start capability to initiate a Start-up.

Art 9.140 Upon receipt of the instruction from the ETU, Grid Participants providing Black Start shall start-up immediately to energize a part of the NITS and/or synchronize to the NITS.

Art 9.141 The ETU shall issue directions to Grid Participants in restoring the power system following major disturbances And each Grid Participant shall be responsible for carrying out such ETU directions in accordance with the provisions of the NITS Restoration Plan.

Art 9.142 The ETU shall coordinate the rate that load is restored to prevent adding load faster than generation and transmission capabilities permit.

Art 9.143 During total or partial collapse and as conditions are being brought back to normal, the system may be operated outside normal voltage and frequency standards.

Art 9.144 The ETU shall inform all Grid Participants after completing the restoration of the NITS, that the Emergency State no longer exists and that the NITS is back to Normal State and normal scheduling and dispatching operations shall then be resumed.

Outage/maintenance planning

General

Art 9.145 The purpose of this section of the sub-code is to enable the ETU to review, assess, coordinate, control and manage the impact of outage schedules on the fulfilment of its reliability-related obligation of the NITS.

Art 9.146 The section defines the responsibilities of the various parties with regards to the outage planning process. It provides for the notification of outage requirements, the permitting of outages and identification of the categories of equipment whose outage requires notification or permission prior to withdrawal from service. It requires Grid Participants to obtain the approval of the ETU in respect of planned outage schedules, permits the ETU to reject, defer and recall outages that may have an unacceptable impact on the reliability of the NITS and provides for certain consequences following the cancellation of outages.

Art 9.147 The ETU shall ensure that generation and transmission equipment outages are planned and coordinated to maximize resource utilization and to minimize down-time all in the pursuit of reliable service and least operating cost.

Art 9.148 The planning of the temporary or final shutdown of equipment shall be undertaken sufficiently in advance to enable technical contingency measures to be implemented.

Requirements and exceptions to prior approval for outages

Art 9.149 No person shall take any action that will cause an outage or affect the optimum operation of equipment that forms part of the NITS unless it is approved in writing by the ETU. Such equipment and facilities shall include the following:

- (a) facilities and equipment forming part of the NITS;
- (b) registered generation and auxiliary equipment connected to the NITS;
- (c) protective relaying equipment and facilities; and
- (d) communication and telemetry equipment required for the operation of the NITS.

Art 9.150 The ETU may amend from time to time and publish in the System Operational Manual, a full description of the equipment and facilities the outage of which must be reported to and scheduled with the ETU in accordance with the provisions of this section.

Art 9.151 Grid Participants may not remove from service the equipment and facilities described in Article 9.149 other than in accordance with this section, unless such removal from service is necessary to prevent substantial damage to the Grid Participant's equipment, facilities or the environment or to protect the safety of employees or the public.

Art 9.152 If any equipment or facilities are removed from service for any of the reasons stated in Article 9.151, the Grid Participant shall

- (a) promptly advise the ETU by phone giving the specific reasons for such action, and
- (b) thereafter notify the ETU in writing within 24 hours.

Art 9.153 The ETU shall approve all schedules for equipment outages.

Art 9.154 Outage of the following generation facilities however do not need to be reported to or scheduled with the ETU unless the generation facility has been designated by the ETU as affecting the reliability of the NITS:

- (a) a non-registered generation facility; and
- (b) a registered generation facility having a nameplate rating of less than 10 MW.

Art 9.155 The ETU may, upon request, exempt certain additional facilities and equipment from the application of the outage reporting and scheduling obligations set forth in this section where the ETU determines

that the granting of such an exemption is not inconsistent with the reliable and efficient operation of the NITS.

Art 9.156 A Grid Participant may submit an exemption request to the ETU at any time; however, a Grid Participant that has submitted an exemption request shall continue to comply with the outage reporting and scheduling obligations with respect to the facilities or equipment that they wish to be exempted until the ETU has notified its approval or otherwise of the exemption request.

Responsibility for preparation of outage plans

Art 9.157 The ETU has overall responsibility for assessment of the risk posed to the NITS arising from maintenance and commissioning activities. The ETU shall therefore coordinate maintenance activities, plan outages and administer the outage scheduling process.

Art 9.158 The ETU shall, among other things, prepare the following outage plans:

- (a) provisional 3-year Outage Plan; and
- (b) the annual Committed Outage Plan.

Art 9.159 The ETU shall take the following into account during the preparation of outage plans:

- (a) forecast demand and the requirements of the NITS;
- (b) the needs for maintenance of grid components;
- (c) the maintenance program actually implemented;
- (d) the request by Grid Participants for changes in their maintenance schedules;
- (e) the need to minimize the total cost of the maintenance activity; and
- (f) any other relevant factor.

Outage planning process

Art 9.160 All Grid Participants shall determine their annual Outage Needs based upon their own criteria and assessments.

Art 9.161 A Grid Participant shall provide the ETU with its Outage Needs for the next three years by June 15th of the preceding year.

Art 9.162 The Outage Needs shall include the following information which shall also be provided whenever a Grid Participant wishes to request for an outage on its equipment or facilities:

- (a) identification of the equipment and the capacity to be affected;
- (b) brief operational contingency and impact assessment;
- (c) time to restore the element in an emergency;
- (d) a description of the maintenance work to be carried out;
- (e) the expected duration of the maintenance work;
- (f) an indication of the preferred start date for the outage and the expected completion date for the work; and
- (g) an indication of whether there is flexibility in dates, the earliest start and the latest completion dates.

Art 9.163 Based on the Outage Needs information submitted, the ETU shall prepare an Initial Outage Plan for the next year and a Provisional Outage Plan for a further two years.

Art 9.164 Whereas the ETU, in preparing the outage plans, shall endeavour to accommodate Grid Participants' requests for particular dates, the Outage Needs submitted by a Grid Participant only represent a preference which shall be subject to the scheduling considerations of the ETU.

Art 9.165 The Initial Outage Plan which shall be circulated to Grid Participants not later than August 15th of the preceding year, shall include all the outage needs provided by Grid Participants.

Art 9.166 Where the outage needs of Grid Participants are in conflict or are incompatible with the service requirements of the NITS such that they cannot be accepted by the ETU, the ETU shall inform the affected Grid Participants and suggest, for their consideration, alternatives that resolve the conflict following which the affected Grid Participants shall submit Revised Outage Needs.

Art 9.167 Upon receipt of the Revised Outage Needs, the ETU shall consult with affected Grid Participants over any unresolved conflicts, prepare and issue by the 1st day of December to all Grid Participants, the Committed Outage Plan for the forth coming year.

Art 9.168 The Committed Outage Plan shall comprise a list indicating the planned outages by Grid Participant and the associated facility or equipment that have received the ETU's planning approval.

Art 9.169 Outage needs that are not included in the approved annual outage plan shall be deemed to have been denied by the ETU.

Outage/maintenance coordination

Art 9.170 Towards the coordinated implementation of their individual maintenance programs, each Grid Participant shall develop in accordance with the Committed Outage Plan, monthly Outage Requests which specify the details of the maintenance program for each week of the month.

Art 9.171 The Outage Request for each month shall be submitted to the ETU at least thirty days before the work planned is to start.

Art 9.172 The ETU shall approve all monthly outage requests that are in accordance with the Committed Outage Plan unless unforeseen conditions make it unwise or unacceptable from the reliability, security or safety perspective for the outage to proceed.

Art 9.173 A Grid Participant who no longer intends to proceed with a committed outage shall notify the ETU and any withdrawn outages may only be added to the outage plans of subsequent months at the sole discretion of the ETU.

Art 9.174 The ETU may deny, defer or cancel a previously approved outage if it determines, in accordance with system reliability, security or safety criteria that the planned outage poses a significant risk to the satisfactory operation of the NITS such that it would not be prudent for the outage to proceed.

Art 9.175 Where the ETU cancels or denies a planned outage from proceeding, it shall inform the affected Grid Participant as soon as practical and cooperate with the Grid Participant to arrange for the re-scheduling of the activity at the Grid Participant's earliest convenience.

Art 9.176 The ETU may, where necessary to maintain the reliability of the NITS in extreme emergency conditions, recall a planned outage that has already commenced.

Art 9.177 The ETU shall not recall an ongoing planned outage unless it has first cancelled, deferred or rejected requests for approval of all other planned outages the cancellation, deferral or rejection of which could eliminate the need to recall the ongoing planned outage and yet further control action is required.

Art 9.178 A Grid Participant whose ongoing planned outage has been recalled shall arrange for the accelerated return to service of the facility or equipment in accordance with the instructions of the ETU.

Restoration or return of equipment into service

Art 9.179 Grid Participants shall coordinate with the ETU in respect of the return to service of equipment following an outage taking into account the observance of the necessary Safety Requirements.

Outage records and reporting

Art 9.180 The ETU shall maintain a record of all submissions to the maintenance/outage planning and coordination process and of all forced outage notices and associated forced outage information submitted to it.

Art 9.181 The ETU shall, at the end of every quarter, provide a report indicating the following with respect to outages and related requests for compensation and disputes occurring:

- (a) list of all forced outages that occurred during the period, including planned outages that have been deemed as forced outages because they exceeded their approved duration and differentiating the outage types and provide the reasons for each outage;
- (b) a list of all planned outages;
- (c) a list of all outages where the approval of the ETU was withdrawn, including recalled outages together with the reasons for such withdrawal, and a record of whether the Grid Participant submitted the matter to the dispute resolution process;
- (d) a list of all outages which were withdrawn by the Grid Participant prior to commencement of the outage; and
- (e) such other outage-related information as may be requested by the ETC.

Art 9.182 Any planned outage that takes place at a time or times other than the time period approved by the ETU, including outages that extend beyond the time approved by the ETU shall be considered and reported as a forced outage and referred to the ETC.

Equipment testing

Art 9.183 The testing or trial-running of any equipment, plant or facilities which could adversely affect the stability, reliability or security of NITS services or the safety of personnel or cause damage to equipment connected to the NITS shall require the prior approval of the ETU.

Art 9.184 Tests for which the approval of the ETU is required shall include:

- (a) the deliberate application of short circuits;

- (b) generating plant capacity tests,
- (c) stability tests of generation plants, such as turbine over-speed tests, governor response tests and load-rejection tests;
- (d) actions such as line and equipment trip tests which could cause abnormal voltage or frequency excursions or current overload;
- (e) changes to the configuration of the NITS; and
- (f) commissioning tests of new generation facilities and re-commissioning tests of existing generation facilities.

Art 9.185 A Grid Participant who wishes to engage in any such test of its facilities or equipment shall request the prior approval of the ETU to conduct the test.

Art 9.186 The request for a test shall include all the information needed and requested by the ETU and any other parties that are likely to be affected to assess the potential impact. As a minimum, the information provided shall identify:

- (a) the rationale for the tests;
- (b) the equipment involved;
- (c) the test method, system configurations or setup and relevant details of contracts or agreements as they relate to the test activities;
- (d) preferred and alternative dates and times for the conduct of the test;
- (e) the expected impact of the test activities on power flows, voltage and frequency, and of any other network characteristics that could affect the stability and reliability of the NITS, including details of the steps or precautions to be taken so as to minimize the negative impact on the NITS and its users;
- (f) details of special readings, curves, plots or observations, as available; and
- (g) the names, designation and affiliation of personnel who will be involved in the test activities and methods of communication with those who may be contacted in this respect .

Art 9.187 The request for the proposed test shall be made at least 14 days in advance of the proposed test date to allow for the needed co-ordination and assessment by the ETU to take place. No such test shall commence without the specific approval of the ETU.

Art 9.188 The ETU shall permit a test referred to in this section to be performed unless the ETU determines that the performance of the test poses an unacceptable level of risk or that it will have an intolerable adverse impact.

Equipment identification and nomenclature

Art 9.189 In order to ensure the safe and effective operation of the NITS and to minimize the risk of faults resulting from human error, equipment nomenclature and identification shall be in accordance with a common standard which shall be developed and maintained by the ETU.

Art 9.190 All Grid Participants shall apply the common nomenclature system developed by the ETU to code, number, and otherwise identify all NITS substations, plant and equipment that form part of the NITS or are directly connected to the NITS.

Art 9.191 The nomenclature shall be used in all technical drawings, operations, instructions, notices and other documents.

Art 9.192 A Grid Participant shall use reasonable endeavours to ensure that its representatives comply with the nomenclature standards in any operational communications with the ETU.

Art 9.193 A Grid Participant shall ensure that name plates on its equipment at any point within the NITS conform to the nomenclature standards and that the nameplates are maintained to ensure easy and accurate identification of equipment.

Art 9.194 The ETU may, by notice in writing, request a Grid Participant to change the existing numbering or nomenclature of transmission equipment and apparatus of the Grid Participant for purposes of uniformity, and the Grid Participant shall comply with such a request provided that if the existing numbering or nomenclature conformed with the nomenclature standards, the ETU shall pay all reasonable costs incurred by the Grid Participant in complying with the request.

Communication systems and facilities

Art 9.195 The ETU is responsible for maintaining redundant means of communication which are continuously available with all Grid Participants, particularly, Wholesale Suppliers, Distribution Companies and Bulk Customers.

Art 9.196 The ETU and all Wholesale Suppliers, Distribution Companies and Bulk Customers shall provide adequate and reliable telecommunication facilities, including telephone, facsimile, electronic mail, internally and with other Grid Participants (where appropriate) to ensure the exchange of information necessary to maintain system reliability. When possible, these facilities shall be redundant and diversely routed.

ETU Communication Procedures

Art 9.197 Procedures for operator-to-operator communication shall be established by each Wholesale Supplier or Distribution Company working with the ETU so that communication between operating personnel is consistent, efficient, and effective during normal and emergency conditions.

Art 9.198 Operating instructions and procedures shall be established by each Grid Participant to enable operations to continue during the loss of communication facilities.

Guidelines and requirements for notification

Art 9.199 All Grid Participants shall provide the names of their contact persons.

Art 9.200 All Grid Participants shall give reasonable prior notice to all who may be affected by operational actions, such as switching or parameter adjustments that they intend to execute. The notice shall be given sufficiently in advance to allow others to consider the impact and prepare.

Art 9.201 A notification of an operation shall, whenever possible, be communicated in writing and shall be of sufficient detail to enable the recipient of the notification to consider and analyze the implications and risks arising.

Art 9.202 Where there is insufficient time before the scheduled operation for notification to be given in writing, then the notification shall be communicated by voice call to enable the action to be taken without delay followed by a written confirmation of the notification soon after the action has been completed.

Art 9.203 A notification shall include the name, position and other identification of the individual issuing the notice.

Art 9.204 The individual issuing the notice shall be competent and capable of discussing the technical merits, alternatives and implications of the notice.

Art 9.205 The issuing individual shall respond promptly and fully to any questions or requests for clarification or additional information.

Art 9.206 The recipient of the notification may ask questions to clarify the notification and the giver of the notification will, as far as is able, answer any questions raised.

Art 9.207 While in no way limiting the specific requirements for notification as set out in this section, the ETU and Grid Participants shall review from time to time the operations and events that require notification.

Notification of planned ETU operations

Art 9.208 Prior to carrying out any operation such as switching or parameter adjustment on a NITS equipment or device, the ETU shall inform all Grid Participants who may be affected or the operator of any equipment or network connected to the NITS that may experience an undesirable operational effect from the intended action.

Art 9.209 The notification shall give details of the operation to be carried out, the intended time and the expected or possible impact and effect to be experienced.

Art 9.210 The notice shall also suggest the corresponding actions expected of the recipient of the notification, if any.

Notification of Grid Participant operations

Art 9.211 A Grid Participant shall notify the ETU of any operations within the Grid Participant's facility which will or may have an operational effect on the NITS.

Art 9.212 The ETU may use the information gathered from the Grid Participant's notification in notifying any other Grid Participant whose facility or operations, in the reasonable opinion of the ETU, is likely to be affected by the issued (Grid Participant) notification.

Notification of Alert conditions and events

Art 9.213 Each Grid Participant shall advise the ETU without delay as soon as it becomes aware of any condition that poses a risk to the smooth operation of the NITS including the following specific conditions:

- (a) Security Emergency: - when civil or public order problems which may affect grid operations exist.
- (b) Operating Reserves:- when the Operating Reserve is less than required;
- (c) Overload:- when there is critical loading or imminent overloading of transmission lines or equipment;

- (d) Weather Disturbance:- when weather conditions or activities pose a risk to grid operations;
and
- (e) Act-of-God: any Act-of-God event or other relevant condition that poses a threat to grid operations.

Art 9.214 The ETU shall assess the risks and potential impact on the NITS as soon as it becomes aware of any condition that poses a risk to grid operations.

Art 9.215 The ETU, if it considers it necessary, shall declare a state of Alert and notify all Grid Participants who may be affected accordingly with such information as the ETU deems appropriate.

Art 9.216 . A Grid Participant may be furnished with extra any relevant information upon request.

Art 9.217 For the duration of the Alert, each Wholesale Supplier, Distribution Company or Bulk Customer in receipt of the Alert notice shall take the necessary steps to place and maintain its plant or apparatus in the operational mode in which it is best able to withstand the anticipated disturbance, unless otherwise instructed by the ETU.

Art 9.218 During the period while an Alert notice is still in effect, the ETU may vary the scheduling and dispatch instructions from those dictated by the merit order procedures in order to manage the risks.

Reporting of emergency, automatic or unplanned ETU operations

Art 9.219 Under circumstances where it is not possible to provide notification prior to the execution of an operation or in the event that the ETU needs to carry out an operation urgently, the ETU shall proceed with the action and thereafter inform Grid Participants of the occurrence of the operation without undue delay.

Art 9.220 Immediately following an emergency, automatic or unplanned operation of NITS equipment or devices, the ETU shall inform each Grid Participant whose system may have, or could experience an operational effect and give details of what has happened.

Art 9.221 The ETU shall also inform the Grid Participant as to the likely duration of the condition and provide updates, as appropriate. In addition, the ETU shall inform the Grid Participant when the condition has ended or as soon as reasonably possible thereafter.

Routine monthly reporting

Art 9.222 The ETU shall prepare and submit within 15 days of the succeeding month, a monthly report on NITS operations for the previous month.

Art 9.223 The monthly NITS operations reports shall include an evaluation of events and other problems that occurred within the Grid for the previous month, the measures undertaken to address them and the

recommendations to prevent recurrence in the future. In addition the monthly report shall contain data and information on the following:-

- (a) Frequency profile;
- (b) Voltage profile at selected NITS Nodes;
- (c) Major Generation and Transmission Outages;
- (d) Transmission Constraints;
- (e) Instances of persistent/significant non-compliance with the Grid Code.

Art 9.224 The monthly NITS operations reports shall be made readily available to Grid Participants for a period of at least 12 months.

Quarterly and Annual reports

Art 9.225 The ETU shall prepare and submit quarterly and annual reports on the performance of the NITS. The quarterly and annual reports shall evaluate the performance of the NITS against established targets, standards and benchmarks for reliability, security and quality of service as stipulated in Section 12 of the Grid Code. It may also indicate constraints, if any, along with details of the Grid Participants responsible for causing the constraints and any actions being taken by these Grid Participants to address the constraint.

Event and disturbance recording

Art 9.226 Recorded information about transmission system faults or disturbances is essential to determine the performance of system components and to aid in post-disturbance analysis. Such information can help to identify equipment malfunctions and the cause of swings that may have contributed to a disturbance. Protection system and control deficiencies can also be analyzed and corrective action taken to reduce the risk of recurring disturbances.

