JAMAICA ELECTRIC UTILITY SECTOR TRANSMISSION CODE

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The data, conclusions and recommendations will remain draft until the documents have gone through the review process and is approved by the legally authorized entities.

TRANSMISSION CODE REVISIONS

LIST OF REVISIONS

Current Rev.	Date	Page affected	Prepared by	Checked by (technical)	Checked by (quality assurance)	Approved by
			REVISION HISTORY			
		All				

Contents

TC 1 SCOPE

This Transmission Code sets out the procedures and principles governing the operation of the Jamaica Transmission System and applies to the conveyance of electricity by means of the Transmission System, which includes electric power lines operating at 69kV and higher, including the secondary circuit breakers and up to the outgoing Isolators at Transmission Substations transforming to 24kV, 13.8kV and 12kV. The Code provides the guidelines controlling the development, maintenance and operation of an efficient, co-ordinated and economic *Transmission System* in Jamaica.

This Transmission Code sets out the procedures and principles governing the System Operators relationship with all Users of the System Operators Transmission System.

The Transmission Code shall be complied with by the System Operator and existing and potential Generators and Users connected to or seeking to Interconnect to the System.

TC 2 GENERAL REQUIREMENTS

TC 2.1.1 This Transmission Code contains the procedures to provide an adequate, safe and efficient service to all parts of Jamaica, taking into account a wide range of operational circumstances. It is however necessary to recognise that the Transmission Code cannot address every possible situation. Where such unforeseen situations occur the System Operator shall act as a reasonable and prudent operator in the pursuance of any or a combination of the following General Requirements:

a. To protect the safety of the public and employees;
b. The need to preserve the integrity of the System;
c. To prevent damage to the System;
d. Compliance with conditions under its Licence;
e. Compliance with the Act;
f. Compliance with the Distribution Code
g. Compliance with the Generation Code; and
h. Compliance with the Dispatch Code

TC 2.1.2 Users shall provide such reasonable co-operation and assistance as the System Operator reasonably request in pursuance of the General Requirements.

TC 3 TRANSMISSION PLANNING

TC 3.1 Purpose and Scope

Section 41-(1) of the Act provides that the Minister shall be responsible for planning the development of the system, which planning shall include:

(a) The collection of data from electricity sector participants;
(b) Consultations with the Office, the Single Buyer and other electricity sector participants; and
(c) The conduct of any relevant forecast.

This provision further requires that the planning process for transmission and distribution, consider the location of renewable and other generation sources, taking into account the potential for electrification of rural areas. The provision also requires that all Licence holders must comply with a request made by the Minister for information for the purposes of executing his planning responsibility under this Section and failure to comply with a request under this Sub-section, without reasonable cause, shall be an offence.

TC 3.2 Planning Process

TC 3.2.1 Introduction

The Transmission Code anticipates a three phase process for planning: long term midterm, and (short term) planning.

The Ministry of Energy is responsible for long-term planning, leading the integrated resource planning process that establishes the policy guidelines for grid development.

The System Operator is responsible for mid-term and operational planning.

TC 3.2.2 Long Term Planning

The 2015 Electricity Act Sections 4(a) and 7(1) contain new provisions that charge the Minister of Energy with responsibility for planning the development of the electricity system under the management of the system operator, including integrated resource planning, the collection of data from electricity sector participants and the conduct of any relevant forecast. The Electricity Act Section 7(2) requires that the planning process specifically consider the location of renewable and other generation sources, taking into account the potential for electrification of rural areas. Finally, Electricity Act Section 7(3) mandates that all electricity sector participants must comply with a request from the Minister for information for the purposes of executing his planning responsibility.

The Ministry has informed OUR and electricity stakeholders that the Ministry will develop detailed procedures for development of an integrated resource plan, engaging key electricity sector stakeholders in a collaborative development process. The IRP process

design is now underway, and will be published after the Grid Code publication in August 2016. It is anticipated that the long-term planning sections of the Generation, Transmission, and Distribution Codes may be revised soon after publication to fully support the Ministry's IRP development process, once finalized, and may be further revised in the future to adjust for changes in the IRP process.