Disturbance monitoring requirements

Art 9.227 Disturbance monitoring equipment including sequence-of-event fault recording and dynamic disturbance recording equipment which are necessary to ensure that data is available to analyze system performance and the causes of system disturbances, shall be installed by the NITS Asset Owner at appropriate points within the NITS as determined by the ETU. The equipment shall also be capable of capturing power quality information such as voltage and frequency profiles, voltage dips and surges, voltage imbalance.

Art 9.228 A Grid Participant may also install disturbance monitoring equipment within any part of its facility to track any relevant system disturbances that may occur.

Art 9.229 A NITS Assets Owner shall provide information to the ETU on the disturbance monitoring equipment installed and operational within the NITS and the data/signals being monitored at each location. Every NITS Assets Owner shall maintain a database of the disturbance monitoring equipment and shall provide such information to the ETU on request. Data from transmission system disturbance monitoring equipment shall be in a consistent, time synchronized format.

Art 9.230 Following a disturbance, data from all recorders shall be systematically retrieved, preferably automatically, and correlated.

Art 9.231 To provide meaningful data, it is required that the recorders be synchronized to standard time and equipped with GPS-synchronized clocks, for time and date stamping.

Art 9.232 Sequence of event recorders shall be provided with time resolution between one and one hundred milliseconds. This is necessary to determine the sequence in which events occurred. Other details of minimum technical specifications, data format and standards for disturbance monitoring equipment shall be provided and updated, as necessary, by the ETU in consultation with Grid Participants.

Monitored data

Art 9.233 The basic data or signals to be monitored and recorded shall include, but not be limited to the following:

- (a) the transient and dynamic response of each generating unit in terms of real and reactive power output;
- (b) the voltage at the generating unit terminal;
- (c) generating plant bus frequency;
- (d) generating unit field voltage;
- (e) generating unit field current;
- (f) the system voltage at the high voltage side of the unit step-up transformer;
- (g) power system stabilizer output;
- (h) AGC pulses;

- (i) active and reactive power flow at a Connection Point;
- (j) substation busbar voltage and frequency; and,
- (k) circuit breaker and protective device status.

Required Locations of recorders

Art 9.234 The ETU shall determine and recommend the locations for installation of recorders. It is recommended that all major transmission substations and generating plants in the NITS be equipped with disturbance monitoring equipment.

Incident and fault reporting

General

Art 9.235 This section provides procedures to be adopted for reporting faults, forced outages and significant incidents which may occur in the NITS or a Grid Participant's system or facility which has an operational impact on others. It also describes the procedure for setting up joint investigation of a Significant Incident.

Reporting of significant incident by Grid Participant

Art 9.236 A Grid Participant shall notify the ETU through a report, as soon as practicable and in any event within twenty-four hours, of any forced outage, malfunction, fault or significant incident to a NITS component or the Grid Participant's facility or network that may have an impact on other Grid Participants or the quality, reliability or security of NITS services. The report shall include all the necessary information on the circumstances of the incident to enable the ETU and the NITS Asset Owner readily and correctly investigate and remedy any operational deficiency.

Art 9.237 Where the ETU determines that an incident which was reported earlier by a Grid Participant is significant, or an incident within the NITS is of significance, the ETU may request the Grid Participant to submit a detailed written report of the event.

Art 9.238 The ETU is not required to forward the report to other persons, but may use the information obtained in preparing its report for other Grid Participants who may have been affected by the incident.

Reporting of significant incidents by the ETU

Art 9.239 The ETU shall notify as soon as practicable and in any event within twenty-four hours, the relevant NITS Asset Owner or its designated representative of any forced outage, malfunction, fault or significant incident to a NITS component. The report shall include all the necessary information on the

circumstances of the incident to enable the NITS Asset Owner readily and correctly investigate and remedy any operational deficiency.

Art 9.240 If a Grid Participant determines that an incident which was reported earlier by the ETU is of significance, the Grid Participant may request the ETU to submit a written report containing details of the incident.

Art 9.241 The Grid Participant shall not pass on the report to other persons.

Guidelines for written reports

Art 9.242 A report prepared under this section may contain a confirmation of oral notification with more details relating to the significant incident (although it need not state the cause of the event) and shall, as a minimum, include the following details of the incident (where applicable):

- (a) time and date of event;
- (b) location;
- (c) plant and/or equipment directly involved;
- (d) description and cause of event;
- (e) conditions before the event;
- (f) demand and/or generation (in MW) interrupted and duration of interruption;
- (g) all Relevant system data including copies of records of all recording instruments including Disturbance Recorder, Event Logger, etc;
- (h) sequence of tripping with time;
- (i) details of relay operations; and
- (j) remedial measures taken.

Investigation of incidents

Art 9.243 A NITS Asset Owner or designated representative shall investigate the causes of any incident of forced outage or equipment fault/failure reported by the ETU and immediately effect all advisable temporary, containment or remedial actions.

Art 9.244 Upon completion of the immediate or remedy actions the NITS Asset Owner shall submit its investigation report of the event to the ETU.

Investigation of significant incidents

Art 9.245 The ETU shall at its sole discretion initiate an investigation into any Significant Incident that occurs on the NITS. The purpose of any investigation shall be to

- (a) establish the probable causes of the incident,
- (b) analyze the chronology and development,
- (c) assess the impact,
- (d) draw conclusions and
- (e) outline the measures necessary for prevention or impact mitigation of similar incidents in the future.

Art 9.246 A Grid Participant who is directly affected by a significant incident may request a joint investigation of the incident. The request for joint investigation shall be made in writing to the ETU, giving reasons for the request. A joint investigation shall be undertaken if, in the opinion of the ETU, this is so warranted.

Art 9.247 A joint investigation shall be organized by the parties concerned and independent experts may be invited to take part in the investigation by mutual agreement between the parties.

Art 9.248 The form and procedure of joint investigation of a particular incident shall be agreed upon in advance by the parties concerned.

Art 9.249 The results of the joint investigation shall be recorded in a report, copies of which shall be lodged with the ETU.

Section 10. SCHEDULING AND DISPATCHING SUB-CODE

Background, purpose and scope

Art 10.00 Scheduling the operations of generating units is a major component of the ETU's activities. The optimal schedule is influenced by factors on both the demand-side and supply-side as well as the limits and constraints of the NITS. The scheduling and dispatch process is to ensure that the continuously changing demand on the grid is met in the most economic manner bearing in mind the limitations on the transmission system, security requirements, etc.

Art 10.01 The Scheduling and Dispatch Sub-code defines, among others, the following:

- (a) responsibilities of the ETU, Wholesale Suppliers, and Bulk Customers in the scheduling and dispatch process, including suppliers and customers in the WAPP system;
- (b) load forecasting obligations, procedures and methodologies;
- (c) operational criteria for the preparation of the generation schedule and procedures for issuance of dispatch instructions;
- (d) the process and requirements for the preparation of the generation schedule;
- (e) the central dispatch procedures; and
- (f) requirements relating to the availability for dispatch of sufficient ancillary services including regulation and reserve services, reactive support and voltage control and black start services so that the ETU can maintain the reliability of the grid, including requirements under emergency conditions.

Demand Forecast

Art 10.02 The preparation of demand forecasts is essential for operational planning and to ensure reliable operation and service delivery from the NITS. Demand forecasting is an integral part of the Generation Scheduling and Dispatch process.

Generation scheduling and dispatch

Art 10.03 The generation scheduling and dispatch process involves the balancing of available generation with demand at all times, to ensure least cost and reliable operation of the NITS. The ETU projects demand, considers the generating plants that are available to provide supply to the NITS, the constraints within the NITS and then schedules generation in merit-order to meet the projected demand at minimal

cost and in accordance with the NITS Performance and Reliability Standards and Safety rules and standards.

Purpose

Art 10.04 The overall objective of this part of the sub-code is to:

- (a) specify the responsibilities of the ETU and Grid Participants in generation scheduling and dispatch;
- (b) provide general guidelines for the preparation and submission of demand forecasts for the effective planning of the operations of the NITS.
- (c) define the operational principles and criteria for the preparation of the Generation Schedule and issuance of Dispatch Instructions;
- (d) establish the procedures and requirements for the preparation of the Generation Schedule; and
- (e) define the Dispatch procedures.

Responsibilities of the ETU

Art 10.05 The ETU has the obligation to ensure that there is sufficient generation to meet demand at all times in the most optimal manner, making provision for reserve requirements, while maintaining the integrity of the NITS to ensure quality and security of supply.

Art 10.06 The generation scheduling activity (i.e. determining the unit commitment and economic dispatch) which shall be undertaken by the ETU requires generating plant data as its basis, to enable the ETU prepare a merit-order table for use in the preparation and issuance of the Generation Schedule.

Art 10.07 The ETU shall be responsible for:

- (a) collating and preparing the demand forecast on the NITS;
- (b) determining the generating capacity needed to meet the demand requirements of the NITS, including energy consumption, losses, internal usage, operating reserves, etc;
- (c) the preparation and issuance of the Generation Schedule in accordance with the procedures described in this Sub-code;
- (d) issuing of Dispatch Instructions for the scheduled generating units following the procedures outlined in this Sub-Code as well as the Operations Sub-Code;

- (e) ensuring that appropriately located generating units are available to provide ancillary services; and,
- (f) fully documenting the operation of the generation scheduling process, including the principles adopted in making the calculations required.

Responsibilities of NITS Asset Owners

Art 10.08 All NITS Asset Owners shall provide data on the availability, capability and operating states of transmission facilities and equipment as the basis for determining the operational limits of the NITS for generation scheduling and dispatch.

Responsibilities of Wholesale Suppliers

Art 10.09 A Wholesale Supplier shall comply promptly with an ETU request, to submit its Capability and Availability Declaration data, generation scheduling and dispatch parameters and any other relevant data as may be requested.

Art 10.10 A Wholesale Supplier shall ensure that all Dispatch Instructions from the ETU relating to a scheduled generating unit or plant are implemented.

Art 10.11 A Wholesale Supplier nominated to provide ancillary services shall be responsible for ensuring that its generating units are capable of providing the necessary support when so instructed by the ETU.

Responsibilities of Distribution Companies, Bulk Customers and other off-takers

Art 10.12 Distribution Companies and Bulk Customers and other off-takers connected to the NITS shall submit their Demand data to be used in the Demand Forecast process, required for the generation scheduling program.

Art 10.13 Distribution Companies, Bulk Customers and other off-takers shall implement all Dispatch Instructions pertaining to demand management control during the period while an emergency situation persists.

Demand forecast process

Art 10.14 Distribution Companies, Bulk Customers and other off-takers connected to the NITS shall forecast the total and the net (after deducting embedded generation) of energy and power demand that they expect to impose at each nodal point of the NITS.

Art 10.15 A Grid Participant shall prepare and provide to the ETU at least one week in advance, the forecasted hourly load profiles for each day of the next two weeks. These forecasts are to provide an

indicative estimate of the total generation capacity and of the corresponding Generation Schedule needed to meet the forecast demand requirements of the NITS over the relevant periods.

Art 10.16 The following factors shall be taken into account in the development of the demand forecasts, to the extent that the factors are relevant to the particular forecast:

- (a) historic demand data as recorded, including transmission losses and station service consumption;
- (b) growth patterns in the annual demand and load profiles of existing loads;
- (c) load management expectations and expected energy output from embedded generating facilities;
- (d) demand forecasts for new connections or step increases in the requirements of existing users;
- (e) known weather patterns and forecasts;
- (f) major events or anticipated activities which are likely to affect demand;
- (g) expected changes in economic activity; and
- (h) any other relevant information provided by Grid Participants.

Art 10.17 The ETU shall collate all demand information provided by the relevant Grid Participants and in accordance with the timetable prescribed in Technical Schedule TS-T the ETU shall produce the following schedules and demand forecasts:

- (a) dispatch schedule for each hour of the day ahead;
- (b) hourly load forecasts for each of days 2 to 7 (inclusive) ahead;
- (c) weekly demand forecast for 4 weeks ahead giving the daily energy forecast as well as the peak and off-peak demand forecasts for each day; and
- (d) monthly demand forecast for the period 12 months ahead of the current month, giving for each month the energy forecast, peak and off-peak demand forecasts, including also the typical hourly profiles of total system load for working and non-working days in the first month only.

Art 10.18 The ETU shall develop a methodology to collate the information obtained and acquire the appropriate tools to create the indicative demand forecasts for the entire system.

Art 10.19 The demand forecasts produced by the ETU shall be indicative only as the ETU has no direct influence over Grid Participants in the decisions about their levels of demand.

Art 10.20 The demand forecast shall be adopted and used in operational planning and more specifically, for the purposes of determining the dispatch schedules, operation reserves, short and medium term capacity reserve requirements in accordance with the power system security and reliability standards.

Generation margin

Art 10.21 The NITS shall have adequate Operating Reserve at all times to respond to normal variations in demand and to respond to a sudden reduction in generation during emergency conditions, in accordance with the Power system Operating Criteria specified in the Operations Sub-Code.

Art 10.22 The ETU shall allocate the required spinning reserve to strategically located generating plants in order to achieve the required levels of primary and secondary regulation.

Art 10.23 The ETU shall allocate adequate non-spinning reserve to cover uncertainties in generating plant availability.

Scheduling and dispatch criteria

Art 10.24 The ETU shall take into account the following criteria in scheduling and dispatch:

- (a) the synchronized generating capacity shall be sufficient to match, at all times, the forecast demand and the required operating reserves to ensure the security and reliability of the NITS;
- (b) the availability of adequate generating capacity so that the grid will continue to operate in Normal State, even with the loss of the largest generating unit or power import from a single interconnection, whichever is larger;
- (c) the technical and operational constraints of the Grid and generating units; and
- (d) security and stability of the NITS.

Scheduling and dispatch data

Art 10.25 A Wholesale Supplier shall submit to the ETU all specified generation data one day ahead of the Dispatch Day.

Art 10.26 The generation data information to be submitted shall consist of the Availability Declaration, generating plant scheduling and dispatch parameters and other relevant generation data, and also including the following:

- (a) details of any special factors which may have a significant impact on the output of a scheduled generating unit;
- (b) any temporary change to the registered data of the scheduled generating unit indicating the duration of the temporary change; and
- (c) any temporary change of a generating unit's availability to provide ancillary services and the duration of the temporary change.

Art 10.27 A Wholesale Supplier shall without delay notify the ETU of any change in the Capability and Availability Declaration, Generation Scheduling and Dispatch parameters and other relevant generating plant data.

Art 10.28 The Capability and Availability Declaration data to be provided by a Wholesale Supplier shall be as specified by the ETU in the System Operational Manual.

Art 10.29 A Distribution Company or Bulk Customer shall notify the ETU of:

- (a) its hourly demand forecast one day ahead of the Dispatch Day;
- (b) constraints on its distribution system or Grid Participant system which may need to be taken into account in scheduling and dispatch;
- (c) the requirements for voltage control and reactive power, which the ETU may need to take into account for the reliability of the Grid; and
- (d) the requirements for ancillary services which the ETU may need to consider for the reliability and stability of the NITS.

Merit order operation

Art 10.30 The ETU shall employ merit order operation of all sources to optimally meet the collective power demand on the NITS irrespective of the market arrangements covering the demand, whether by bilateral contracts or on the spot market. The commercial arrangements and contractual bases of each

component of demand shall nevertheless be taken into account in determining the settlement obligations of Grid Participants and in accordance with the rules and procedures of the Wholesale Electricity Market.

Art 10.31 To meet the continuously changing power demand of users on the NITS at the least cost, generating units shall, as far as practicable be stacked for dispatch by the ETU in accordance with submitted “price data” or the relative magnitude of their “operating costs” of producing electricity, excluding their capital charges and other fixed costs.

Art 10.32 The generating plants with the least operating costs shall be used to meet the demand for power with the required margin for Operating Reserves.

Art 10.33 Recognizing that the merit-order for generation is dependent upon the chosen time-frame for optimization, (i.e. the merit-order that produces the least cost for one-day only is different from that which results in the least cost for the week, the month or the year), Merit-order dispatch within the NITS shall take into consideration the various time frames.

Art 10.34 The dominant contribution of hydroelectric energy production within the NITS also means that annual rainfall and hydrologic events have a major influence in determining the optimal production proportions among the various sources of supply, so that, the overriding objective for merit order dispatch of generation plants within the NITS shall be that Merit-order which delivers the least cost of supply over the hydrologic year (November 1st to October 31st) which shall also be regarded as the Planning Year.

Art 10.35 The merit order for day-to-day or weekly dispatch shall be from the least cost generating unit to the highest bearing in mind the objective of achieving the least cost of supply over the Planning Year.

Art 10.36 For the purposes of merit order dispatch, generating units shall be listed in a Merit Order Table according to the lowest to highest operating costs..

Merit Order Table

Art 10.37 Using the operating cost or price data submitted by each generating plant in accordance with the rules of the Wholesale Electricity Market, the ETU shall prepare a Merit Order Table based on ascending operating costs or prices such that the scheduled generating unit that has the lowest price, per kWh, shall be at the top of the Merit Order Table.

Art 10.38 The Merit Order Table shall be updated periodically with the Availability Declarations submitted by Wholesale Suppliers and in accordance with the Wholesale Electricity Market Rules.

Art 10.39 The updated Merit Order Table shall be used in selecting the generating unit that will be committed for the day ahead Generation Schedule.

Generation scheduling procedure

Art 10.40 Generation scheduling procedures include the following:

- (a) collation of hourly demand forecast for the next Dispatch Day by the ETU;
- (b) the submission of an Availability Declaration to the ETU by each Wholesale Supplier;
- (c) the submission to the ETU of any revised generation scheduling data or dispatch parameters for the following Availability Declaration period by each Wholesale Supplier; and
- (d) the use of the information provided by Wholesale Suppliers and other Grid Participants in the preparation of a Generation Schedule for the next Dispatch Day.

Art 10.41 In preparing the Generation Schedule, the ETU shall take into account the following factors:

- (a) NITS system constraints from time to time, as determined by the ETU and as advised by NITS Asset Owner(s), Wholesale Power Suppliers and other Grid Participants;
- (b) the requirements and standards for voltage control and reactive power reserves;
- (c) the need for operating reserves and the requirements for maintaining frequency control as specified in the Operations Sub-Code;
- (d) the requirements for maintaining frequency control;
- (e) availability of ancillary services; and
- (f) cross-border power exchange transactions as governed by the WAPP Cooperation Model and other inter-utility bilateral agreements.

Art 10.42 The Generation Schedule, as compiled by the ETU shall, in addition to the above factors, satisfy the following conditions:

- (a) be in accordance with the Merit-Order Table;
- (b) be sufficient to match the forecast system demand together with the required reserve margin as defined by the Operations Sub-Code and

- (c) be sufficient to maintain frequency within the required limits.

Preparation of the Generation Schedule

Art 10.43 The ETU shall prepare, each day, an hourly demand forecast, taking into account system losses, for the next Dispatch Day.

Art 10.44 By 10:00h each preceding day, every Wholesale Supplier shall submit to the ETU, in writing, generation unit capability and availability declaration data to be used in preparation of the generation schedule for the next day.

Art 10.45 If a generating unit Capability and Availability Declaration for the next Dispatch Day is not submitted within the prescribed deadline, the Wholesale Supplier shall be deemed to have submitted on such day an Availability Declaration in the same value and terms as indicated in the most recent Capacity and Availability Declaration and the ETU shall use this data in preparing the Generation Schedule.