The Grid Code long-term planning requirements anticipate coordinated data collection system and ICT/software requirements among the Ministry, OUR, JPS, and all IPPs required to support the IRP long term planning process, to assure that the Ministry receives the information required for its planning duties, and to minimize any inefficiencies.

The Ministry will lead the long term planning process, establishing the objectives and metrics of the IRP, and communicating those to all stakeholders, informing the public (including OUR and JPS) of the status and outcome of the planning process.

It is anticipated that Transmission and Distribution Planning studies will be developed by JPS and approved for use by MSET, with rates impacts analyzed by the OUR.

It is anticipated that JPS will develop Load Forecasting projections and that MSET would develop assumptions and inputs for use in the Load Forecast, informing OUR of the Load projections.

It is anticipated that MSET will be responsible for Supply Technologies modelled within the study and Feasibility Studies used to determine viable technologies are the responsibility of MSET. JPS approves the integration of any technologies for operational purposes and contracting for resources; OUR will review rates impacts. MSET will approve contracting for third party resources to ensure consistency with Integrated Electricity Planning results.

Table 3-1 summarizes the anticipated IRP Inter-Agency Roles and Responsibilities.

Table 3-1: Inter-Agency Roles and Responsibilities

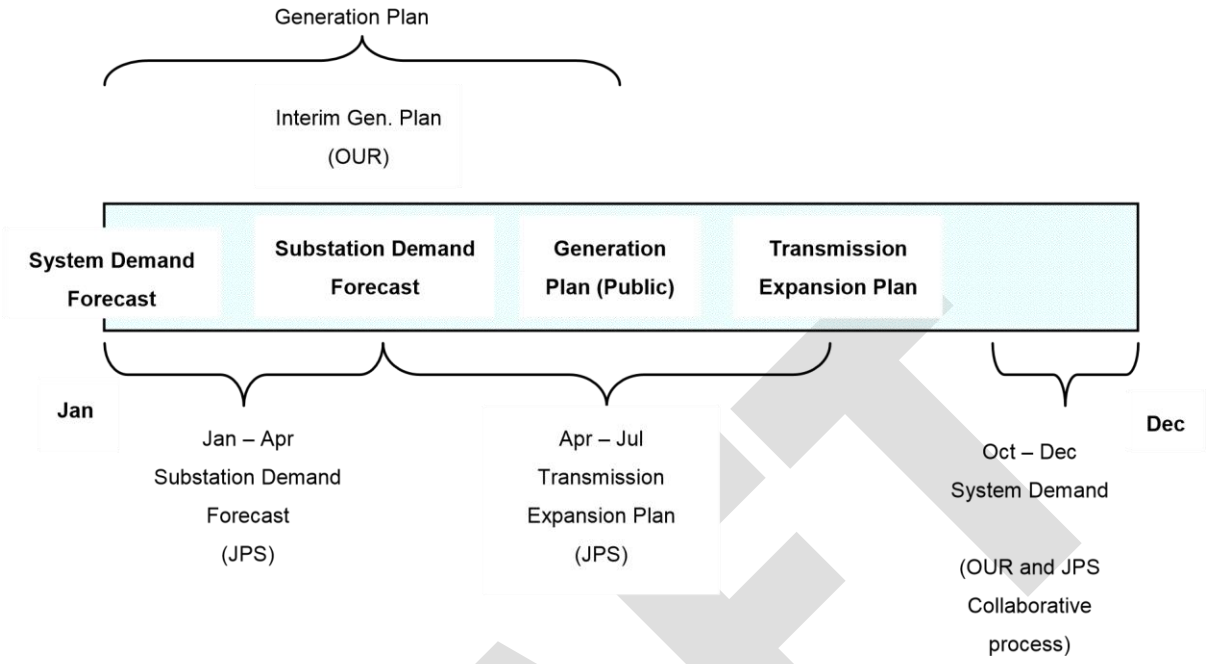
Responsibility	MSET	JPS	OUR (Rates)
Objectives and Metrics	Develop	Inform	Inform
Transmission & Distribution Planning Studies	Approve	Develop	Review for rates
Load Forecasting: Assumptions/Inputs supplied by MSET	Approve	Develop	Inform
Stakeholder Process: communication & policy	Develop	Inform	Inform
Supply Technologies and Feasibility Studies	Develop	Approve	Review for rates
Third Party Supply/Demand Contracts	Approve	Develop	Approve Rates
Sales Forecasting	Approve	Develop	Approve Rates
Energy Efficiency and Demand Programs	Develop	Inform	Approve Rates
Policy Action Plans	Develop	Inform	Inform
Environmental Impacts – NEPA compliance management interface with JPS	Develop	Inform	Inform

OUR will request the Grid Code Review Panel to prioritize development of detailed Long-Term Planning provisions consistent with the Ministry's planning process, once published.

4. Mid-Term Planning
5. Operational Planning

TC 3.3 Planning Timescales

TC 3.3.1 The planning process above should operate on an annual cycle. The cycle commences with the development of the system demand forecast in Q4 (year n), then the development of the Substation Demand Forecast in Q1 (year n+1), and is completed with the production of the Least Cost Expansion Plan in Q3 (year n+1).



TC 3.3.2 Interconnection Related Planning Studies shall be undertaken outside the above process, but new load information will be used to inform the demand forecasts. The timescales required to undertake the new Interconnection studies necessary to plan the system vary depending on the driver for the studies and the ability to obtain consented routes.

TC 3.4 Transmission System Security Standards

This Sub- section of the Code sets out the Transmission Security Standards against which the System Operator will plan the Transmission System.

TC 3.4.1 Normal Conditions

The System Operator shall plan, design and operate the Transmission System such that under normal steady state conditions, prior to any fault, there shall not be:

a. Equipment loadings exceeding the pre-fault rating;
b. Voltages outside – 5% of nominal values on all 69 kV and 138 kV buses;
c. Voltages outside – 5% of nominal values on Generator buses; or
d. System instability.

TC 3.4.2 Contingency Conditions

The System Operator shall plan, design and operate the Transmission System such that the system is secured against the following contingencies:

TC 3.2.1 Single Forced Outage

The loss of any single transmission element or interbus transformer, except in cases of radial lines, shall not affect the system s ability to adequately supply the required demand of its sub-station(s).

TC 3.2.2 Generator Outage

The loss of any single transmission element connecting a Generator to the Transmission System shall not result in a loss of generation greater than 60 MW. This implies that Interconnection for Generators of greater than 60 MW shall be designed on the N-1 principle.

TC 3.2.3 Voltages

TC 3.3.1 Under contingency conditions voltages shall be maintained as follows:

Voltages at all Generator terminal buses are to be within – 5% of nominal voltage; and Voltages at all 69 kV and 138 kV buses are to be within – 10% of nominal voltages.

TC 3.4 Load Power Factor

TC 3.4.1 The system will be planned for a normal load power factor of 0.95 with a voltage planning criteria of –5% for normal operation and –10% for contingency conditions.

TC 3.5 Thermal Loadings

TC 3.5.1 Under contingency conditions, transmission line loading of up to 110% of rated continuous rating for 30 minutes (Emergency Rating) may be used.

138/69 kV Interbus Transformer loadings may not exceed nominal rating.