Art 10.46 By 10:00h each preceding day, all Distribution Companies, Bulk Customers and other Grid Participant who wish to off-take power or energy from the NITS shall submit to the ETU in writing the following information for the next day's Generation Schedule:

- (a) requirements for power and energy;
- (b) requirements for voltage control and reactive power compensation; and
- (c) constraints or conditions on its distribution system or network, which the ETU may need to take into account.

Art 10.47 If no data is received within the prescribed deadline, the ETU shall make assumptions based on the most recent data submitted and other known factors for the requirements of the relevant Distribution Company, Bulk Customer or other Grid Participant,.

Art 10.48 Scheduled generating units shall be committed in accordance to the Merit Order Table, until the forecast demand and system losses are fully covered. Additional generating units shall be committed to cover the Operating Reserve requirements and at this stage, a day-ahead unconstrained Generation Schedule shall be developed.

Art 10.49 Following the development of the unconstrained Generation Schedule, the ETU shall determine the feasibility of the unconstrained Generation Schedule, considering any constraints within the NITS.

Art 10.50 The unconstrained Generation Schedule shall be adjusted as may be necessary to develop the final constrained Generation Schedule, after taking the constraint factors into account.

Art 10.51 Scheduled generating units that are not included in the Generation Schedule shall be set aside for possible inclusion in the latter stage of the generation scheduling process.

Art 10.52 The Generation Schedule shall reflect the true operating characteristics of generating units. If a scheduled generating unit becomes available at a different capacity the ETU shall be provided with a revised Capability and Availability Declaration within the prescribed deadlines. If provided within the prescribed deadlines, the ETU shall take the revised Capability and Availability Declaration into account in the preparation of the final day-ahead Generation Schedule.

Art 10.53 The Generation Schedule shall be submitted by the ETU to all relevant Wholesale Suppliers by 15:00h of each preceding day for the next Dispatch Day.

Adjustments to Generation Schedule

Art 10.54 The ETU may deem it necessary to make changes to the output of the generation scheduling process, before the issue of the Generation Schedule. Such changes may be necessary due to the following factors:

- (a) changes in offered availability and parameters of generating units, brought to the attention of the ETU after the commencement of the generation scheduling process;
- (b) changes to system demand forecasts;
- (c) changes in transmission network configuration and equipment availability, resulting in constraints not previously foreseen; and
- (d) any other condition which in the opinion of the ETU would result in additional risk to the security of the NITS.

Art 10.55 Any of the factors listed in Article 10.52 may result in a generating unit being chosen out-of-merit. Any deviation from the use of the Merit Order Table for dispatch shall be reported by the ETU, including details of the reasons or those responsible for the deviation.

Art 10.56 If an event on the NITS occurs which requires substantial amendment in the data being used in preparing the Generation Schedule, the ETU may issue a revised Generation Schedule to the extent necessary, as a result of such events.

Issuing of Generation Schedule

Art 10.57 The final Generation Schedule for the next Dispatch Day shall be issued by the ETU at 15:00 h each day except in the event that a significant incident occurred while the Generation Schedule is being prepared, where the ETU may extend the deadline for issuance of the final Generation Schedule.

Art 10.58 The final Generation Schedule shall indicate

- (a) the hourly output of each scheduled generating unit for the following Dispatch Day;
- (b) the generation units that are providing specific ancillary services and
- (c) interconnection power transactions.

Dispatch Instructions

Art 10.59 Dispatch Instructions shall take into account the Capacity and Availability Declaration, generation scheduling and dispatch parameters and other relevant generating plant data supplied to the ETU.

Art 10.60 The Dispatch Instruction shall contain, at the minimum, the following:

- (a) the specific generating unit to which the instruction applies;
- (b) the MW and MVar output required;
- (c) start and synchronizing time of scheduled generating units;
- (d) target time of ramp-up and ramp-down rates for generating units; and
- (e) the time Dispatch Instruction is issued.

Art 10.61 The Dispatch Instruction may also include:

- (a) details of the type of reserves to be carried by each unit, including specifications of the duration in which that reserve may be dispatched;
- (b) an instruction for generating units to provide operational requirements and other ancillary service;
- (c) target voltage levels at instructed generating capacity level or the individual reactive power output at the bus or connection point;
- (d) requirements for changes in AGC mode; and
- (e) an instruction to carry out tests as specified in the Operations Sub-Code.

Art 10.62 The ETU shall maintain records of the following Dispatch Instructions in an electronic format and a written logbook or both:

- (a) synchronizing and de-synchronizing Instructions;

(b) MW and MVar Dispatch Instructions.

Art 10.63 For each of the instructions listed in Art 10.62, the required action, time of issuance of the instruction and the time the action is to be implemented shall be recorded.

Art 10.64 The ETU shall issue to all Wholesale Suppliers and generating plants through an appropriate means of communication (telephone and confirmed by email or fax), the Dispatch Instruction regarding their day-ahead hourly Generation Schedule.

Art 10.65 The hourly loading as defined by the Generation Schedule and issued to scheduled generating units shall remain valid, unless superseded by another Dispatch Instruction.

Art 10.66 A generating plant shall be deemed to have complied with a Dispatch Instruction when it achieves an output within the allowable tolerance of its declared available capacity for both active and reactive power and within the time for the change according to its registered operating parameters and characteristics.

Art 10.67 In the event of two or more generating units having the same price, the ETU shall dispatch the generating unit that will result in a smaller system loss.

Art 10.68 Dispatch Instructions may be subsequently cancelled or varied. Generating units that are declared to be available but not included in the Generation Schedule may be issued with Dispatch Instructions.

Art 10.69 A generating unit that has been declared as available shall be ready to provide power within 30 minutes of being instructed.

Art 10.70 Where a generating plant has received a Dispatch Instruction to change the output of a synchronized generating unit, it shall carry out the instruction to achieve the new target within the unit's registered operating parameters and characteristics and within the time specified by the ETU.

Art 10.71 The form of instructions and terms to be used by the ETU in issuing instructions are to be mutually agreed by all relevant parties.

Art 10.72 A Dispatch Instruction for Operating Reserves shall specify the type of reserve that the generating unit is required to provide.

Art 10.73 A Dispatch Instruction for emergency load reduction shall contain the quantity and magnitude of load to be dropped and the time the load reduction is to be implemented.

Art 10.74 In the event that while carrying out a Dispatch Instruction, an unforeseen problem arises, the ETU shall be notified without delay by telephone.

Art 10.75 Where a Wholesale Supplier is unable to comply with a Dispatch Instruction correctly issued by the ETU, the Wholesale Supplier shall inform the ETU by telephone without delay and the Wholesale Supplier shall follow up and issue a new Declaration.

Art 10.76 The Dispatch instruction to shutdown a generating unit shall specify the shutdown time.

Art 10.77 Where a Wholesale Supplier has not informed the ETU of the inability to comply with a Dispatch Instruction, but the ETU assesses that the Wholesale Supplier is not in compliance with a Dispatch Instruction, the Wholesale Supplier shall be deemed to have breached the Grid Code and the prescribed sanctions or penalties shall apply.

Instruction to Wholesale Suppliers

Art 10.78 A Wholesale Supplier shall comply with all Dispatch Instructions issued by the ETU.

Art 10.79 If an unforeseen problem arises, which affects the safety of the plant or personnel, the Wholesale Supplier may disregard Dispatch Instructions and take necessary corrective actions and shall notify the ETU.

Art 10.80 De-synchronizing may take place without the ETU's prior approval, if it is done solely to protect plant or personnel safety.

Art 10.81 De-synchronization as a result of low-frequency-relay operation shall be reported to the ETU immediately.

Art 10.82 A Wholesale Suppliers shall, without delay, notify the ETU of any changes to or loss (temporary or otherwise) of operational capability of any unit that is synchronized or instructed to be synchronized or designated for operation as Operating Reserve.

Art 10.83 Where a Wholesale Supplier or a particular generating unit fails to respond to a dispatch instruction within a tolerable time and accuracy (in accordance with generating plant declared technical characteristics and Prudent Utility Practice), the generating unit shall be declared and identified as non-conforming and the relevant Wholesale Supplier may face financial penalties or other sanctions imposed under its license for breach of the Grid Code.

Instruction to Distribution Companies and Bulk Customers

Art 10.84 The ETU shall issue instructions to a Distribution Company or Bulk Customer for special actions relating to

- (a) load transfer,

- (b) demand management actions,
- (c) disconnection, or
- (d) restoration of load.

Reactive power dispatch

Art 10.85 The ETU may issue Dispatch Instructions to a Wholesale Supplier to adjust the reactive power output of any scheduled generating unit that has been instructed to be synchronized.

Art 10.86 The reactive power output of the scheduled generating unit in respect of which a Dispatch Instruction is given shall then, without delay, be adjusted in accordance with its Declared operating characteristics to the new target reactive power so instructed.

Art 10.87 Generating units having achieved the new target reactive power output shall allow the reactive power output to vary under AVR control in accordance with the applicable declarations for ancillary services and generating unit operating characteristics.

Art 10.88 Dispatch Instructions in relation to reactive power may include target voltage levels to be achieved by the generating unit on the transmission system at the NITS Connection Point and a generating unit so instructed must comply and achieve that target within a reasonable tolerance.

Art 10.89 Under certain conditions, such as low system voltage, an instruction to achieve maximum reactive power output at instructed MW output may be given and a Wholesale Supplier shall take appropriate action to maximize reactive power output unless constrained by plant operational limits or on safety grounds relating to personnel or plant.

Art 10.90 Under certain conditions such as high system voltage, an instruction to achieve maximum reactive power absorption at instructed active power output may be given and a Wholesale Supplier shall take appropriate action to maximize reactive power absorption unless constrained by plant operational limits or on safety grounds relating to personnel or plant

Art 10.91 The issue of a Dispatch Instruction relating to reactive power shall be made with due regard to any resultant change in reactive power capability and may include reduction in active power generation in order to increase reactive power capability.

Art 10.92 Where an instruction to synchronize is given or where a generating unit is synchronized and a MW Dispatch Instruction is given, a MVar Dispatch Instruction consistent with the generating unit's

relevant parameters may also be given. In the absence of a MVar Dispatch Instruction with an instruction to synchronize, the MVar output shall be maintained at the minimum possible.

Art 10.93 Mar Dispatch Instructions issued by the ETU shall reflect the limits contained in the applicable registered generating unit parameters and characteristics.

Art 10.94 Under system fault conditions, where reactive power output is driven outside its Declared operating characteristic limits, the Wholesale Supplier shall immediately inform the ETU of the situation. However, if the Wholesale Supplier reasonably believes that the situation may be dangerous to personnel or plant, then appropriate action may be taken to remedy the situation.

System emergency conditions

Art 10.95 During periods when the prevailing conditions for the NITS constitute an Emergency Condition, the ETU shall notify Wholesale Suppliers of the existence of a System Emergency Condition and under such a condition issue any instructions necessary to maintain the integrity of the NITS.

Art 10.96 The ETU may instruct a Wholesale Supplier to operate outside the limits implied by the current Capacity and Availability Declarations. When issuing such an Instruction, the ETU shall inform the Wholesale Supplier that the instruction is being issued under a System Emergency Condition.

Art 10.97 Where the ETU has issued an instruction requiring the operation of a generating unit outside the applicable Capacity and Availability Declaration limits, the Wholesale Supplier shall comply with the instruction unless in the reasonable opinion of the Wholesale Supplier the safety of personnel and plant will, in complying with the instruction, be unduly compromised.

Section 11. SAFETY SUB-CODE

Background, purpose and scope

Art 11.00 The electromechanical systems that have been interconnected to form the NITS are designed so that when operated normally they are safe but they contain inherent dangers. The personnel of the ETU, Grid Participants and their agents often have to work on or in close proximity to NITS facilities or equipment connected to the NITS. In order to ensure safe working conditions for these situations, it is necessary for the ETU and Grid Participants to operate in accordance with Safety Rules and Procedures.

Art 11.01 The Safety Sub-Code establishes the principles and arrangements that ensure safe working conditions for personnel working on or in close proximity to NITS equipment or personnel who may have to work on or use equipment at the Connection Points. The general arrangement involves making electrical equipment dead and providing secure isolation and grounding such that the equipment cannot be inadvertently made live.

Art 11.02 The Sub-Code does not define the Safety Rules to be adopted by the ETU or Grid Participants, but sets out the principles and arrangements which govern the interface between the parties.

Preparation of Safety Rules

Art 11.03 All owners of NITS Assets, equipment and facilities as well of owners of facilities connected to the NITS shall prepare comprehensive Safety Rules which must be followed to achieve safety from the inherent dangers whenever work is to be carried out on or near to the facility.

Art 11.04 The Safety Rules shall be based on a philosophy that persons will be protected from the inherent dangers.

Art 11.05 The Safety Rules shall define procedures and responsibilities for achieving safety of all persons from the inherent dangers and shall include the following provisions:

- (a) making available the equipment concerned for the work to be carried out;
- (b) establishing safe conditions for work which may be achieved by either
 - i) limiting the scope of work,
 - ii) isolation from a system , or
 - iii) adopting specialized procedures required to be applied when the work has to be done on equipment which remains energized;

- (c) authorizing the commencement of work;
- (d) receiving the authority to commence work and executing the work;
- (e) supervising safety during the work and clearing the authority when the work is terminated;
- (f) cancelling the authority on termination of the work; and
- (g) restoring the system to normal operation.

Art 11.06 Safety procedures for personnel working on or in close proximity to the NITS shall in addition be governed by the ETU requirements for safety coordination, as may from time to time be in force.

General principles for safety coordination

Art 11.07 The following principles shall be adopted to fulfil the requirements of safety:

- (a) The physical arrangement of equipment and facilities at NITS Nodes shall be designed with safety as a primary consideration. Standard designs shall be utilized for ease of operation and maintenance and to also promote standardization of switching procedures. These arrangements shall also provide means to properly isolate equipment for maintenance and allow appropriate working clearances for installed equipment as well as for construction of future facilities. In addition, the appropriate interlocking device shall be provided.
- (b) Grid Participants shall adopt safety procedures in respect of any service or equipment connection to ensure the safety of personnel and/or plant for the performance of works or tests to be carried out by any Grid Participant
- (c) The primary means of achieving safety when work is to be carried out on equipment shall be by isolation. In the case of mechanical equipment this shall be followed by draining, venting and purging as appropriate. In the case of high voltage equipment, this shall be followed by grounding. Wherever practicable the isolating devices shall be locked and where possible, the grounding devices shall also be locked.
- (d) Approved specialized procedures shall be required for the work where normal isolation procedures cannot be applied.
- (e) Persons shall be formally appointed to carry out defined duties, where safety is concerned
- (f) Application of Safety Rules shall ensure that safety is maintained within the entire power system.

- (g) In the process of safety coordination, the provisions of the relevant National laws and regulations shall be mandatory.
- (h) The ETU shall coordinate the activities of persons responsible for the testing, monitoring and maintenance of facilities or equipment connected to the NITS, in order to ensure that testing and maintenance are carried out in a safe manner.

Safety coordination procedure

Art 11.08 The ETU shall make available to all Grid Participants a copy of its Safety Rules concerning the NITS and Connection Point facilities.

Art 11.09 A Grid Participant shall also make available to the ETU a copy of its current local Safety Instructions concerning safety precautions on its facilities.

Art 11.10 In the event that a Grid Participant wishes to change the local Safety Instructions that apply to its facilities, it shall inform the ETU and other relevant Grid Participants in writing, substantiating the necessity for the proposed change.

Art 11.11 Work or tests on any equipment at the Connection Point shall be carried out only in the presence of persons designated by the ETU.

Art 11.12 A Grid Participant shall seek authority from the ETU and the relevant NITS Asset Owner if it wishes to access any NITS equipment.

Art 11.13 The ETU shall coordinate, establish and maintain the necessary isolation and grounding when work and/or tests are to be carried out on NITS facilities or a Grid Participant's electrical system that is connected to the NITS.

Art 11.14 When work or tests are to be carried out within the NITS the ETU shall ensure that the necessary safety precautions are coordinated and implemented on the systems that may be affected.

Art 11.15 The Grid Participant shall nominate and the ETU shall appoint a Safety Coordinator who shall, for the stated tasks or period, be responsible for the coordination of safety precautions on the NITS equipment at their respective sides of the Connection Point. A second authorized person shall be appointed to act as Safety Coordinator at any time that the first authorized person is unavailable.

Art 11.16 The Safety Coordinator shall be responsible in all matters concerning safety of personnel and equipment.

Art 11.17 In the event of a need to replace the person appointed as Safety Coordinator, all other affected persons shall without delay be notified of the identity of the new Safety Coordinator.

Art 11.18 The ETU may at its sole discretion delegate or issue Operating Instructions to agents of Grid Participants to perform required switching operations.

Art 11.19 Operating Instructions shall include, but not limited to:

- (a) detailed switching sequences (which meet as a minimum, the requirements of the ETU Safety Rules) to be followed;
- (b) control and operational procedures; and
- (c) identification of operational boundaries.

Art 11.20 All switching operations for isolation and restoration of the complete transmission system equipment or circuit shall be recorded in the sequence of their performance in the log books of the parties concerned.

Art 11.21 The ETU and Grid Participant shall maintain Safety Logs in which all messages relating to safety coordination shall be recorded in chronological order.. The Safety Logs shall be retained for at least one year.

Art 11.22 Before any work is carried out by a contractor at any NITS Node, the ETU and the relevant NITS Asset Owner shall ensure that contract personnel designated to work in such installations are either competent to work at such installations or are supervised by competent personnel.

Isolation and grounding principles

Art 11.23 The ETU, the NITS Asset Owner and each connected Grid Participant shall adopt isolation and grounding principles no less stringent than those outlined in this section.

Art 11.24 Isolation shall be implemented by any of the following:

- (a) a disconnect switch that is secured in an open position by a lock and affixing a Safety Tag to it or secured by such other method in accordance with the local Safety Instructions of the NITS Asset Owner or Grid Participant, as the case may be; or
- (b) an adequate physical separation in accordance with the local Safety Instructions of the NITS Asset Owner or Grid Participant in addition to placing a Safety Tag at the switching points.

Art 11.25 Where isolation is achieved by means of an isolating device, the device shall allow the isolating position to be maintained in a manner that minimizes the risk of inadvertent, accidental or unauthorized operation and that when put in this position, a notice or “tag” to that effect shall be attached.

Art 11.26 Grounding shall be implemented by any of the following:

- (a) a grounding switch secured in a closed position by a lock and with a safety tag affixed to it or secured by such other method in accordance with the Local Safety Instructions of the NITS Asset Owner or Grid Participant as the case may be; or
- (b) an adequate physical connection which shall be in accordance with the methods set out in the Local Safety Instructions of the NITS Asset Owner or Grid Participant, in addition to a Safety Tag which shall be placed at this point of connection and all related switching points.

Art 11.27 Where grounding is achieved by means of a grounding device, the grounding position shall be maintained in such a manner as to minimize the risk of inadvertent, accidental or unauthorized operation and that when put in this position, a notice or “tag” to that effect shall be attached.

Authorization of testing

Art 11.28 If a Safety Coordinator wishes to authorize a test on any NITS equipment, he shall only do so after the following procedure has been implemented:

- (a) confirmation is obtained from the other Safety Coordinators or other Parties that no person is working on or testing or has been authorized to work on or test any part of the system within the points of isolation identified for the test;
- (b) all Safety Precautions other than the current Safety Precaution have been cancelled; and
- (c) the other Safety Coordinators of the other Parties agree with him on the conduct of testing in that part of the system.