TC 3.6 Spinning Reserve

TC 3.6.1 The System Operator shall have in place a Spinning Reserve policy, subject to review by the OUR, at all times. The policy shall seek to ensure that the spinning reserve margin is adequate to cover the loss of a small generator without the loss of load. Loss of large generators could result in loss of demand, which under these circumstances shall not be deemed to be a breach of the transmission security standards. For further details of the Spinning Reserve Policy refer to the System Operator's 'System Operation Policy No 8'. Loss of demand under these circumstances shall not be deemed to be a breach of the Transmission Code.

TC 3.7 Fault Levels

TC 3.7.1 The maximum fault levels in the system should be below 80% of the rated interrupting capacity of the circuit breakers determined using the generators transient impedances.

TC 3.8 Frequency Criteria

TC 3.8.1 Maintain frequency within the limit of 50 Hz ± 0.2 Hz, with a dead band of 30 mHz. In case of outage of some elements, the system may resort to under frequency load shedding scheme to control the frequency, as outlined in Schedule B of the Generation Code.

TC 3.9 Network Stability

The Transmission system should remain stable when subjected to severe system disturbances, such as the loss of a large generating plant, or Short Circuit condition.

TC 3.9.2 Fault Clearing Time

The Fault Clearance Time for a Short Circuit fault, shall not be longer than:

a 100 ms for 138 kV; and
b 120 ms for 69 kV.

TC 3.10 Transmission System Resiliency

How to best minimize and mitigate System damage and outages due to extreme weather events and how to best assure rapid restoration of power following any unavoidable outages.

TC 3.11 PLANNING PROCEDURES

TC 3.11.1 General

The System Operator shall conduct Transmission System planning studies consistent with the planning process and established planning criteria to ensure the Safety, Reliability, Security, and Stability of the Transmission System for the following:

a. Preparation of the Transmission Least Cost Expansion Plan for submission to the OUR;
b. Evaluation of Transmission System reinforcement projects; and
c. Evaluation of any proposed User Development, which is submitted to the System Operator in accordance with an application for an Interconnection Agreement or an Amended Interconnection Agreement for loads or generators.

The Transmission System planning studies shall be conducted to assess the impact on the Transmission System of any Demand Forecast or any proposed addition or change of Equipment or facilities in the Transmission System and to identify corrective measures to eliminate the deficiencies in the Transmission System.

The Transmission System planning studies shall be conducted periodically as required to assess:

a. The behaviour of the Transmission System during normal and Outage contingency conditions; and
b. The behaviour of the Transmission System during the electromechanical or electromagnetic transient induced by disturbances or switching operations.

Power system analysis studies shall be conducted by JPS or third party consultant pre-approved by JPS, according to the Study Guidelines outlined in the Transmission Code (TC), and using a suitable power system software such as PSS/E and DIgSILENT. The final results and the used models, including the validated user model have to be handed over to the System. The studies must demonstrate the capability of the plant to meet all the grid code requirements outlined in this the Transmission Code. The model shall comprise all facilities necessary for the generation of power from the generating plant to be integrated in the system model.

TC 3.12 Load Flow Studies

Load flow studies shall be performed to evaluate the behaviour of the Transmission System for the existing and planned Transmission System facilities under forecasted maximum and minimum Load conditions over a planning horizon of up to 10 years. These studies will determine the impact on the Transmission System of the Interconnection of new Generating Plants, Loads, or transmission lines.

Load/power flow simulations shall be conducted in line with the planning criteria, to include both normal and contingency conditions. The results of the studies will provide, information regarding equipment loading (lines or transformers) and bus voltages together with any deficiencies in reactive support.

Sensitivity analyses shall also be carried out to determine the impact that any proposed changes will have on the operation of the Transmission System at other times than peak and minimum loads.

For new transmission lines, any condition within the planning criteria that produces the maximum power flows through the existing and new lines shall be identified and evaluated in order to determine any remedial measures necessary.

TC 3.13 Short Circuit Studies

Short circuit studies shall be performed to evaluate the effect on Transmission System Equipment associated with the Interconnection of new Generating Plants, transmission lines, and other facilities that will result in increased fault duties for Transmission System Equipment. These studies shall identify the Equipment, such as switchyard devices and substation buses, that could be permanently damaged when the current exceeds the Equipment design limit. The studies shall also identify the circuit breakers, which may fail when interrupting possible short circuit currents.

Short Circuit studies are also required to allow for the correct setting of protection relays on which depends the stability of the Transmission System under fault conditions.

Short-circuit studies shall be performed for all busbars on the Transmission System for different feasible generation, load, and system circuit configurations. These studies shall identify the most severe conditions that the Transmission System Equipment may be

exposed to. Alternative Transmission System circuit configurations shall be studied to reduce the short circuit currents within the limits of existing Equipment. Such changes in circuit configuration shall be subjected to load flow and stability analysis to ensure that the changes do not cause steady-state load flow or stability problems.

The fault type to be consider, should include but not limited to the various fault type listed below:

a) Three Phase
b) Double Line
c) Double Line to Ground and
d) Single Line to Ground

The results shall be considered satisfactory when, at the planning stage, the short-circuit currents are within 80% of the design limits of Equipment and the proposed Transmission System configurations are suitable for flexible and safe operation.

TC 3.14 Transient Stability Studies

Transient Stability studies shall be performed to verify the impact of the Interconnection of new Generating Plants, transmission lines, and substations and changes in Transmission System circuit configurations on the ability of the Transmission System to seek a stable operating point following a transient disturbance. Transient Stability studies shall simulate the outages of critical Transmission System facilities such as major transmission lines and large Generating Units. The studies shall demonstrate that the Transmission System performance is satisfactory if:

a. The Transmission System returns to a stable condition after any Single
b. Outage Contingency for all forecasted Load conditions; and
c. The Transmission System remains controllable by other means, such as operator intervention and automatic tripping of demand or generation after multiple outage contingencies within the planning criteria.

Transient Stability studies shall be conducted for all new transmission lines or substations and for the Interconnection of new Generating Units equal to or larger than [60] MW connected to the Transmission System. In other cases, the System Operator shall determine the need to perform transient Stability studies.

TC 3.15 Steady-State Stability Analysis

Transient stability is the inherent ability of a power system to remain stable and maintain network synchronism when subjected to severe disturbances. The starting point of the stability studies is the steady-state conditions (determined by the load flow study). System parameters that can be derived from a steady-state stability study includes the rotor (stability phase) angle of Generators, real (MW) and reactive (MVAR) power flows, and bus voltages.

Stability Studies shall be carried out to check the dynamic performance of the Transmission System in the following circumstances:

a. load shedding by under-frequency relays following tripping of large Generators:
   i. Normal system operation with the network intact, for both the day and evening peak;
   ii. After system separation occurs, and iii) System minimum load condition.

b. slow clearance of faults due to mal-operation of the protection systems, and
c. the loss of strategic Transmission circuits including transformers.

The ability of the system to withstand the most severe fault shall be tested. The most onerous fault is defined as the application of a solid three phase fault or a single line to ground fault close to the main generating stations. The Critical Fault Clearing Time (CFCT) should also be examined to determine the response of the system to a prolonged fault.

The stability studies shall identify solutions, such as the installation of power system stabilizers or the identification of safe operating conditions.

TC 3.16 Voltage Stability Analysis

Periodic studies shall be performed to determine if the Transmission System is vulnerable to voltage collapse under heavy loading conditions. A voltage collapse can proceed very rapidly if the ability of System s Reactive Power supply to support system voltages is exhausted. The studies shall identify solutions such as the installation of dynamic and static Reactive Power compensation devices to avoid vulnerability to voltage collapse. In addition, the studies shall identify safe Power System operating conditions where vulnerability to voltage collapse can be avoided until solutions are implemented.