Part D: Standards of Performance

**Section 12. BENCHMARKS AND INDICES FOR STANDARDS OF SUPPLY:
RELIABILITY AND QUALITY**

Background, purpose and scope

Art 12.00 Power system performance and reliability encompasses all aspects of providing reliable electricity supply to customers efficiently. The concept of Reliability has been described as “the degree to which the performance of the elements of the system result in power being delivered to customers within accepted standards and in the amount desired”. This definition contains the concepts of adequacy and security.

Art 12.01 Adequacy has been defined as “the ability of the system to supply the aggregate power and energy requirements of the consumers at all times” and Security as “the ability of the system to withstand sudden disturbances”

Art 12.02 Reliability of a power system pertains to its ability to satisfy its load demand under the specified operating conditions and policies and a reliable power system is one which only allows few interruptions to customers’ services. Reliability as regards the NITS is therefore a measure of the ability of the NITS to adequately perform its designated functions under the conditions within which it has to operate.

Art 12.03 The purpose of this Section of the Grid Code is to:

- (a) specify the various indices to be used to monitor the performance of the ETU and Grid Participants;
- (b) define minimum level of quality of electric power supply in the NITS;
- (c) define minimum reliability standards, benchmarks and performance targets for the NITS;
and
- (d) enable Grid Participants to design, operate and maintain their systems and equipment to fit the environment within which they operate.

Art 12.04 The reliability of the NITS shall be quantified in terms of probability or frequency of encountering an outage or inadequate state, or the period of time a system spends in these states. Reliability may be evaluated by the frequency, duration, and magnitude of any adverse deviations from stipulated service standards.

Art 12.05 Maintaining acceptable reliability of the power system means that the power system is dimensioned and operated so that

- (a) the impacts of disturbance situations are minimised,
- (b) there are provisions for restoring the power system to the normal state, and
- (c) disturbance incidents are cleared as quickly as possible.

Art 12.06 The ETU shall monitor and report to the ETC the performance of the NITS in terms of quality and reliability (i.e. adequacy and security) of supply.

Standards for power quality and reliability

Art 12.07 The quality of power supply shall be considered to be acceptable when none of the following conditions is present:

- (a) the system frequency has deviated from the nominal value of 50 Hz by more than 0.2 Hz or otherwise contrary to the limits stipulated in Technical Schedule TS F;
- (b) voltage magnitudes are outside the allowable deviation of 5% or otherwise contrary to the limits stipulated in TS-E
- (c) there is imbalance in the magnitude of the phase voltages or otherwise contrary to the limits stipulated in Technical Schedule TS-E;
- (d) the phase displacement between the voltages is not equal to 120 degrees or otherwise contrary to the limits stipulated in Technical Schedule TS-E;
- (e) voltage fluctuations that cause flicker are outside the allowable limits or otherwise contrary to the limits stipulated in TS-E.
- (f) voltage harmonics exceed the limits stipulated in Technical Schedule TS-E.

Art 12.08 The reliability of power supply in any period is acceptable when the total duration of unacceptable quality of supply is within the limits provided in Technical Schedule TS-L.

Voltage

Art 12.09 The objective of voltage level and reactive power regulation is to

- (a) achieve specified voltage standards,

- (b) prevent over-voltage and under-voltage situations which may pose a danger to equipment and the security of the grid, and
- (c) minimize transmission system losses.

Voltage limits during Normal State

Art 12.10 While the NITS is in the Normal State, the voltage on each electrical bus at each NITS Node shall be regulated to within $\pm 5\%$ of the nominal voltage and all Bus voltages and Line voltages shall remain within the prescribed limits, except under abnormal conditions such as the occurrence of a system fault outside of the design, planning or operating standards.

Voltage limits during Alert State

Art 12.11 When the power system is in the Alert State, the voltages within the NITS shall be regulated to within $\pm 10\%$ of the nominal voltages and this situation shall not persist for more than ten minutes.

Voltage limits during Emergency State

Art 12.12 When the power system is determined to be in an emergency state, voltages levels within the NITS shall be regulated to within $\pm 10\%$ and this situation shall not persist for more than thirty minutes

Voltage unbalance

Art 12.13 The phase voltages of a 3-phase supply at a NITS Node shall nominally be of equal magnitude and 120 degrees apart in phase angle. Phase voltage unbalance shall not exceed one percent when the NITS is in the Normal State and two percent when in the Alert State.

Voltage harmonics

Art 12.14 Harmonics shall be defined as sinusoidal voltages and currents having frequencies that are integral multiples of the fundamental frequency. The maximum permissible harmonic limits shall be as defined in IEEE Standard 519-1992 - "*Recommended Practices and Requirements for harmonic control in the electrical power system*".

Art 12.15 A Grid Participant shall take preventive or corrective action, where necessary, to mitigate harmonic distortions and comply with the specified Standard.

Voltage flicker

Art 12.16 The maximum permissible voltage flicker limits shall be as defined in IEEE Standard 519-1992 - "*Recommended Practices and Requirements for harmonic control in the electrical power system*".

Art 12.17 A Grid Participant shall promptly identify the sources of and implement corrective actions for voltage depressions and voltage flicker that are in excess of the maximum permissible limits.

Reactive power and power factor

Art 12.18 Every generating unit shall be capable of operating within the power factor limits stipulated in Technical Schedule TS-G.

Art 12.19 Upon the instruction of the ETU at any time, a generating unit shall be required to operate continuously to provide reactive power within the capability limits of the generating unit.

Art 12.20 It is desirable that loads on the NITS have power factors at or close to unity as that represents the most efficient use of the NITS capability and minimizes loss of energy. A Distribution Company, Bulk Customer or any other Grid Participant off-taking power from the NITS shall operate its system to ensure that the power factor of its load, measured at the connection point does not fall below 0.90 lagging and not exceed unity.

Art 12.21 Penalties in addition to compensation payment to the ETU shall be applied for loads whose power factor fall below the 0.90 limit at rates to be determined and published by the ETU from time to time based upon the load level and the burden for extra reactive power support imposed on the NITS.

System frequency limits

Art 12.22 The ETU shall maintain the system frequency at all times between 49.8 Hz to 50.2 Hz, when operating the system in the Normal State. System frequency variations outside the prescribed limits shall be included in the NITS Performance Report in accordance with Technical Schedule TS-R only when the duration of the variation exceeds a continuous period of ten minutes.

Art 12.23 System operations outside the frequency range defined in Article 12.22 but within the range of 49.5 Hz to 50.5 Hz shall be permitted for a period of thirty minutes when operating the system in the Alert State. All frequency excursions outside these limits and for a period exceeding the stated durations shall be included in the NITS Performance Report in accordance with Technical Schedule TS-R.

Art 12.24 Every generating unit shall have the capability of operating within the frequency range of 48.75 Hz to 51.25 Hz without automatically disconnecting from the NITS.

Art 12.25 During emergency conditions, all generating units shall continue to be connected to the NITS provided the system frequency remains within the range stipulated in Article 12.24 except when doing so will result in damage to a generating unit.

Load shedding scheme

Art 12.26 Each Distribution Company, Bulk Customer, or other Grid Participant off-taking power from the NITS shall cooperate with the ETU to implement an automatic load shedding scheme to provide for load disconnection when system frequency decays.

Art 12.27 The AFLS scheme shall be defined from time to time by the ETU in consultation with other Grid Participants.

Protection relays

Art 12.28 Protective relay systems perform a critical service by detecting and initiating fault clearing thereby protecting the power system from prolonged voltage depression, transient instability, and equipment damage. The design and setting of protective relay systems requires a delicate balance between dependability and security. A relay system needs to be dependable enough to initiate a trip for all faults within its zone of protection and secure enough to avoid initiating trips for faults that occur outside of that zone. Consequently, protective relay systems shall be designed and maintained to sufficiently high standards in order to minimize mis-operation.

Art 12.29 The ability of a protection scheme to initiate the tripping of a circuit breaker associated with faulty equipment measured by the System Protection Dependability Index shall not be less than 95%.

Monitoring and reporting of NITS performance

Art 12.30 The performance of the NITS shall be assessed with reference to the following three defined ranges of voltage and frequency at each NITS Node:

- (a) a “normal unlimited time operation” range which applies when the system is in a Normal State;
- (b) a “contingency” range when the system is in the Alert State where continued operation is allowed for a period, although the system is not in a Normal State; and
- (c) an “emergency” range when the system is in an “Emergency State” typically as the result of an emergency or multiple contingency condition such that operation is only permitted for a limited correction period and continued operation of the system in that range is not allowed

Art 12.31 A uniform system of recording and reporting of NITS performance shall be defined by the ETU in consultation with the ETC and implemented by all Grid Participants.

Art 12.32 The same equipment reliability indices shall be used for all NITS facilities in similar situations and the Performance Standards as set out shall also be applicable to all. The benchmarks for service delivery may however vary between NITS Nodes because of differences in configuration, equipment redundancy and other local factors.

Art 12.33 The ETU shall compile and submit to the COC every quarter, half-yearly and annually a System Reliability Performance Report for the NITS, giving details of the actual levels achieved in respect of the performance and reliability indices defined in this Sub-Code.

Art 12.34 A copy of the System Reliability Performance Report shall be published or posted at the ETU Website for access by all Grid Participants.

Art 12.35 The performance of the NITS shall be evaluated by the ETU at quarterly, half-yearly and annual intervals, to compare the actual performance of the NITS with the benchmarks.

Reliability performance indices

Art 12.36 The ETC shall, from time to time, prescribe indices that shall be used to evaluate the performance of the NITS. Historical data for the past two years may be used to derive performance benchmarks to be defined for the reliability indices.

Art 12.37 The following indices shall, at the minimum, be monitored and calculated for the purposes of assessing the performance of the NITS:

- (a) *System Average Interruption Duration Index (SAIDI)* - Total duration of connection point interruptions in a given period divided by the number of connection points in the system;
- (b) *System Average Interruption Frequency Index (SAIFI)* - The average interruptions per connection point which is calculated by dividing the total number of interruptions at all system Connection Points by the number of Connection Points in the system;
- (c) *Availability* - Percentage of time the entire transmission system (or a particular class or circuit) is available for the transmission of electricity and it shall be calculated as the sum of planned, unplanned, and disturbance outage durations divided by the total hours that the system or the relevant circuit should have been available in a given period;
- (d) *Loss of Supply* - A sustained disturbance on the transmission system, that results in the loss of electricity supply service to one or more customers. The cause of this disturbance can be

initiated either by a distribution or transmission event, with the cause being noted and tracked;

- (e) *System Minutes Lost* - This index is calculated by dividing the amount of energy not supplied by the system peak demand for that year and expressing the value in minutes;
- (f) *Index of Transmission Reliability (ITR)* - Represents the percentage of time that transmission circuits are available for the transmission of electricity from one terminal to another or others (ITR is a measure of unplanned unavailability of the transmission system. It is deduced by using outage time due to unplanned outages or disturbances on the system and excludes outage time due to planned outages); and
- (g) *Transmission Line Faults* - Number of faults per 100 km of circuit lines.

Quality performance indices - Voltage

Art 12.38 The ETU shall report on the following for each NITS Node with respect to voltage and power factor deviations outside the limits stipulated for the Normal, State:

- (a) the number of occurrences of deviation incidents;
- (b) the total duration of deviation incidents;
- (c) the maximum continuous period of deviation; and
- (d) the maximum and minimum values recorded indicating the time and date of occurrence.

Quality performance indices - Frequency

Art 12.39 The ETU shall report on the following with respect to frequency deviations from both the normal and emergency limits stipulated:

- (a) the number of occurrences of deviation incidents;
- (b) the total duration of deviation incidents;
- (c) the maximum continuous period of deviation; and
- (d) the maximum and minimum values recorded indicating the time and date of occurrence.

Efficiency performance indices

Art 12.40 The ETU shall report on the following with respect to energy balance of the NITS:

- (a) total energy received, supplied and net energy at each NITS Node;
- (b) energy used at each NITS Node; and
- (c) Transmission Loss Ratio which is calculated as the total transmission system losses divided by the total energy entering the NITS expressed in percentages.

Event inclusions and exclusions for performance reporting

Art 12.41 A power interruption shall include any outage which may be due to the tripping action of protective devices during faults or the failure of transmission lines and/or power transformers and which results in the loss of service to a Grid Participant or a group of Grid Participants.

Art 12.42 For the purpose of reporting on NITS reliability, the following shall be reported separately and excluded from calculations of indices:

- (a) planned outages where Grid Participants have been notified in accordance with the relevant notification provisions contained in the Operations Sub-Code;
- (b) outages caused by Force Majeure conditions; and
- (c) outages due to fundamental shortage of generation capacity.

Equipment loading reporting

Art 12.43 The ETU shall identify the transmission circuits and power transformers that are loaded over 85% of their nameplate rating for more than 10% of total operating time in a given year; and it shall report this to the COC on an annual basis along with the plans to relieve such loading pro

Section 13. METERING SUB-CODE

Background

Art 13.00 This section of the Grid Code sets out the requirements for standards, procedures and guidelines in respect of metering, at Connection Points within the NITS, in order to ensure accurate and transparent accounting, billing and settlement for power and energy generated and consumed.

Art 13.01 The objectives of the Metering Sub-Code are to:

- (a) define the minimum acceptable accuracy and minimum standards for metering at the Connection Points, to facilitate energy accounting, billing and settlement;
- (b) set out provisions relating to design, specifications, installation, maintenance and testing of metering facility equipment;
- (c) describe provisions relating to security and rights of access to metering data, settlement and auditing; and
- (d) define procedures for the resolution of metering disputes.

General metering principles

Art 13.02 The key principles underlying energy metering shall be as follows:

- (a) every NITS Connection Point at which energy is injected into or extracted from the NITS shall have a metering facility for the purposes of energy accounting;
- (b) active and reactive energy and power demand shall be measured at all Connection Points in the NITS to determine both the input and output quantities;
- (c) two revenue metering facilities, Main and Check meters, are required at each Connection Point;
- (d) each metering facility shall measure power and energy flow and shall be arranged to ensure continuous recording even in the event of failure of one of the metering facilities;
- (e) the ETU shall have responsibility for the provision and installation of the Main Meter at appropriate locations at all Connection Points and Grid Participants shall have responsibility for the provision and installation of Check Meters at appropriate locations at their own expense;

- (f) the Main Meter shall be the revenue meter and the Check Meter shall be used to provide metering data when a revenue meter, current transformer or voltage transformer is out of service;
- (g) the revenue metering facilities shall be located as close as practicable to the Connection Point;
- (h) the NITS Asset Owner or Grid Participant shall provide adequate space in panels and rooms at substations or Connection Points for installation of the meters; s
- (i) the Check Meter installation shall involve the provision of a separate metering facility using separate current transformer cores and separately fused voltage transformer secondary circuits, preferably from separate secondary windings;
- (j) the metering facility shall comply with the prescribed standards and equipment shall be manufactured to prescribed and internationally recognized quality standards;
- (k) metering facility shall be
 - i) secure,
 - ii) registered with the ETU, and
 - iii) capable of providing data for electronic transfer to a metering database maintained by the ETU;
- (l) energy meter data shall be based on units of watt-hours (active energy) and var-hours (reactive energy) and shall be collated at defined metering intervals;
- (m) every Grid Participant is entitled to access the metering database in respect of their own production, demand or consumption of power and energy;
- (n) historical data shall be maintained in the metering database for thirteen months in accessible format and for six years in archive;
- (o) the ETU and the Grid Participant may replace their respective metering facility at any time after it has been installed, subject to the provisions of this section of the Grid Code.

Metering facility

Art 13.03 In addition to conformity with the principles specified in Article 13.02, a metering facility shall:

- (a) contain a device which has a visible or an equivalent accessible display of, at a minimum, the cumulative total energy measured by that metering facility;
- (b) be capable of separately registering and recording flows in each direction where bi-directional active energy flow occurs;
- (c) be capable of communicating from the site of the metering facility to the metering database located at any site that may be specified by the ETU; and
- (d) include facilities for storing metering data for at least thirty-five days

Art 13.04 A metering facility shall consist of some or all of the following:

- (a) current transformers;
- (b) voltage transformers;
- (c) a secure and protected wiring from the current transformer and the voltage transformer to the meter;
- (d) a revenue class meter (Main and Check Meter) and a data recorder which may be internal (within the meter) or external to the meter or a combination;
- (e) an appropriately constructed panel on which the meter and data logger are mounted with a facility to keep the metering facility secure from interference;
- (f) a communication interface equipment such as modem, isolation devices, telephone service, radio transmitter and data link equipment;
- (g) an auxiliary electricity supply to the meter;
- (h) tests links and fusing;
- (i) lightning protection;
- (j) a totalizing equipment, integrating pulse recorder and time source;
- (k) a monitoring system to alert the ETU of any failure of critical components of the metering facility.

Use of meters

Art 13.05 Main metering data is to be used as the primary source of metering data for billing purposes.

Art 13.06 Check metering data is to be used for validation, substitution in the event of the failure of the Main Meter and account estimation of revenue metering data.

Art 13.07 Energy consumed at a generating station and drawn from the NITS shall be measured by using a revenue meter and the generating plant shall pay for this energy. The metering shall be connected to the high voltage side of the supply transformer and shall be owned by the ETU.

Metering facility equipment standards

Art 13.08 The following are minimum requirements for metering facility equipment. A Grid Participant may, at its own cost, install a metering facility equipment of higher level accuracy.

Voltage Transformers

Art 13.09 The voltage transformer shall comprise three units from a three-phase set, each of which shall comply with the relevant provisions of the IEC 60044 Standard or its equivalent national standard for metering, and corresponding to the accuracy class of 0.2.

Art 13.10 The voltage drop in each phase of the voltage transformer connections of the same accuracy class shall not exceed 0.2V. The voltage transformer shall be connected only to a billing meter with a burden that shall not affect the accuracy of measurement.

Art 13.11 A voltage changeover scheme shall be provided where more than one voltage transformer is available.

Current transformers

Art 13.12 The current transformer shall comprise three units for a three-phase set, each of which shall comply with the relevant provisions of the IEC 60044 Standard or its equivalent national standard for metering, and corresponding to the accuracy class of 0.2.

Art 13.13 The current transformer's rated secondary current shall be 1A or 5A. The neutral conductor of the current transformer shall be effectively grounded at a single point and shall be connected only to a billing meter with a burden that shall not affect the accuracy of measurement.

Meters

Art 13.14 Meters shall be solid-state, multifunction meters, of three-phase four-wire type rated for the required site, and shall comply with the updated and current versions of IEC 60687 and IEC 61268

Standards or equivalent national standards and correspond to the accuracy classes as defined in Schedule TS-M.

Art 13.15 The meters shall measure and locally display at least the kW, kWh, kVar, kVarh and kVA with features for pulse output.

Art 13.16 Main and Check Meters shall be connected to different sets of current transformers and voltage transformers.

Art 13.17 A cumulative record of the parameters measured shall be available on the meter and where a bi-directional meter is used, it shall have two such records available.

Art 13.18 Where a combined active energy and reactive energy meters are provided, then a separate record shall be provided for each measured quantity and direction.

Art 13.19 The loss of auxiliary supply to the meter shall not erase the cumulative records.