TC 3.17 Data Requirements

TC 3.17.1 General

A critical part of all the studies mentioned above is the large volume of input data that is required by each study. This data set is necessary for the development of accurate mathematical models that can mimic the system real-time response. Refer to Section 18 for data registration detail Schedules

TC 3.17.2 Demand

In order to carry out load flow studies, substation loads can be represented by their constant real (MW) and reactive (MVAR) power requirements. However, voltage and transient stability studies require complex models for substation loads. In the absence of these complex models the System Operator shall continue to use the constant power model for its transient and voltage stability studies

Demand forecast are required to enable the network to be developed in a coordinated and economic manner. A consumption forecast using an econometric regression methodology is considered suitable for this. This forecast of unit consumption is then to be developed into a peak demand forecast for each substation: this demand data shall then be used in the system studies outlined in TC 3 above.

The overall process for development of the grid wise forecast is illustrated below. This process is undertaken on an annual basis.

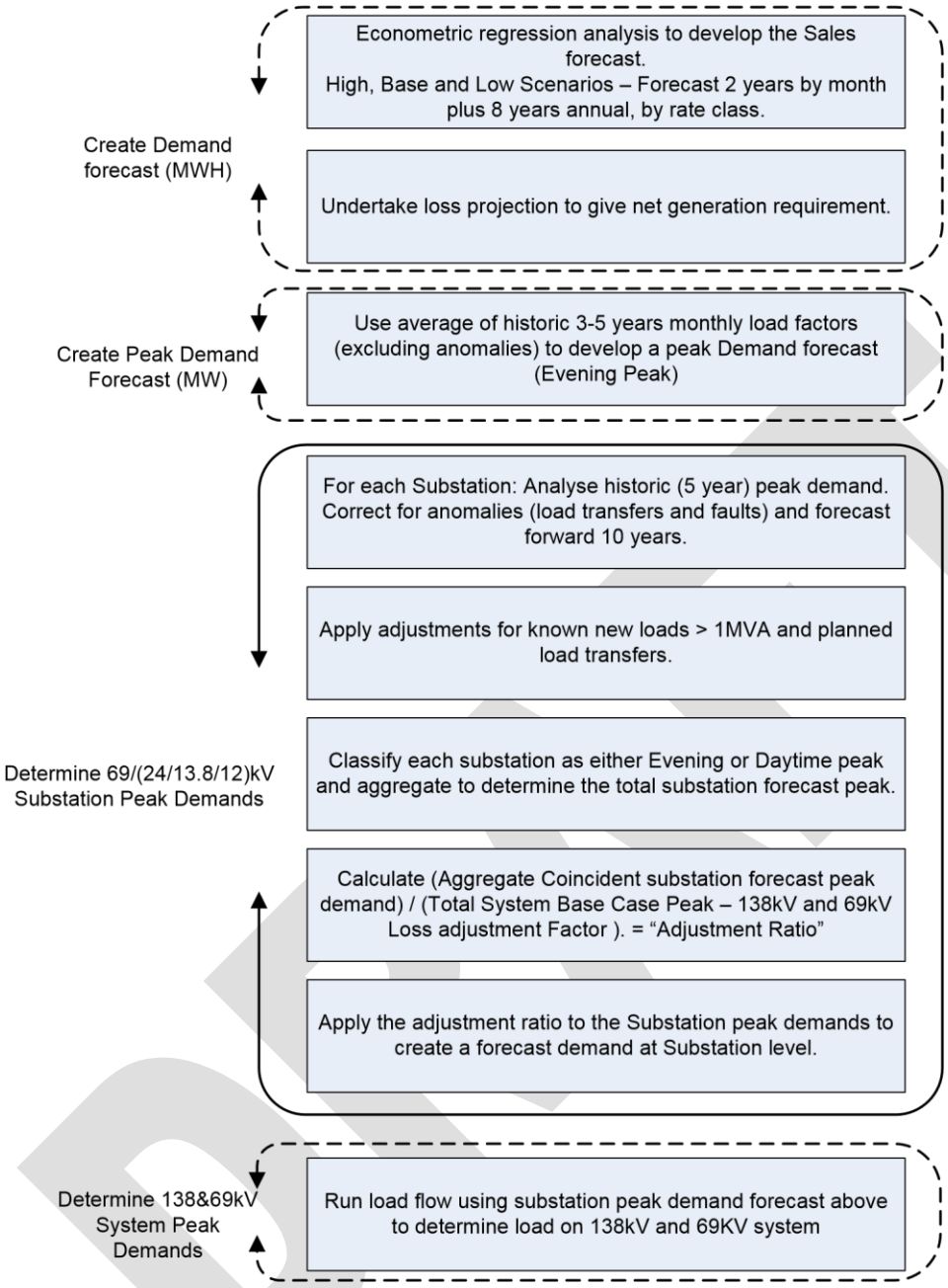


Figure TC 3.7 System and Substation Demand Forecast Process

TC 3.17.3 Transmission System Data

The System Operator shall have available all the network data relevant to the Transmission System itself. This network data is set out in section Transmission System Data Registration and includes among others, the following:

TC 3.17.4 Transformers

The primary input data for transformers includes MVA rating, primary and secondary winding voltages, windings connection, sequence impedances, X/R ratio, tap ranges, tap settings, emergency ratings.

TC 13.7.5 Transmission Lines

Transmission lines are generally represented by single-phase models with equivalent series impedances (resistance-inductance combinations) between line terminals and equivalent shunt admittances at each terminal. The primary input data required among other things are line voltage, conductor type, type of construction, thermal ratings, emergency rating, sequence impedances.

TC 13.7.5 Generators

Generators are modelled by their real and reactive power capabilities for steady state analysis. For dynamic analysis more detailed mathematical models are required for generators, exciters and governor control systems. The generators are represented by their mathematical model which includes the synchronous, transient and sub transient reactance and inertia constants. The excitation and governor control systems are modelled by their excitation and general-purpose governor control model respectively. The appropriate dynamic dataset and block diagram model should be provided, where necessary.