Art 13.20 A metering facility shall provide a pulse output for each measured quantity. The pulse output shall be for a three-wire terminal with pulse duration in the range from 40 to 80 milliseconds, preferably selectable and with selective pulse frequency or rate. The minimum pulse frequency shall comply with the IEC Standard or its equivalent national standard for the shortest integration period and the accuracy class of the meter. Pulse output shall be galvanically isolated from the voltage and current transformers being measured and from the auxiliary supply input terminals.

Art 13.21 A metering equipment shall be of proven quality, fully type tested, individually tested and accepted by the ETU. Appropriate test certificates shall be kept by the ETU or the NITS Asset Owner as the case may be. All metering equipment shall be supported with evidence of approval from accredited laboratory recognized under the International Certification Scheme.

Art 13.22 The limits of accuracy for classes of meters shall be as prescribed in Technical Schedule TS-M.

Integrating Pulse Recorders

Art 13.23 Integrating Pulse recorders shall be capable of recording integrated demand periods adjustable between fifteen minutes and sixty minutes.

Art 13.24 Each recorder shall be capable of transferring the data through communication channels to be provided to the metering database by the ETU. A Remote Terminal Unit shall be installed at the meter location that can be interrogated by the dispatch centre data acquisition computer.

Art 13.25 The integrating pulse recorder shall provide a record for reference at a future time. The record shall be suitable for reference for a period of at least one year after it was generated. The integrating pulse recorder shall be regularly interrogated and the (interrogation) record shall be maintained by the recorder for sixty days.

Art 13.26 The recorder's time and the meter's time shall be based on the UTC Standard time. The time reference used with the recorder shall ensure that the accuracy of the integrating pulse recorder is with a time error no more than ± 1 sec.

Art 13.27 Reprogramming of an integrating pulse recorder shall be done as soon as possible, within one billing cycle, if there is a time error.

WAPP Interconnections

Art 13.28 All metering facilities at WAPP interconnection points shall, at the least, meet the requirements of the Grid Code.

Metering Register

Art 13.29 The ETU shall keep and maintain a Metering Register containing static metering information associated with metering facilities. The register shall facilitate the following:

- (a) the registration of a Connection Point, Metering Point and affected Grid Participants;
- (b) verification of compliance with the Grid Code; and
- (c) auditable control of changes to the registered information.

Art 13.30 The ETU shall update the Metering Register from time to time, to ensure that the accuracy of the Metering Register is maintained.

Metering equipment testing and maintenance

Instrument transformer testing

Art 13.31 Testing of instrument transformers at the Connection Point shall be performed by the ETU or a party authorized by the ETU during the test and commissioning stage and then at least once every five years or as the need arises due to questions of accuracy.

Art 13.32 All tests shall be carried out in accordance with acceptable international standards. Relevant Grid Participants may witness the tests.

Art 13.33 An instrument transformer shall not be connected to a load beyond its rated burden and shall be operated at the optimum burden range to achieve maximum accuracy of the metering system.

Art 13.34 Burden tests shall be conducted during commissioning, re-installation or relocation or when requested by the Grid Participant and/or the ETU. Loading resistors for compensating low burdens may be allowed as long as the accuracy level is sustained.

Meter testing and calibration

Art 13.35 The ETU and the Grid Participant shall test and seal the meters at least once a year and recalibrate or replace such meters if found to be outside the acceptable accuracy stipulated in the Grid Code.

Art 13.36 The ETU and the Grid Participant shall notify each other when the Main or Check meters are due to be tested.

Art 13.37 Suitable isolation facilities shall be provided to facilitate testing and calibration of the metering facility.

Art 13.38 Suitable drawings and supporting information detailing the metering facility shall be made available for maintenance, testing and auditing purposes.

Art 13.39 Test equipment used in the calibration of instrument transformers or meters shall be certified to values of accuracy and precision which are, at least, twice as accurate as the required accuracy of the equipment under test.

Art 13.40 Solid-state watt-hour standards of 0.2% or better accuracy shall be used in the testing of watt-hour meters. All watt-hour standards shall be certified as accurate every twelve months.

Request for tests

Art 13.41 A Grid Participant may request the ETU to arrange for a test of any metering equipment where it has cause to believe that the performance of the equipment is not within the accuracy limits specified in the Grid Code. The requested test shall be carried out by the ETU or an independent party approved by the parties and may be witnessed by concerned parties if they so wish.

Art 13.42 Where the metering equipment fails the requested test, the ETU shall pay for the cost of the test; but where the meter equipment passes the test, the party who requested the test shall pay for the cost of the test.

Maintenance of metering equipment

Art 13.43 Maintenance of metering equipment shall only be performed at pre-appointed times after notice has been given to all interested parties.

Art 13.44 Maintenance of the metering equipment at the Connection Point shall be performed by the ETU for a Main Meter and by the Grid Participant for a Check Meter in the presence of the other party who may have elected to be present.

Art 13.45 All test results, maintenance programs and sealing records shall be kept for the life of the equipment. The equipment data and test records shall be made available to authorized parties.

Art 13.46 A meter shall be considered faulty only if it is determined that the meter does not comply with the prescribed accuracy standards.

Art 13.47 Upon any Grid Participant or the ETU observing that a meter may not be operating properly, the other party shall be notified, as soon as reasonably practicable of the existence of a fault and the length of time the fault may have existed.

Art 13.48 The meter owner shall ensure that repairs are made to the metering facility as soon as reasonably practicable after becoming aware of the fault or malfunction.

Art 13.49 Until any meter or metering equipment affected by an outage, defect or malfunction is repaired, adjusted or replaced, the affected Grid Participants and the ETU shall ensure that suitable proxy data is obtained or estimated and recorded for the period of time the fault condition persists.

Metering equipment security

Art 13.50 The ETU and all Grid Participants shall take all reasonable measures to prevent unauthorized access and interference with the metering facility equipment.

Art 13.51 The ETU shall provide seals and other appropriate devices to prevent or detect unauthorized interference or possible alteration to settings and calibrations.

Art 13.52 The ETU shall provide appropriate security against corruption of data in transmission.

Meter reading and metering data

Art 13.53 The ETU shall download integrating pulse metering data for each Connection Point at pre-defined intervals for billing and settlement purposes. Each Grid Participant shall be provided full access to the data for its Connection Point.

Art 13.54 The pulses from two or more meters may be combined into one integrating pulse recorder provided all the other requirements of this Sub-Code are met.

Art 13.55 The meter pulses that need to be integrated into the recorder are:

- (a) active energy and active power demand, exported to and imported from the NITS; and
- (b) reactive energy and reactive power demand exported to and imported from the NITS.

Art 13.56 Provision shall be made by all Grid Participants to permit on-site as well as remote interrogation of the Integrating Pulse Recorder.

Electronic data transfer capability

Art 13.57 All metering facilities shall have the capability of electronic data transfer.

On-Site meter reading

Art 13.58 Where on-site meter reading is necessary, it shall be witnessed by authorized representatives of all concerned parties on the agreed date and time and as stipulated in the Connection Agreement or Amended Connection Agreement.

Billing and settlement procedure

Art 13.59 The billing and settlement procedure shall be as specified in the relevant Power Purchase and Energy Supply Agreements or in accordance to the Wholesale Electricity Market Rules.

Art 13.60 The ETU and relevant Grid Participants shall agree to adjustments to metering data to account for system losses and unaccounted-for energy.

Settlement audit procedure

Art 13.61 A Grid Participant shall have the right to request for an audit of the settlement data related to its account and the right to choose an independent party approved by all concerned parties and qualified to perform the audit. Interested NITS Asset Owners, Grid Participants and the ETU shall cooperate in the auditing process.

Allocation of audit cost

Art 13.62 The defaulting party following an audit conducted under Article 13.61 shall be responsible for all the costs of the independent auditor, unless otherwise agreed.

Audit results

Art 13.63 The results of an audit conducted shall be issued in a report and discussed with the ETU who shall issue a response to the Audit Report, including any adjustments in account billing and payments proposed.

Audit appeals

Art 13.64 Where a Grid Participant disagrees with the ETU's response to the audit report, the ETU's response may be appealed to the COC.

Confidentiality

Art 13.65 Metering data and associated metering database constitute confidential information and shall be treated as such at all times. The ETU shall ensure that metering data is protected from access by unauthorized persons.

Art 13.66 The ETU shall not provide metering data from a metering facility to any person other than the metered entity to whom the data relates except when:

- (a) the data must be supplied for law enforcement purposes or for the purpose of complying with a regulatory or legal requirement; or
- (b) it is otherwise permitted by the Grid Code.

Section 14. INFORMATION & DATA EXCHANGE AND DISCLOSURE MANUAL

Background, purpose and scope

Art 14.00 The ETU has an obligation to ensure that the NITS is operated in a reliable and secure manner.

To achieve this, the ETU shall obtain from and provide Grid Participants with power system information needed for the maintenance of system security. The exchange of information will enable Grid Participants to carry out their obligations and meet statutory reporting requirements.

Art 14.01 The ETU shall obtain from Grid Participants, the technical and operational information needed for the discharge of the ETU's responsibilities in order to provide open, fair and non-discriminatory access to the NITS for all Grid Participants.

Art 14.02 The Information and Data Exchange Sub-Code is based on the requirements of the Grid Code and other statutory requirements. The Sub Code defines the reciprocal obligations of Grid Participants with regard to the provision of information and exchange of data for the implementation of the Grid Code.

Art 14.03 The requirements of this Sub-Code are complementary to any information and data exchange requirements defined in other sections of the Grid Code.

Information exchange interface

Art 14.04 The ETU shall designate an office as its contact office for the exchange of information pertaining to the real time operation of the NITS.

Art 14.05 A Grid Participant shall designate an office as its point of information and data exchange and shall provide the ETU with all the relevant details of contact for its offices.

Art 14.06 A Grid Participant shall identify the following for each type of information exchange:

- (a) the name(s), title(s)/position(s) and contact details of the person(s) designated by the Grid Participant to be responsible for provision of information; and
- (b) the purpose for which the information is required.

Art 14.07 Grid Participants shall agree on appropriate procedures for the transfer of information.

General principles for implementation of information and data exchange

- Art 14.08 A Grid Participant shall keep readily available, complete and accurate records of all data required for the proper administration of the Grid Code.
- Art 14.09 The ETU will provide open and timely exchange of relevant information among Grid Participants, to facilitate the secure and reliable operation of the NITS.
- Art 14.10 The information exchanged between the ETU and a Grid Participant may be either confidential (bilateral) information or public information intended for all parties. The provider of the information shall indicate whether the information being provided should be considered confidential or public.
- Art 14.11 The ETU shall make available critical data to allow a Grid Participant to make rational and informed decisions regarding the operations of the NITS.
- Art 14.12 The ETU shall publish all relevant non-confidential information in a timely manner, or make them accessible by all Grid Participants, in an open and non-discriminatory manner.
- Art 14.13 In the case of electronic data sharing, access to NITS information shall be provided on read-only basis.
- Art 14.14 A Grid Participant shall be responsible for the procurement and maintenance of the required communication systems as well as the data communication costs of its systems used for the purpose of Information and Data Exchange.

Information exchange between Grid Participants

Provision of Information to the ETU

- Art 14.15 The ETU may require information of a technical nature, to the extent not supplied under any other provisions of the Grid Code, to be supplied by Grid Participants to enable it (the ETU) to undertake the following:
- (a) analysis and evaluation of equipment and service performance of the NITS as well as the preparation of the NITS performance reports;
 - (b) survey of NITS conditions;
 - (c) assessment of risks to NITS operations;
 - (d) analysis of NITS equipment performance; and
 - (e) analysis and validation of policies of the Grid Code.

Art 14.16 The ETU shall, for the purposes of Article 14.15, send a written request to a Grid Participant, setting out the information it reasonably requires, the preferred medium and format for the submission and the time by which it reasonably requires a response to the request.

Art 14.17 A Grid Participant shall use all reasonable endeavours to provide the required information in the required format and within the time stated.

Art 14.18 Unless specifically provided in other sections of the Grid Code, communications with the ETU on all other matters shall be with the Head Office of the ETU.

Planning information

Art 14.19 A Grid Participant shall provide on a regular basis such information as the ETU may reasonably request for the purposes of planning and developing the NITS and to enable the ETU fulfil its statutory or regulatory obligations. Grid Participants shall submit the information to the ETU without unreasonable delay.

Art 14.20 The Planning Information to be provided shall be as specified in the Planning Code and any other information which may from time to time be required.

Art 14.21 A NITS Asset Owner shall provide a Grid Participant with information about equipment and systems installed at HV transmission substations.

Art 14.22 The ETU shall keep an updated technical database of the NITS for purposes of modelling and studies on the NITS.

Art 14.23 The ETU shall provide Distribution Companies and Bulk Customers with any relevant information that may be reasonably required to properly plan and design their networks and to comply with their obligations under the Connection Sub-Code.

Art 14.24 A Distribution Company or Bulk Customer shall upon request to upgrade an existing connection or when applying for a new connection, provide the information specified in the Connection Sub-Code.

Art 14.25 A Wholesale Supplier shall submit to the ETU all maintenance planning information with regard to each unit at each power station, as specified in the Operations Sub-Code.

Network information exchange

Art 14.26 A Grid Participant shall promptly provide to the ETU, on request, network information that is considered reasonable for the security and integrity of the NITS

Art 14.27 The ETU shall communicate network information as required for safe and reliable operation to the contact points designated by each Grid Participant required.

Art 14.28 The network information exchange shall be both electronic and paper based and within the time frame agreed upon between the Grid Participants.

Operational communication and data retention requirements

Art 14.29 Adequate communication facilities and procedures shall be established between the ETU and each Grid Participant to allow the timely transfer of information.

Art 14.30 The communication facilities for voice and data that are to be installed and maintained between the ETU and a Grid Participant shall comply with the applicable IEC and ITU standards for SCADA and Communication equipment.

Art 14.31 The communication facilities shall support data acquisition from Remote Terminal Units. The ETU shall be capable of monitoring the state of the NITS via telemetry from the Remote Terminal Unit connected to plant or facility of a Grid Participant plant and/or substation.

Art 14.32 The ETU and Grid Participants may in place of the above systems adopt the use of new technologies and methodologies for communication of information, where there is a recognizable benefit in quality, reliability and features and to do so would be reasonable in the circumstances.

Telephone/fax

Art 14.33 Each Distribution Company, Bulk Customer or Grid Participant shall be responsible for the provision and maintenance of telephone and facsimile equipment as required.

Art 14.34 A Grid Participant shall provide no fewer than two separate Public Switched Telephone Network circuits to its Control Room.

Art 14.35 A Grid Participant shall provide no fewer than one facsimile unit, connected to a dedicated Public Switched Telephone Network at its Control Facility.

Art 14.36 The ETU may provide one or more telephone extensions to be connected to the ETU's private operational telephone system. This facility shall be reserved for operational purposes only and shall be attended by an authorized person and answered without delay. Grid Participants shall be responsible for optimizing the reliability and security of this telephone service.

Art 14.37 The ETU shall install and operate a system for recording of all operational voice communication with Grid Participants. The historical archives of these voice recordings shall be available for at least one year and shall be made available to authorized persons when required.

Computer Equipment

Art 14.38 A Grid Participant shall provide appropriate Information Technology and data networking equipment to allow data exchange such as electronic mail, dispatch instructions, etc between the ETU

and the Grid Participant. The equipment shall only be used by the Grid Participant for operational communications with the ETU.

File Transfers

Art 14.39 The structure and format for data transfer shall be negotiated and defined by the supplier and receiver of the information.

Art 14.40 The transfer media shall be mutually agreed by the parties involved.

Art 14.41 The parties shall make adequate arrangements for data backup purposes so as to enable the recovery of information in the event of equipment or communication failure.

SCADA infrastructure

Art 14.42 Each NITS Node shall be accessible to the SCADA system which shall be used for storage, display and processing of operational data.

Art 14.43 All Grid Participants shall make available outputs of their respective operational equipment to the SCADA System.

Art 14.44 SCADA Remote Terminal Units shall be installed for the transmission of signals and indications to and from the ETU. The signals and indications which must be provided by Grid Participants for transmission by SCADA equipment are those specified in the Connection Code, together with such other data or information as the ETU may reasonably request, from time to time, by notice to Grid Participants..

Art 14.45 All SCADA, metering, computer and communications equipment and the data or information carried by the NITS shall be secure from unauthorized access. Procedures governing security and access shall be agreed with Grid Participants, but shall allow for adequate access to the equipment and information by the relevant Grid Participant and ETU for the purposes of maintenance, repair, testing and recording of measurements.

Time standard

Art 14.46 The time standard used shall be the Coordinated Universal Time (UTC) Standard and all time information shall be referenced to it. To maintain synchronization, each NITS Node shall be provided with a connection to GPS satellite receivers that enable all relevant devices to maintain time synchronization.

Data retention and archiving

Art 14.47 The ETU and every Grid Participant shall maintain sufficient records to support audit and verification requirements and to support monitoring of compliance with the provisions of the Grid Code. They shall also maintain adequate data and records, in sufficient detail, to support event diagnostics and trouble shooting.

Art 14.48 The ETU shall maintain a complete and accurate record of all Operational Data supplied or maintained under the Grid Code.

Art 14.49 All Operational Data shall be so maintained for a period of not less than five years, commencing from the date the Operational Data was first supplied or first created, if earlier.

Art 14.50 The ETU shall allow Grid Participants access to its records of Operational Data.

Art 14.51 The obligations for data retention and archiving shall be the responsibility of the information owner.

Art 14.52 The systems for the storage of data and information to be used by the parties shall be of their own choice and installed at their own cost.

Art 14.53 The ETC may at any time audit the data retention and archiving systems of Grid Participants.

Art 14.54 A Grid Participant shall store operational information that is kept electronically for a period of at least five years or for the life of the plant or equipment concerned, whichever is the longer.

Art 14.55 A Grid Participant shall ensure reasonable security against unauthorized access, use and loss of information. To this end, a Grid Participant shall, among other things, develop and implement a backup strategy for the information system equipment.

Generating plant performance data

Art 14.56 A Wholesale Supplier shall provide the ETU with the performance parameters of each generating unit at its power plant such as availability, reliability, etc. as detailed in the Grid Code and the relevant Connection Agreement.

Distribution Company and Bulk Customer performance data

Art 14.57 The performance measurement of all Distribution Companies and Bulk Customers shall be supplied to the ETU and NITS Asset Owner(s) in accordance with the relevant provisions of the Connection Agreement.

NITS performance data

Art 14.58 The following NITS performance indicators and operational information shall be made available by the ETU to all Grid Participants:

- (a) Daily-
 - i) Power and energy generation by each generating facility registered with the ETU;
 - ii) Hourly actual demand of the previous day in MW;
 - iii) Reserve amounts during the morning and evening peaks of the previous day in MW
- (b) Monthly -
 - i) Energy balance indicating internal generation, imports, exports, energy available for sale and transmission losses;
 - ii) Generating plant Availability;
 - iii) Number and total duration of frequency excursions outside statutory limits;
 - iv) Number and total duration of voltage excursions outside statutory limits;
 - v) Outage time at each NITS Node.
- (c) Annually -
 - i) Annual energy balance for the year;
 - ii) Annual peak demand in MW, date and time;
 - iii) Annual minimum demand in MW, date and time;
 - iv) Outage time at each NITS Node.

Art 14.59 A NITS Asset Owner shall also make available all information collected via recorders installed at substations to the ETU for analysis. The ETU shall make this information available to affected Grid Participants on request.

Art 14.60 The ETU shall publish each week a report on the power system performance for the previous week, including a report on Significant Incidents and operating conditions relevant to the operation of the NITS.

Events reporting

Art 14.61 In the case of a Significant Incident which has been notified by a Grid Participant to the ETU, the Grid Participant shall provide a written report to the ETU.

Art 14.62 In the case of a Significant Incident which has been notified by the ETU to a Grid Participant, the ETU shall provide a written report to all affected Grid Participants.

Art 14.63 The reports referred to in Articles 14.61 and 14.62 shall, where applicable, include at least the following:

- (a) time and date of Significant Incident;
- (b) location;
- (c) plant and/or equipment involved;
- (d) brief description of the Significant Incident;
- (e) estimated time and date of return to service;
- (f) supplies/generation interrupted and duration of interruption;
- (g) generating unit – frequency response achieved;
- (h) generating unit – MVar performance achieved;
- (i) any other information that the ETU or Grid Participant reasonably considers may be required in relation to the Significant Incident

Confidentiality obligations

Art 14.64 A Grid Participant shall use all reasonable endeavours to keep as confidential any information classified as such and which comes into the possession or control of that Grid Participant or of which the Grid Participant becomes aware.

Art 14.65 The information owner may request the recipient of the information to enter into a confidentiality agreement before information established to be confidential is provided.

Art 14.66 A Grid Participant shall not:

- (a) disclose confidential information to any third party without the written consent of the owner or provider of the information.

- (b) use or reproduce confidential information for any purpose other than that for which it was disclosed or for purposes contemplated by the Grid Code; and
- (c) permit unauthorized persons to have access to confidential information.

Art 14.67 A Grid Participant shall use all reasonable endeavours to prevent unauthorized access to confidential information which is in the possession or control of that Grid Participant.

Art 14.68 A Grid Participant shall ensure that any person to whom it discloses confidential information observes the provisions for confidentiality in relation to that information.

Art 14.69 A Grid Participant shall report any unauthorised disclosure of information that is governed by a confidentiality agreement as soon as practicable after it has become aware of the unauthorised disclosure and shall provide all reasonable assistance to ensure recovery or destruction of that confidential information as may be deemed appropriate by the information owner or provider.

Exceptions

Art 14.70 The confidentiality provisions in these section of the Grid Code do not prevent the disclosure, use or reproduction of information,

- (a) if the relevant information is at the time generally and publicly available other than as a result of breach of confidentiality by a Grid Participant or any person to whom the Grid Participant has disclosed the information;
- (b) by a Grid Participant for the use of an employee or officer of the Grid Participant or a related body corporate of the Grid Participant; or a legal or other professional adviser, auditor or other consultant which require the information for the purposes of the Grid Code, or for the purpose of advising the Grid Participant ;
- (c) with the consent of the person or persons who provided the relevant information under the Code;
- (d) to the extent required by law or by a lawful requirement of any government or governmental body, authority or agency having jurisdiction over a Grid Participant or its related bodies corporate;
- (e) if required in connection with legal proceedings, arbitration, expert determination or other dispute resolution mechanism relating to the Grid Code;

- (f) if required to protect the safety of personnel or equipment; or
- (g) of an historical nature in connection with the preparation and submission of reports under the Grid Code.

Disclosure of confidential information

Art 14.71 A Grid Participant who needs to disclose confidential information shall consult with the provider of the information prior to its release and inform those affected by the information disclosure.

Part E: DEFINITION

In this National Electricity Grid Code, unless the context otherwise requires—

access :means the contracted right to use an electrical system to transfer electrical energy ;

acre-foot :means the volume of water that will cover one acre to a depth of one foot and is a unit for measuring the volume of water. One acre –foot equals 325,851 gallons or one million gallons equals 3.07 acre –feet;

active energy :means the electrical energy produced, flowing or supplied by a electric circuit during a time interval, being the integral with respect to time of the instantaneous active power, measured in units of Watt-hours or standard multiples thereof: i.e.

$$1000\text{Watt-hours} = 1 \text{ Kilo Watt-hour (kWh)}$$

$$1000 \text{ Kilo Watt-hour} = 1 \text{ Mega Watt-hour (MWh)}$$

$$1000 \text{ Mega Watt-hour} = 1 \text{ Giga Watt-hour (GWh)}$$

$$1000 \text{ Giga Watt-hour} = 1 \text{ Tera Watt-hour (TWh)}$$

active power :means the product of the components of the alternating current and the voltage that equate to true power which is measured in units of watts and standard multiples thereof, for example:

$$1000 \text{ Watt} = 1 \text{ Kilo Watt (kW)}$$

$$1000 \text{ Kilo Watt} = 1 \text{ Mega Watt (MW)}$$

$$1000 \text{ Mega Watt} = 1 \text{ Giga Watt (GW)}$$

$$1000 \text{ Giga Watt} = 1 \text{ Tera Watt (TW)}$$

adequacy :means the ability of the electric system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements;

aerial plate :means a number plate to aid the aerial observer to identify the transmission tower;

- alternating current :means an electric current that reverses its direction of flow at periodic intervals, of 50 times per second;
- ammeter is an electrical instrument, with a scale usually graduated in amperes, placed in a circuit to measure the magnitude of electric current;
- ampere (amp) is a unit of measure of an electric current and is proportional to the quantity of electrons flowing through a conductor past a given point in one second;
- ancillary service :means a service necessary to support the transmission of energy from supply sources to loads while maintaining reliable operation of the transmission system in accordance with Prudent Utility Practice and these services include voltage control, operating reserves, black-start capability and frequency control;
- arc is the discharge of electricity through gas occurring across a gap or set of electrodes;
- arcing is the process of current flowing across a gap, such as fault current flowing across an insulator string that flashed over due to a lightning surge;
- Asset Owner :means a person who owns the whole or part of the NITS or any facility connected to the NITS;
- automated meter reading system: means a system capable of reading the data from a meter preparing and conditioning the data and transmitting the accumulated data from the meter location to a central data and accumulation device;
- Automatic Generation Control: means the regulation of the power output of electric generators within a control area in response to changes in load, system frequency, and other factors to maintain the scheduled system frequency and interchanges with other control areas;
- Automatic Voltage Regulator: means the continuously acting automatic equipment controlling the terminal voltage of a synchronous generating unit by comparing the actual terminal voltage with reference value and controlling by appropriate means the output of an exciter, depending on the deviations;

availability is a measure of time a generation unit, transmission line or other facility is capable of delivering energy to the transmission system at the delivery point or of providing ancillary services to the transmission system;

availability declaration: means a notice that declares the availability of the relevant facility;

availability factor :means a percentage representing the number of hours an equipment or unit is ready for or in service in a given period, compared to the number of hours in the period;

black start capability .. :means the ability of a generating unit to start and synchronize to the NITS without using supply from the power system ;

Bulk Customer :means a customer that purchases or receives electric power or energy of the amount or level specified by the Board of the Commission;

bus is an electrical conductor which serves as a common connection for two or more electrical circuits and is used to interconnect equipment of the same voltage. A bus may be in the form of rigid bars or in the form of stranded conductor overhead cables held under tension;

capability :means the maximum load a generator, piece of equipment, substation, or system can carry under specified (standardized) conditions for a given time interval without exceeding approved limits;

capability curve :means a curve developed for generators showing the limits of reactive and active power that a generator can produce without overheating or becoming unstable ;

capacity :means the rated continuous load-carrying ability, expressed in megawatts (MW) or megavolt-amperes (MVA) of generation, transmission, or other electrical equipment ;

capacity factor :means the ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full-power operation during the same period ;

cascading outage :is the occurrence of an uncontrollable succession of outages, each of which is initiated by conditions (e.g. instability or overloading) arising or made worse as a result of the event

preceding it. The tendency of a local line fault to trigger problems elsewhere on the system and lead to a widespread power outage;

Check Meter.....:is a meter installed by the transmission customer which provides the source data for comparison with the Main Meter;

circuit:means a conductor or a system of conductors through which an electric current flows or is intended to flow ;

circuit breaker:is a protective device located on a circuit to interrupt the flow of current at that particular point and used to disconnect from a power system which experiences an electrical fault or overload ;

combined cycle:means the use of a combustion turbine and a steam turbine in an electrical generation plant so that the waste heat from the combustion cycle provides heat energy for the steam cycle to increase its thermal efficiency of the entire system;

combustion turbine ..:means a turbine that generates power from the combustion of a fuel;

commissioning test ...:means a test conducted on equipment that is connecting to the grid for the first time or after modification or major maintenance;

compensation.....:means the use of devices like capacitors or voltage regulators to improve performance of an electric system with respect to some specified characteristic ;

conductor:is a material through which electricity is transmitted, such as an electrical wire, or transmission or distribution line;

Connection Agreement: is an agreement between the ETU and a Grid Participant that seeks connection of its facilities to the NITS and sets out the rights, obligations and liabilities of both parties;

Connection MOU:is an MOU between the ETU and the Grid participant required to be negotiated and signed prior to commencement of construction of the connection to the NITS;

connection point :is the point of physical linkage to or with the transmission network for the purpose of enabling the flow of electricity as the boundary between the transmission system and a facility or other equipment;

Connection Proposal: means the document required to be submitted to the ETU for the purpose of a new connection to the NITS;

constraints :is the physical and operational limitations on the transfer of electrical power through transmission facilities ;

contingency :means the possibility of a fault or equipment failure in a power system;

control action :means an action, like switching by which the Transmission System is operated ;

control area :means an electric power system or a combination of electric power systems bounded by interconnection metering and telemetry, capable of controlling generation to maintain its interchange schedule with other such areas and contributing to frequency regulation of the interconnection;

control centre :means the facility from which a power system is monitored and regulated where dispatchers use computerized displays to match generation with load and to respond to faults in the system;

control system :means the method of monitoring and controlling the operation of the power system or equipment including generating units connected to a transmission or distribution network;

Current Transformer (CT): means an instrument transformer, with its primary winding connected with the conductor carrying the current to be measured, which gives an accurate low-current indication in its secondary winding of the high amperage current in its primary winding. The low-current output is used for relaying, metering and indication;

customer :means a person that contracts for an electricity service;

demand :means the rate at which electric energy is delivered to or by the System or part of the System and is the sum of both active and reactive power, unless otherwise stated;

demand forecast :means predicted demand for electric power. A forecast may be short term (e.g, 15 minutes) for system operation purposes, long-term (e.g, five to 20 years) for generation planning purposes, or for any range in between. A forecast may include peak demand, energy, reactive power, or demand profile. A forecast may be made for total system demand, transmission loading, substation/feeder loading, individual customer demand, or appliance demand;

demand profile :is the hour by hour profiles of demand as at each Bulk Supply Point;

demand management: means the instructions by the ETU for the purposes of balancing the load with generation;

dispatch :means the operating control of an integrated electric system to

- (a) assign specific generating units and other sources of supply to meet the power demand as load rises or falls,
- (b) control operations and maintenance of high voltage lines, substations and equipment, including administration of safety procedures,
- (c) operate interconnections,
- (d) manage energy transactions with other interconnected control areas, and
- (e) curtail power demand to balance generations ;

Dispatch Day :means the day assigned on a daily basis by the ETU for the forecasted generation and dispatch of power and energy to meet demand;

dispatch instruction: . means an instruction given by the Grid Company from its System Control Centre to the Generator's approved contact person or location to change the output, fuel or manner of operation of the Generation Unit;

Distribution Company: means a person licensed under the Energy Commission Act, 1997 (ACT 541) to distribute and sell electricity without discrimination to consumers in an area or zone designated by the Board of the Energy Commission;

disturbance :means an unplanned event that produces an abnormal system condition or any occurrence that adversely affects normal power flow in a system;

ECOWAS Energy Protocol: means the protocol signed by the Authority of the Heads of State and Governments of the ECOWAS on January 6, 2003 which establishes a legal framework in order to promote long term cooperation in the energy field based on complementarities and mutual benefits with a view to achieving increased investment in the energy sector and increased energy trade in the West Africa Sub-Region;

electrical energy loss: means the energy loss in an electric system, consisting of transmission, transformation, and distribution losses between sources of generation and ultimate consumer;

Electricity Transmission Utility: means the entity charged with operation of the NITS by virtue of the Energy Commission Act,1997(ACT 541);

elements of the power system: includes generating units, transmission lines, transformers, circuit breakers and switches;

embedded generation : means production of electricity utilizing a generation facility that is electrically connected directly to a distribution system and for which the total output of the facility is distributed and utilised locally without any requirement for use of the national interconnected transmission system

emergency :means any abnormal system condition that requires automatic or immediate manual action to prevent or limit loss of generation supply or transmission facilities that could adversely affect the reliability of the electric system;

Emergency Transfer Capability: means the overall capacity of interregional or international power lines, together with the associated electrical system facilities, to transfer power and energy from one electrical system to another under emergency conditions;

energize..... :is the action of connecting a component to a source of power by the movement of an isolator, breaker or switch enabling it to transfer active and reactive power;

energy storage :means the process for storing, or converting energy from one form to another, for later use;

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- event :means an unscheduled or unplanned occurrence on, or relating to, a system including, faults, incidents and breakdowns;
- event reporting :is the procedure set out for reporting events;
- fault :is an event occurring on an electric system such as a short circuit, a broken wire, or an intermittent connection;
- feeder :means an electrical supply line, either overhead or underground, which runs from the NITS Node. It is the start of a distribution circuit, usually less than 36000 volts, which carries power from the substation. Also, a line from a generating plant or an interchange point between a transmission system and a load or distribution system;
- firm :means guaranteed or assured;
- flicker :means a fast fluctuation in voltage leading to quick intermittent coming on, of an appliance and gives the impression of unstable visual sensation induced by a light stimulus with luminance or spectral distribution that fluctuates with light;
- force majeure :means superior force that is unexpected or uncontrollable event and which upsets plans or releases a person from fulfilling an obligation;
- forced outage :means removal of service of ,the temporary de-rating of, restriction of use of, or reduction in performance of, equipment other than those specified as a scheduled outage;
- frequency :is the number of alternating current cycles per second (expressed in Hertz) at which a system is running;
- frequency control..... :means the retention of the frequency on the power system within acceptable limits;
- frequency regulation.. :means the automatic adjustment of active power output by a generation unit, initiated by free governor action in response to continuous minor fluctuations of frequency on the power system;

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- gas turbine :means a combustion turbine that converts energy of hot compressed gases (produced by burning fuel in compressed air) into mechanical energy that can be used to generate electricity ;
- generating unit :is an equipment or plant for producing energy from other forms of energy;
- generation (electricity):is the process of producing electric energy from other forms of energy expressed in watt-hours (Wh);
- generation schedule .. :means a statement prepared by the ETU setting out which generating units are anticipated to be required to ensure, so far as practicable, that the integrity of the Transmission System, the security and quality of supply and that the generating units assigned are sufficient to meet demand at all times (to extent practicable) together with an appropriate margin of reserve;
- governor system :is the automatic control system which regulates the speed of the power turbine of a generating unit through the control of the rate of entry into the generating unit of the primary energy input (for example, steam, gas or water);
- Grid Participant :means a Wholesale Supplier, Distribution Company or Bulk Customer with facilities that are connected to the NITS;
- grid :means an interconnected network of transmission lines of the NITS including associated equipment for the transfer of electric energy between points of supply and points of demand;
- Grid Code :means this code that contains the technical and operational rules of practice and standards of performance rules developed and approved by the Board of the Energy Commission to facilitate the operations related to the bulk transmission of electricity within the NITS;
- harmonic :means a sinusoidal wave having a frequency that is an integral multiple of a fundamental frequency;
- high voltage :is descriptive of transmission lines and electrical equipment with voltage levels greater than 36 kV;

imbalance is a condition where the generation and interchange schedules do not match demand;

impedance is a characteristic of an electric circuit that determines its hindrance to the flow of electricity and measured in ohms;

inadvertent interchange: means the difference between a control area's net actual interchange and net scheduled interchange.

Independent System Operator (ISO): is a neutral operator licensed by the Energy Commission responsible for maintaining instantaneous balance of the NITS by controlling the dispatch of generating units to ensure that loads match resources available to the system and is effected in a safe, reliable, economic and non-discriminatory manner;

insulator :means a material usually a ceramic ,porcelain, elastic polymeric rubber, or fiberglass when used in the transmission line and is designed to support a conductor physically and to separate it electrically from other conductors and supporting material;

interchange :means electric power or energy that flows from one entity to another;

interchange schedule: consists of an agreement between the ETU and the Grid Participant on the amount, start and end times, ramp rate, and degree of firmness for the purpose of an arrangement to transfer electric power;

interconnected system: is a system consisting of two or more individual electric systems that normally operate in synchronism and that have connecting tie-lines;

interconnection transmission lines: means the linkage of transmission lines between two utilities, enabling power to be moved in either direction;

interruptible load :means load which can be automatically disconnected by the use of under frequency relay or other means;

island :means a portion of a power system or several power systems that is electrically separated from the interconnection due to the disconnection of transmission system equipments;

line voltage :means the voltage present between any two of the conductors in a three-phase system;

- load :means the amount of power carried by a utility system or subsystem, or amount of power consumed by an electric device at a specified time;
- load factor :is the ratio of the actual electrical energy produced/consumed to the possible maximum electrical energy that could be produced/consumed in any defined period;
- load flow studies :means computer simulations of the transmission system, with representations of the complete electrical transmission system along with loads and different generation schedules to meet the loads and used by engineers to study various operating conditions and to plan future system additions to assure reliable service to customers;
- load following :means an electric system's process of regulating its generation by selected generators to follow the changes in demand;
- load forecasts :means predicted demand for electric power which may be short-term like for a duration of one hour for system operation purposes or long-term for five to twenty years for generation planning purposes ;
- load management :methods to reduce or reshape or redistribute electrical loads to match available resources designed to influence the timing and amount of electricity that customers may use and it generally attempts to shift loads from peak periods to low use periods;
- load shedding :is the process of deliberately removing pre-selected loads from a power system, usually done automatically by relays, in order to maintain the integrity of the system under unusual conditions;
- losses :means electric energy losses in the electric system which occur principally as energy transformation from kilowatt-hours (kWh) to waste heat in electrical conductors and apparatus;
- low voltage :is descriptive of electricity supply lines and equipment with voltage levels up to 1000V (1KV);
- Main Meter: is the meter installed by the ETU which provides source data for the accounting and billing function for NITS supply and services;

maintenance outage .. :means the removal of equipment from service availability to perform work that can be deferred for a while, but requires the equipment be removed from service before the next planned outage;

medium voltage..... :is descriptive of electricity supply lines and equipment with voltage levels above 1000V (1KV) up to 36KV;

merit-order :is the ranking in order of which generation plant should be used, based on ascending order of price together with amount of electricity that will be generated;

merit-order dispatch . :means the allocation of demand to individual generating units to effect the least cost production of electricity for customers. The process of determining the desired generation level for each of the generating units in a system in order to meet consumer demand at the lowest possible production cost given the operational constraints on the system;

meter..... :is a device for measuring and recording units of electrical quantities;

metering..... :is the method of applying devices to measure and record the amount and direction of electrical quantities with respect to time;

metering data..... :means the data associated with a metering point;

metering database :is the system for the storage of data for meters and associated equipments in the NITS to facilitate easy retrieval;

metering equipment . :includes 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 related to a metering point;

metering facility :means a combination of metering equipments;

metering intervals :means the time between electricity meter consumption recordings;

metering information :means data related to a metering facility that is prescribed by the ETU for record in the metering register;

metering point :means a point in the NITS at which a meter and its accessories are located;