TC 3.17.5 Other System Parameters

In order to carry out Transient and dynamic stability Studies, data are required on the settings of overcurrent, distance under frequency and under voltage relays. Data are also required for circuit breaker operating time. Transient and dynamic stability studies required information on relay and breaker times and operating sequences.In order to develop a reliability data bank outage rates and durations for all major equipment are also necessary.

TC 3.17.6 User System Data

In the context of this Long – Term Transmission System Planning, User means a customer interconnected directly to the /Transmission System at the 69 or 138 kV voltage level.

Any User applying for Interconnection or modification of an existing Interconnection to the Transmission System shall submit to the System Operator the data required for the Transmission System in accordance with TC 3.17.4 above. These data requirements are also set out in the Interconnection Section of this Code.

All Users shall also notify the System Operator of any changes that take place in the parameters of his equipment at the Interconnection Point.

User shall also submit in writing to the System Operator each year in week [4] his best estimate of Energy and Demand at his Interconnection Point(s) projected for five (5) succeeding years.

The System Operator will make available to the User or potential User Planning data as will enable such Users to determine the effect of their systems of Transmission System development.

TC 4 MAINTENANCE STANDARDS

All Plant and Apparatus on the System shall be operated and maintained in accordance with Prudent Utility Practice and in a manner that shall not pose a threat to the safety of employees or the public.

The System Operator shall establish a Transmission System Maintenance Policy which shall be reviewed and approved by the OUR.

TC 4.1 Competency of Staff

The System Operator shall have in place training polices that serve to ensure that persons operating, maintaining, testing and controlling the System Operator Transmission and Distribution Systems are competent for the tasks to be undertaken. The policies shall include refresher training at appropriate intervals to maintain the currency of the training.

All persons operating, maintaining, testing and controlling the System Operator Transmission and Distribution Systems, shall have received appropriate training to ensure competency for the tasks that they will be undertaking and refresher training at appropriate intervals to maintain the currency of the training.