Metering Register :has the meaning assigned to it under Art 13.29;

metering system :includes metering equipment, processes associated with metering, roles and activities related to metering;

multiple contingency :means the failure or outage of an element of the power system and the coincidental unexpected failure or outage of any other related element of the power system;

nameplate rating :means a manufacturer's guaranteed performance of an equipment in the power system under standardized conditions and is usually expressed in amperes, volts, kilovolt-amperes, kilowatts or other appropriate units usually indicated on a nameplate attached to the individual machine or device;

network :means the plant and equipment used to convey, and control the conveyance of, electricity to customers

NITS node :see substation;

node :means a point in the NITS where active or reactive power or energy can be injected or withdrawn;

nominal voltage :means the voltage by which the system is designated and to which certain operating characteristics are related, and the voltage at which the system operates and is normally about 5 to 10 percent below the maximum system voltage for which system components are designed;

non-spinning reserve :has the meaning assigned in Art 9.22;

- off-peak :means the hours or other periods defined by contract or other agreements or guide as the periods of lower electrical demand. Off- peak normally refers to a period of relatively low demand on an electric system and is typical to occur in the middle of the night;
- on-peak :means the hours or other periods defined by contract or other agreements or guide as the periods of higher electrical demand. On- peak normally refers to a period of relatively high demand on an electric system;
- open access :means the equal right to connect or use a system to transfer electrical energy provided established requirements are met;
- operating criteria :means the fundamental principles of reliable interconnected systems operation;
- operating procedures: means a set of policies, practices, or system adjustments that may be automatically or manually implemented by the ISO within a specified time frame to maintain the operational integrity of the interconnected electric systems;
- operating reserve :means the additional megawatt output required from a generation unit or demand reduction which must be realizable in real time operation to contain and correct any potential power system frequency deviation to an acceptable level;
- operating standards... :means the established measureable criteria for determining the performance of obligation within a control area or a power system;
- operational data..... :means the data required by the ETU for the purpose of satisfactorily operating, planning and managing the NITS;
- operational planning: means planning through various time scales, the matching of Generation Output with forecast Demand together with a reserve of Generation to provide a Margin, taking into account Outages of certain Generation Units and of parts of the Transmission System carried out to achieve as far as possible, the required level of System Security;
- outage :means a scheduled or unexpected period in a power system, during which a facility or component ceases to provide its full functioned capability and in relation to a generation unit, a total or partial reduction in availability such that the generation unit is unavailable to

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achieve its full registered megawatts capacity in accordance with its registered operating characteristics;

outage needs :means the time and periods specified by the Grid Participant for planned and maintenance outage;

overload :means operation of equipment in excess of its normal, full load rating or operation of a conductor in excess of ampacity, which if continued for a sufficient length of time, would cause damage or overheating;

peak demand :means the maximum load during a specified period of time;

performance standard: is a set of standards for the purpose of monitoring the performance of the ETU and the GRID participants in the delivery of their services;

planned outage :means the removal of the equipment from service availability for inspection or the general overhaul of a major equipment and is usually scheduled well in advance;

Planning Year :means the period between 1st November in one year to 31st October in the ensuing year;

power factor :means the ratio of the active power to the reactive power at a metering point;

power flows :See 'load flow studies';

power pool :means two or more interconnected electric systems planned and operated to supply power for their combined demand requirements;

power system :means the interconnected system of generation units, transmission and distribution networks operated as an integrated arrangement for the supply of electricity;

Prudent Utility Practice: means the generally accepted design, practices, methods, and operation of a power system, to achieve safety, dependability, efficiency, and economy, and to meet utility and industry codes, standards, and regulations;

ramp rate :means the rate at which the power output of a generator or can be increased or decreased;

reactive energy :is the integral with respect to time of the instantaneous reactive power produced, flowing or supplied by an electric circuit during a time interval measured in units of VARH or standard multiples thereof;

reactive power :is the product of voltage and current and the sine of the phase angle between them measured in units of volt-amperes reactive and standard multiples thereof;

reactive power capability curve: is a diagram, which shows the MW and MVar capability limits within which a generation unit will be expected to operate under steady state conditions ;

reactor :means a device specifically arranged to be connected within the transmission system during periods of low load demand or low reactive power demand to counteract the natural capacitive effects of long transmission lines in generating excess reactive power and so correct any transmission voltage effects during these periods;

reliability :means the degree of performance of the elements of the electric power system that results in electricity being delivered to customers within accepted standards and in the amount desired. It is a measure of the ability of a power system to provide uninterrupted service, even while that system is under stress. Reliability may be measured by the frequency, duration, and magnitude of adverse effects on the electric supply;

remote terminal unit: is a device that collects codes and transmits data;

reserve :means an ancillary service that consists of a generation capacity that is available , or a load that can be interrupted by the Utility in the event of an unexpected outage of a scheduled plant;

reserve margin:means the difference between an electric utility's system capability and anticipated peak load during a specific period, measured either in megawatts or as a percentage of peak load;

reservoir elevation..... :means the level of the water stored behind a dam. Also can be the reservoir's elevation above sea level;

reservoir storage :means the volume of water in a reservoir at a given time;

safety procedures :means processes defined by safety rules;

safety rules :means the rules which ensures that persons working on Plant and/or apparatus to which the rules apply are safeguarded from hazards arising from the System;

security :means the ability of the electric system to withstand sudden disturbances like electric short circuits or unanticipated loss of system facilities;

shunt capacitor :means an equipment connected to a network to generate reactive power;

shunt reactor :means an equipment connected to a network to absorb reactive power;

significant incident :means an event;

single contingency :includes the singular

(a) sudden, unexpected failure or outage of a power system or of an element like generating unit, transmission line and transformer; or

(b) removal from service of an element of the power system like generating unit, transmission line or transformer as part of the operation of a remedial action scheme, the occurrence of which shall not affect the normal operation of the NITS;

spinning reserve :has the meaning assigned in Art 9.21

stability :means the ability of an electric system to maintain a state of equilibrium during normal and abnormal system conditions or disturbances;

static VAR compensation: means a controllable VAR supply, that consist of a complete system of static components like capacitors, reactors and solid-state switches combined in one device, to provide rapid and continuously controllable reactive compensation;

substation :means a facility at which two or more lines are switched for operational purposes and which may in addition have one or more transformers to enable some connected lines operate at different nominal voltages in relation to others;

Supervisory Control and Data Acquisition: means a computer system that allows an electric system operator to remotely monitor and control elements of an electric system;

surge..... :means a transient variation of current, voltage, or power flow in an electric circuit or across an electric system;

switchgear includes the combination of various switching and interrupting devices used in a power system like disconnecting switches circuit breakers, and automatic circuit reclosers;

synchronize :means the process of connecting two previously separated alternating current apparatuses after matching frequency, voltage, phase angles like paralleling a generator to the electric system;

System Emergency Condition: means a partial shutdown or total shutdown or any other physical operational condition or occurrence on the power system which is

(a) imminently likely to endanger life or property; or

(b) imminently likely to impair

i) the ETU's ability to discharge its obligation or

ii) the safety and reliability of the power system;

System Protection Dependability: means a measure of the ability of protection to initiate successful tripping of circuit-breakers which are associated with a faulty item of apparatus. It is calculated using the

formula:
$$D_p = 1 - F_1 / A$$

Where:

A= Total number of system faults

F_1 = Number of system faults where there was a failure to trip a circuit breaker;

- tie-line :means a circuit connecting two or more control areas or systems of an electric system;
- time error :means an accumulated time difference between control area system time and the time standard and is caused by a deviation in Interconnection frequency from 50.0 Hertz;
- time error correction :means the offset to the interconnection's scheduled frequency to correct for the time error accumulated on an electric clock;
- transfer capability :means the amount of power, that can be transmitted between one system and another and which power flow and stability studies can determine under various outage, system loading and system operating conditions;
- transformer :means a device that consists of a magnetic core on which there are two or more windings which can be used to transfer electrical energy from one circuit to another by magnetic induction, usually between circuits of different voltages;
- transient stability :means the ability of an electric power system to maintain synchronism between its parts when subjected to a disturbance of a specified severity and to regain a state of equilibrium following that disturbance;
- transmission system .. :means an interconnected group of electric transmission lines and associated equipment for moving or transferring electric energy in bulk between points of supply and points at which it is transformed for delivery over the distribution system lines to consumers, or to other electric systems;
- turbine :means a machine to generate rotary mechanical power from the energy of a stream of fluid like water, steam, or hot gas;
- unit commitment :means the process of determining which generator will be brought on-line to meet load or provide ancillary services for the next generation schedule;
- VAR :means a single unit of reactive power;
- voltage :means the electronic force or electric potential between two points that gives rise to the flow of electricity;

National Electricity Grid Code

voltage collapse :means an event that occurs when an electric system does not have adequate reactive support to maintain voltage stability and which may result in the outage of the components of the power and the interruption in service to customers ;

voltage control :means the control of transmission voltage within acceptable limits through adjustments in generator reactive output and transformer taps, and by switching;

voltage stability :means the condition of an electric system in which the sustained voltage level is controllable and within predetermined limits;

Watt (Electric) :is the electrical measuring unit for active power;

Watt-hour (Wh) :means the unit of electrical energy equal to one (1) watt of power supplied to, or taken from, an electric circuit steadily for 1 hour;

wheeling :means the use of the facilities of one transmission system to transmit power and energy from one power system to another; and

Wholesale Supplier :means a person licensed under the Energy Commission Act, 1997 (Act 541) to install and operate a facility to procure or produce electricity for sale to a bulk customer or to a distribution company for distribution and sale to consumers.

Part F: TECHNICAL SCHEDULES

- TS - A** AFLS Philosophy
- TS - B** (left blank – for future use)
- TS - C** Offences and Penalties
- TS - D** Declaration: Capability and Availability Declaration
- TS - E** Voltage limits
- TS - F** Frequency limits
- TS - G** Power factor and reactive power limits
- TS - H** (left blank – for future use)
- TS - I** (left blank – for future use)
- TS - J** (left blank – for future use)
- TS - K** (left blank – for future use)
- TS - L** Limits for Operating Parameters
- TS - M** Accuracy Classes of Meters
- TS - N** (left blank – for future use)
- TS - O** Standard Data (Outage and Planning)
- TS - P** Detailed Data (Outage and Planning)
- TS - Q** (left blank – for future use).
- TS - R** Reliability Requirement.
- TS - S** Security Requirement.
- TS - T** Timetable for Data and Information Submissions.
- TS - U** (left blank – for future use).
- TS - V** (left blank – for future use).
- TS - W** (left blank – for future use).

TS - x (left blank – for future use).

TS - y (left blank – for future use)

TS - z (left blank – for future use)

Technical Schedule TS – A: AFLS Philosophy

Introduction

1. Power system frequency is controlled mainly by the generation. Small frequency excursions occur continually as generation is controlled to match changing loads. The frequency is stable when generation and load match. Frequency is normally controlled by the following:
 - (a) generator governors
 - (b) automatic generation control (AGC)
 - (c) System operators/Dispatchers
2. When these actions fail, the system is in danger of a total blackout and a final safety net is the Automatic Frequency Load Shedding (AFLS) scheme.

Justification

3. The intent of the AFLS Program is to provide a last resort system preservation measure during severe frequency declines that can result from an extreme disturbance or a condition where load substantially exceeds generation. An AFLS program can minimize the risk of total or partial system collapse, prevent damage to generation and transmission facilities, provide for equitable load shedding, and, improve the overall reliability of the power system.

Philosophy

4. An Automatic Frequency Load Shedding (AFLS) program shall be developed, coordinated, and documented by the ETU. All Distribution Companies and bulk customers are obligated to participate in the AFLS program, in accordance with good utility practice.
5. The AFLS Program shall be coordinated between all Participants and with interconnected utilities, as necessary. The AFLS Program shall also be coordinated with generation protection, any tie-line tripping schemes, etc.
6. Loads shed during AFLS operations shall not be restored except with the approval of the ETU.
7. The AFLS Program shall be in steps, set to drop predetermined blocks of load at discreet frequency steps and for each step, the following shall be defined:

- (a) the frequency and/or rate of frequency decay settings and time delays;
- (b) the substation or location of loads to be shed;
- (c) the estimated magnitude of loads/percentage of load to be shed for both peak and off-peak periods.

8. The AFLS program shall be determined by the ETU following consultations with relevant Grid Participants and published in a Demand Management Guidelines Manual by 1st November each calendar year, to cover the immediately following twelve-month period.
9. The ETU shall ensure that, as far as is practicable, the burden of load shedding is fairly distributed among Participants.
10. The AFLS program shall be reviewed annually or as and when necessary, by the ETU.

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Technical Schedule TS – C: Offences and Penalties

TS-C Continued

REFERENCED REGULATION	DESCRIPTION OF BREACH	PENALTY
Art 8.09 Obligations of Off-takers	Distribution or Bulk customer contravenes any of the stated obligations.	As specified under Rule 31 of LI 1934, Art 31.
Art 8.32 Timely processing of application for connection by ETU	Failure of the ETU to evaluate the application and inform applicant of its acceptability or otherwise of a Grid participant's proposed development within 60 days from the date of submission of completed application.	As specified under Rule 31 of LI 1934,
Art 8.133 Grid Participant notification to ETU of disconnection of facility from the NITS node	Failure of a Grid participant to give six months prior notice in writing to the ETU of participant's intention to permanently disconnect a facility from the NITS node in contravention of Connection Agreement.	ETU compensated as determined by Electricity Market Rules PLUS Payment of penalty specified under Rule 31 of LI 1934 or Rule 39 of LI 1937.
Art 9.27, 9.38, & 9.45 Response to provision of compensation requirements	Failure of a Wholesale supplier's generating unit to provide normal ancillary service requirements when called upon by ETU.	ETU compensated as determined by Electricity Market Rules, PLUS payment of penalty to the Commission as specified under Rule 31 of LI 1934 or Rule 39 of LI 1937.
Art 9.40, 12.21 Adherence to power factor limit requirements by NITS Off-takers	Failure of a Distribution company, Bulk Customer or any other NITS Off-taker to maintain its reactive power requirement or power factor within the stipulated range	ETU compensated as determined by Electricity Market Rules PLUS Payment of penalty specified under Rule 31 of LI 1934 or Rule 39 of LI 1937.

Technical Schedule TS – D: Capability and Availability Declaration

1. Capability and Availability Declarations shall contain the following information:
 - (a) The average active power expected to be available for each hour during the following day (including start time and date)
 - (b) Estimated initial conditions (time required for notice to synchronize within the Technical Limits and Plant Performance Characteristics), last on or off time,
 - (c) Generating Unit run-up rates in MW for each level of warmth (cold, warm or hot starts);
 - (d) Unit run-down rates;
 - (e) The reactive power capability of each unit
 - (f) Minimum load for each Unit; and
 - (g) Any maintenance which is planned during the period that could reasonably affect the available power.

Definitions

Cold Start: More than 96 hours since the last shutdown

Warm Start: 8 hours or up to 96 hours since the last shutdown

Hot Start: Less than 8 hours since the last shutdown

Technical Schedule TS – E:

Voltage Limits

1. NITS voltage magnitudes shall be kept within the following limits:
 - (a) $\pm 5\%$ of the nominal voltage at all times under Normal State;
 - (b) $\pm 10\%$ of the nominal voltage under Alert State for a period not exceeding 10 minutes;
 - (c) $\pm 10\%$ of the nominal voltage under Emergency State for a period not exceeding 30 minutes.
2. Imbalance in phase voltage magnitude shall not exceed 3%.
3. Phase displacement between voltages shall be within the limits stated in the Operational Manual of the ETU.
4. The maximum permissible voltage flicker limits shall be in accordance with IEEE Standard 519-1992.
5. The maximum permissible harmonic limits shall be in accordance with IEEE Standard 519-1992.

Technical Schedule TS – F:

Frequency Limits

NITS frequency shall be maintained as follows:

- (a) Between 49.8 to 50.2 Hz at all times, under Normal State of operation;
- (b) Between 49.5 to 50.5 Hz for a period not exceeding ten (10) minutes under Alert State;
- (c) Between 49.0 to 51.0 Hz for a period not exceeding thirty (30) minutes under Emergency State.

Technical Schedule TS – G:

Power Factor and Reactive Power Limits

1. Distribution Utilities, Grid Participants and all off-takers of power from the NITS shall maintain their power factor at values not less than 0.90 at all times.
2. All generating units shall be operable between power factors of 0.85 lagging and 0.95 leading.

Technical Schedule TS – L:

Limits for Operating Parameters

The following indices and limits shall be measured or determined and used in the monitoring and reporting of the performance and reliability of the NITS:

- 1.** NITS frequency shall be maintained as follows:
 - (a) Between 49.8 to 50.2 Hz at all times, under Normal State of operation;
 - (b) Between 49.5 to 50.5 Hz for a period not exceeding ten minutes under Single Contingency State of operation;
 - (c) Between 49.0 to 51.0 Hz for a period not exceeding thirty minutes under Emergency State.
- 2.** NITS voltage magnitudes shall be kept within the following limits:
 - (d) $\pm 5\%$ of the nominal voltage at all times under Normal State;
 - (e) $\pm 10\%$ of the nominal voltage under Single Contingency State for a period not exceeding 10 minutes;
 - (f) $\pm 10\%$ of the nominal voltage under Emergency State for a period not exceeding 30 minutes.
- 3.** All off-takers of power shall maintain their power factor at values not less than 0.90 at all times.
- 4.** Imbalance in phase voltage magnitude shall not exceed 3%.
- 5.** Phase displacement between voltages shall be within the limits stated in the Operational Manual of the ETU.
- 6.** The maximum permissible voltage flicker limits shall be in accordance with IEEE Standard 519-1992.
- 7.** The maximum permissible harmonic limits shall be in accordance with IEEE Standard 519-1992.
- 8.** All generating units shall be operable between power factors of 0.85 lagging and 0.95 leading.

Technical Schedule TS – M: Accuracy Classes of Metering Equipment

Connection Capacity	< 50 MVA	> 50MVA	International Interconnections
CT	0.2S / 0.5 ⁽¹⁾	0.2S	0.2S
VT	0.5	0.2	0.2
Active Energy Meters	0.2S / 0.5 ⁽¹⁾	0.2S	0.2S
Reactive Energy Meters	2	2	2

⁽¹⁾ For new connections and replacements made after the date of approval of the Grid Code, the higher accuracy class shall be used.

Technical Schedule TS – O:

Standard Planning Data

Historical Energy and Power Demand

1. The Grid Participant shall provide its actual monthly energy and demand consumption at each Connection point for the immediate past year.
2. The Grid Participant shall also provide the hourly load profiles for a typical Weekday, Saturday, Sunday and holiday.

Energy and Power Demand Forecast

3. The Grid Participant shall provide its energy and power demand forecast at each Connection Point for the ten 10 succeeding years. Where the Grid Participant is connected to the NITS at more than one Connection Point, the demand data shall also include the coincident peak active demand at each connection point.
4. The forecast data for the first year shall include monthly forecast for energy and power demand, while the remaining four years shall include only one annual energy and power demand forecast.
5. The Grid Participant shall provide the ETU with forecasted hourly load profiles for typical Weekday, Saturday and Sunday and holiday.
6. Distribution Utilities shall provide the net values of energy and power demand forecast for the Distribution System at each Connection Point, after any deductions to reflect the output of embedded generating plants.
7. Wholesale Suppliers of power shall submit to the ETU the projected energy and power to be generated by each Generating Plant.

NB: Energy and power demand forecast shall be accompanied by a short description setting out the basis for the forecast

Generating Unit Data

8. Each Wholesale Supplier of power shall provide the ETU with data relating to its generating units, including a brief description of the configuration of the generation facilities, power station name and location, type of facilities (combined cycle, gas turbine, hydro, etc) and number for each type.
9. The following information shall be provided for the generating units of each generating plant:
 - (a) Rated capacity (MVA and MW);
 - (b) Rated voltage (kV);
 - (c) Maximum available output in MW;

- (d) Minimum stable load (MW)
- (e) Type of generating unit and expected running mode(s);
- (f) Direct axis sub-transient reactance (%); and
- (g) Rated capacity, voltage and impedance of the generating unit's step-up transformer

Grid Participant System Data

10. Each Grid Participant shall provide the electrical diagrams and connection point drawings of the Grid Participant System and the Connection Point. The diagrams and drawings shall indicate the quantities, ratings and operating parameters of the following:

- (a) Equipment (e.g. Generating units, transformers, circuit breakers, motors and drives, etc);
- (b) Electrical circuits (e.g. Overhead lines and underground cables);
- (c) Substation bus arrangements;
- (d) Grounding arrangements;
- (e) Phasing arrangements;
- (f) Switching facilities.

11. The Grid Participant shall provide the values of the following circuit parameters of overhead lines and/or underground cables from the Grid Participant substation to the connection point with the NITS:

- (a) Rated and operating voltage (kV);
- (b) Positive sequence resistance and reactance;
- (c) Positive sequence shunt susceptance;
- (d) Zero sequence resistance and reactance;
- (e) Zero sequence susceptance.

12. If the Grid Participant is connected to the NITS through a transformer, the following data for the power transformer shall be provided:

- (a) Rated MVA;
- (b) Rated voltages, HV, LV, Tertiary (kV);
- (c) Winding arrangement;
- (d) Positive sequence resistance and reactance (at maximum, minimum and nominal tap);

- (e) Zero sequence reactance for three-winding core transformer;
- (f) Tap changer range, step size and type (on-load or off-load); and
- (g) Basic lightning impulse insulation level (kV).

13. The Grid Participant shall provide the following information for the switchgear, including circuit breakers and disconnect switches at the substation of the Grid Participant:

- (a) Rated voltage (kV);
- (b) Rated current (A);
- (c) Rated symmetrical RMS short circuit current (kA); and
- (d) Basic lightning impulse insulation level (kV).

14. The Grid Participant shall provide the details of its system grounding. This shall include the rated capacity and impedances of the grounding equipment.

15. The Grid Participant shall provide the data on reactive power compensation equipment at the connection point and/or at the substation of the Grid Participant. This shall include the following information:

- (a) rated capacity (MVar)
- (b) rated voltage (kV);
- (c) type (e.g. shunt capacitor, shunt reactor, static var compensator, etc);
- (d) resistance/reactance/susceptance of all components of the compensation device; and
- (e) operation and control details (fixed or switched, automatic or manual)

16. If a significant portion of the Grid Participant's demand may be supplied from alternative connection point(s), the relevant information on the demand transfer capability shall be provided by the Grid Participant, including:

- (a) The alternative connection point;
- (b) The demand normally supplied from each alternative connection point;
- (c) The demand which may be transferred from or to each alternative connection point;
- (d) The control (manual or automatic) arrangements for transfer including the time required to effect the transfer for forced outage and planned maintenance conditions.

17. If a distribution or Grid Participant system has embedded generating plants, the short circuit contribution of the embedded generating plants shall be provided by the Distribution Utility or Bulk

Supply customer. The short circuit currents shall be calculated in accordance with the IEC Standards or their equivalent national standards.

General Information

18. For each new connection from a distribution company or bulk supply customer, the following information is required:

- (a) load build-up curve (in the case of a new connection);
- (b) supply date start (start of load build-up);
- (c) load type (residential, commercial, factory, etc);
- (d) annual load factor;
- (e) power factor;
- (f) special requirements (e.g. Quality of supply);
- (g) other information required to enable the ETU provide a Grid Participant with an appropriate supply.

Technical Schedule TS – P:

Detailed Planning Data

Generating Unit and Generating Plant Data

1. The following additional information shall be provided for the generating units at each generating plant:
 - (a) Generating Unit Manufacturer;
 - (b) Rated power factor (over-excited and under-excited);
 - (c) De-rated capacity (MW) on a monthly basis if applicable;
 - (d) Additional capacity (MW) obtainable from the generating unit in excess of net declared capability;
 - (e) Generator performance and efficiency data and curves;
 - (f) Minimum stable loading (MW);
 - (g) Reactive power capability curve;
 - (h) Stator armature resistance;
 - (i) Direct axis synchronous, transient and sub-transient reactances;
 - (j) Quadrature axis synchronous, transient and sub-transient reactances;
 - (k) Direct axis transient and sub-transient time constants;
 - (l) Quadrature axis transient and sub-transient time constants;
 - (m) Turbine and generating unit inertia constant (MWsec/MVA);
 - (n) Rated field current (A) at rated MW and MVar output and at rated terminal voltage; and
 - (o) Short circuit and open circuit characteristic curves.

2. The following information for step-up transformers shall be provided for each generating unit:
 - (a) Rated MVA;
 - (b) Rated frequency (Hz);
 - (c) Rated voltage for both primary and secondary (kV);
 - (d) Voltage ratio;
 - (e) Winding connection and vector group;
 - (f) Positive sequence resistance (at maximum, minimum and nominal tap);
 - (g) Positive sequence reactance (at maximum, minimum and nominal tap);
 - (h) Zero sequence reactance;
 - (i) Magnetizing curve;
 - (j) Tap changer range, step size; and type (on load or off load); and
 - (k) Transformer test certificates from which actual technical detail can be extracted as required are to be supplied on reasonable request.

3. The following excitation control system parameters shall be provided for each generating unit:
 - (a) Voltage regulator model name;
 - (b) DC gain of excitation loop;
 - (c) Rated field voltage;
 - (d) Maximum field voltage;
 - (e) Minimum field voltage;
 - (f) Maximum rate of change of field voltage (rising and falling)
 - (g) Functional description and block diagram showing transfer function of individual elements of the excitation system and the automatic voltage regulator;
 - (h) Dynamic characteristics of over excitation limiter; and
 - (i) Dynamic characteristics of under excitation limiter
4. The following information shall be provided for Power System Stabilizers:
 - (a) Functional description and block diagram showing transfer function of individual elements of the PSS;
 - (b) Report on methodology in deriving the PSS setting, including simulation results and tuning procedures;
 - (c) Commissioning tests or other filed results
5. The following speed governing system parameters shall be provided for each generating unit:
 - (a) Governor deadband - Maximum setting, normal setting, minimum setting;
 - (b) Time constant of steam or fuel governor valve or water column inertia;
 - (c) Governor valve opening limits;
 - (d) Governor valve rate limits;
 - (e) Time constant of turbine; Governor block diagram showing transfer function of individual elements including acceleration sensitive elements in accordance with IEEE Standard Models;
 - (f) Detailed description of setting calculation for each of the governor system functions; and
 - (g) Documents describing the performance of the overall governor system and each governor function for which a setting is derived
6. The following plant flexibility performance data shall be submitted for each generating unit:
 - (a) rate of loading from a cold start-up condition;
 - (b) rate of loading from a warm start-up condition;
 - (c) rate of loading from a hot start-up condition;
 - (d) block load following synchronization;
 - (e) time from minimum stable load to full load (minutes)

- (f) rate of load reduction from normal rated MW;
- (g) regulating range;
- (h) load rejection capability while still synchronized and able to supply load;
- (i) power required for unit auxiliaries

Grid Participant System Data

7. The ETU and each Grid Participant shall exchange information, including details of physical and electrical layouts, parameter, specifications and functional description and settings of generating unit protection and other data needed for power system studies.
8. Each Grid Participant shall provide additional planning data that may be requested by the ETU.

Note: All data to be provided shall be in per unit magnitude with MVA base specified. Generating unit and generating unit's step up transformer data shall be provided in rated MVA capacity base.

Performance Benchmarks

1. Benchmarks for system performance and reliability indices shall be determined by the Commission on the basis of computations of the 3-year record of historical operational performance data submitted by the ETU.
2. The Commission shall, taking into account the historical performance trends, committed reliability improvement projects, system performance requirements, industry and international standards and other considerations, and in consultations with the PURC and relevant Grid Participants, determine the benchmarks for defined reliability indices specified under the Grid Code.
3. The benchmarks shall be defined and become effective, not later than six months following the establishment of the Grid Code.
4. The performance and reliability benchmarks shall be reviewed annually by the Commission.

Information in Performance Report

5. A NITS Performance Report prepared by the ETU shall, in the least, provide information relating to the performance in relation to the following:

A. System Efficiency Performance Indices

- (i) Maximum System Demand
- (ii) Total energy received
- (iii) Total energy supplied
- (iv) Net total energy dispatched
- (v) Average power dispatched
- (vi) Load Factor (%)
- (vii) Transmission losses (%)
- (viii) System Capacity Factor (%)
- (ix) Utilization Factor (%)
- (x) Equipment Loading reporting > 85% of rated capacity, time of occurrence & duration

B. Availability

- (i) Availability Factor for a line segment (%)
- (ii) Availability Factor for group of transmission line segments (%)
- (iii) Equivalent Availability Factor for a line segment (%)
- (iv) Equivalent Availability Factor for a group of line segments (%)

C. Reliability

- (i) System Time error
- (ii) System Average Interruption Duration Index
- (iii) System Average Interruption Frequency Index
- (iv) System Minutes Lost
- (v) Index of Transmission Reliability
- (vi) Transmission line faults/100km of circuit line

D. Quality

Index	Normal State	Alert State	Emergency State
<u>Frequency deviations</u> (a) No. of occurrences (b) Total duration of incidents (c) Maximum continuous period (d) Max Value/Time/Date (e) Min Value/Time/Date			
<u>Voltage profile</u> (a) No. of occurrences (b) Total duration of incidents (c) Maximum continuous period (d) Maximum Value/Time/Date (e) Minimum Value/Time/Date			

E. Events reporting

- (i) Planned outages - Time/Date/Duration
- (ii) Forced Majeure conditions
- (iii) Generation capacity shortage outages - Time/Date/Duration/Amount/Causes

1.0 Criteria for Normal System Conditions

Normal conditions are considered to exist if system voltages, line and equipment loadings are within normal limits and an emergency does not exist on the system or externally. Criteria used to define Operating Security Limits for the normal system conditions are summarized below and must satisfy the conditions in paragraph 4.0.

- (a) A permanent three-phase fault on any generation, transmission line, transformer, or bus section excluding those bus sections contained in (e), cleared in normal time, with due regard to reclosing facilities;
- (b) Simultaneous permanent phase to ground faults on different phases on each of two adjacent transmission circuits on a multiple transmission circuits, tower, cleared in normal time, with due regard to reclosing facilities;
- (c) A permanent phase to ground fault on any generator, transmission circuit, transformer, or bus section with delayed clearing and with due regard to reclosing facilities;
- (d) Loss of any element without a fault; and
- (e) A permanent phase to ground fault (between current transformers) on a circuit breaker, cleared in normal time, and with due regard to reclosing facilities.

2.0 Criteria for Emergency System Conditions

Emergency conditions are considered to exist when observance of Normal Operation Limits would require load cuts or restriction in interconnection transactions during capacity or energy emergencies on the system or externally. Capacity or energy emergency exists when firm loads may have to be cut due to insufficient power or energy is available in the area. Criteria used to define Emergency Security Limits are summarized below and must satisfy the conditions in paragraph 4.0.

- (a) A permanent three-phase fault on any generation, transmission circuit, transformer, or bus section, cleared in normal time and with due regard to reclosing facilities.
- (b) Loss of any element without a fault.

3.0 Criteria for Areas Not Affecting Interconnections

Portions of the network where instability will not significantly affect the interconnected systems may be operating within Security Limits based on the following criteria and must satisfy the conditions in paragraph 4.0.

- (a) Loss of any element without a fault.
- (b) A normally cleared phase-to-phase to ground fault on any generator, transmission circuit, transformer or bus section, with due regard to re-closure.

4.0 Operating Limits

- (a) The system must be stable with all un-faulted elements remaining in service except those associated with normal fault clearance and generation rejection if employed.
- (b) The post-contingency steady-state loading of system elements must be within their 15-minute Limited Time Rating unless a pre-planned course of action exists to return the loading to continuous rating within shorter time period. Where a pre-planned course of action exists, the post-contingency steady-state loading must not exceed the five-minute Limited Time Rating on any system element.
- (c) The system must be able to withstand manual energization of the faulted element without prior readjustment of generation levels unless specific instructions to the contrary are provided. Such instructions will be embodied in Operating Security Limits and will normally apply only under specified conditions of loading in instances where post-contingency conditions would present a radical departure from the normal system configuration.
- (d) The post-contingency voltage levels must be within acceptable limits.

working days after the meeting 1st July each year 30 days after the request by the ETU 60 days after the receipt of the plan 30 days after the signing of the MOU 14 days after receipt of the statement 4 months prior to the planned commissioning date 20 working days after the receipt of design parameter information 3 months prior to commencement of commissioning 15 working days after receipt of the advice of readiness One month prior to addition or change of equipment At least 2 working days notice 7 days after first entry 2 weeks after carrying out the test Next following monthly report 5 days prior to the planned date for test except in an emergency Intervals of at least 12 months At least 15 days 6 months prior notice 60 minutes after the action At least annually 15th June each year 15th August each year 1st December each year 30 days before the commencement date of planned work 15 days after the quarter 14 days before the proposed date of test 15 days after the end of the month 2 months after the end of the quarter or year 24 hours after the occurrence of the incident 24 hours after the occurrence of the incident 1 week in advance As determined by Market Rules As determined by Market Rules As determined by Market Rules As determined by Market Rules One day ahead of scheduled day One day ahead of Dispatch Day 10:00h of each preceding day 10:00h of each preceding day 15:00h of each preceding day 2 months after the end of the quarter or year 2 months after the end of the year Monday of every week 1st November of the preceding year

Technical Schedule TS – T: Timetable for Data & Information Submissions

Ref. Article	Market Player / Entity responsible	Description of submission	Deadline for submission
4.02	Grid Participants/ Asset Owners	Non-compliance List Submission and ETU compilation	3 months after commencement of the Grid Code
4.08	ETU	Compiled Compliance Plans	9 months after commencement of the Grid Code
5.18	ETU	Quarterly report on NITS performance	14 days after the end of the quarter
5.23	COC	Quarterly report on COC activities	6 weeks after the end of the quarter
5.28	ETU	ETU comments on Grid Code revision proposal	3 months after receipt of proposal
5.35	Grid Participants	Comments on lodged complaint	3 months after receipt of complaint
6.11(d)	ETC	Publication of minutes of meeting	10 working days after the meeting
7.16	Grid Participants	Standard Planning Data	1 st July each year
7.18	Grid Participants	Detailed Technical Data	30 days after the request by the ETU
8.32	ETU	Evaluation of development plan as part of connection application	60 days after the receipt of the plan
8.37	Grid Participants	Detailed planning data as part of connection proposal	30 days after the signing of the MOU
8.50	ETU	Response to statement of readiness to connect	14 days after receipt of the statement
8.56	Grid Participant	Design information of new or replacement equipment	4 months prior to the planned commissioning date
8.57	ETU	Comments on proposed parameter settings	20 working days after the receipt of design parameter information

Ref. Article	Market Player / Entity responsible	Description of submission	Dead line for submission
8.59	Grid Participant	Commissioning program including test procedures for new or replacement equipment	3 months prior to commencement of commissioning
8.60	ETU/NITS Asset Owner	Notification of Grid Participant on decision of commissioning program	15 working days after receipt of the advice of readiness
8.78	Asset Owner/Grid Participant	Revised electrical diagram of a NITS -connected equipment	One month prior to addition or change of equipment
8.84	Grid Participant	Notice of intention to inspect NITS facility not owned by participant	At least 2 working days notice
8.90	Grid Participant	Inspection report after exercising right of entry	7 days after first entry
8.98	Grid Participant's Testing officer	Report on any relevant tests carried out	2 weeks after carrying out the test
8.104(c)	Wholesale supplier	Report on remedial actions undertaken to correct detected problems	Next following monthly report
8.112	Grid Participant	Proposal to conduct test on own equipment	5 days prior to the planned date for test except in an emergency
8.121	ETU	Periodic testing of generating unit to assess performance	Intervals of at least 12 months
8.122	ETU	Notification of date of performance test on generating unit	At least 15 days
8.133	Grid Participant	Notification of intention to disconnect facility from the NITS permanently	6 months prior notice
9.91	ETU	Notification of load shedding incident	60 minutes after the action
9.135	ETU	Review of NITS Restoration Plan	At least annually
9.161	Grid Participant	Submission of outage needs for the next three years to ETU	15 th June each year

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Ref. Article	Market Player / Entity responsible	Description of submission	Dead line for submission
9.165	ETU	Circulation of Initial Outage Plan for the next year and Provisional Outage Plan for a further two years	15 th August each year
9.167	ETU	Issue Committed Outage Plan for the next year	1 st December each year
9.171	Grid Participant	Submission of outage request for each month	30 days before the commencement date of planned work
9.181	ETU	Quarterly report on outages, disputes etc.	15 days after the quarter
9.187	Grid Participant	Request for carrying out proposed test	14 days before the proposed date of test
9.222	ETU	Monthly report on NITS operation	15 days after the end of the month
9.225	ETU	NITS Performance (Quarterly & Annual) Report	2 months after the end of the quarter or year
9.236	Grid Participants	Notification of forced outage	24 hours after the occurrence of the incident
9.239	ETU	Report of significant system incident	24 hours after the occurrence of the incident
10.15	Grid Participants	Forecast hourly load profiles for each day of the next two weeks	1 week in advance
10.17(a)	ETU	Hourly day-ahead dispatch schedule	As determined by Market Rules
10.17(b)	ETU	Days 2-7 ahead load forecasts	As determined by Market Rules
10.17(c)	ETU	Weekly demand forecast for 4 weeks ahead	As determined by Market Rules
10.17(d)	ETU	Monthly demand forecast for 12 months ahead	As determined by Market Rules
10.25	Wholesale Supplier	Dispatch Day generation data	One day ahead of scheduled day

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Ref. Article	Market Player / Entity responsible	Description of submission	Deadline for submission
10.25	Wholesale Supplier	Dispatch Day generation data	One day ahead of scheduled day
10.29	Off-taker	Dispatch Day hourly demand forecast	One day ahead of Dispatch Day
10.44	Wholesale supplier	Generation unit capability and availability declaration data	10:00h of each preceding day
10.463	Off-taker	Requirements for power, energy, voltage & reactive power compensation, and system or network constraints	10:00h of each preceding day
10.57	ETU	Generation schedule for the next day	15:00h of each preceding day
12.33	ETU	NITS Reliability & Performance (Quarterly & Annual) Report	2 months after the end of the quarter or year
12.43	ETU	System overload report with relief plans	2 months after the end of the year
14.60	ETU	System performance report for previous week	Monday of every week
TS-A	ETU	AFLS program determination and publication of the Demand Management Guidelines Manual	1 st November of the preceding year