The System Operator shall maintain records of training given and issue certificates indicating the areas of competency of the persons trained.

TC 4.2 Requirement for Inspection

All Plant and Apparatus that will form part of the Transmission System will only become part of the Transmissiion System following inspection and approval by the Government Electrical Inspectorate.

TC 5 TRANSMISSION INTERCONNECTION

TC 5.1 General

This Transmission Interconnection Section specifies the normal method of Interconnection to the Transmission System and the minimum technical, design and operational criteria which must be complied with by any User or prospective User. For the purpose of the Transmission Interconnection Code, User refers to both Generators and Large Customers connected to the Transmission System.

In addition, details specific to each User's Interconnection may be set out in a separate Interconnection Agreement/Interconnection Agreement or in some cases a Power Purchase Agreement. The Interconnection Conditions set out in this Transmission Interconnection Code are complementary to these Agreements.

Conditions of PPAs established before the Code shall control over a conflicting Code provision.

All interconnection costs and responsibility shall normally be borne by the User connected to the Transmission System, unless specified otherwise by an Interconnection Agreement, or policy, or as dictated by the OUR.

TC 5.2 Objective

The objective of Section TC 5 is to ensure that by specifying minimum technical, design and operational criteria the basic rules for Interconnection to the Transmission System shall provide guidance for all System Users and shall enable JPS in its capacity as System Operator and System Users to comply with its statutory and Licence obligations.

This Interconnection Code applies to JPS in its capacity as System Operator and to the following:

a. Generators connected to the Transmission System;
b. JPS in its capacity as Distribution System operator at the Interconnection Points to the Transmission System;
c. Large Customers directly connected to the Transmission System, and

TC 5.3 Method of Interconnection

TC 5.3.1 General

The System Operator in consultation with the User shall determine the optimum Interconnection method on the basis of several technical and economic factors including:

a. Geographical considerations including proximity to the Transmission System;
b. Generating Facility MW capacity and/or maximum Demand to be supplied;
c. Supply voltage;
d. Reliability considerations;
e. Standby or auxiliary power requirements;
f. Substation configuration; and
g. Costs.

It should be noted that it will not be technically or economically practicable to achieve uniformity of the method of Interconnection. In all cases however, Prudent Utility Practice will guide the method adopted.

The provisions relating to interconnecting to the Transmission System are contained in each Interconnection Agreement and Power Purchase Agreement with a User and include provisions relating to both the submission of information and reports relating to compliance with the relevant Interconnection Agreement and Power Purchase Agreement for that User, Safety Rules, commissioning programmes, Operation Diagrams and approval to interconnect.

Prior to the Completion Date under the Interconnection Agreement, the following are to be submitted by the User:

a. updated Planning Code data with any estimated values assumed for planning purposes confirmed or, where practical, replaced by validated actual values and by updated estimates for the future and by updated forecasts for items such as Demand;
b. details of the protection arrangements and settings including a Protection and Control Single Line Diagram;
c. copies of all Safety Rules and Local Safety Instructions applicable at Users Sites which shall be used at the System Operator/User interface;
d. information to enable the System Operator to prepare Site Responsibility Schedules on the basis of the provisions set out in Appendix A;
e. an Operation Diagram for all HV Apparatus on the User side of the Interconnection Point;
f. the proposed name of the User Site (which shall not be the same as, or confusingly similar to, the name of any JPS Site or of any other User Site);
g. a list of Safety Co-ordinators;
h. a list of the telephone numbers for Joint System Incidents at which senior management representatives nominated for the purpose can be contacted and confirmation that they are fully authorised to make binding decisions on behalf of the User;
i. a list of managers who have been duly authorised to sign Site Responsibility Schedules on behalf of the User; and
j. information to enable System Operator to prepare Site Common Drawings.

TC 6 POWER QUALITY STANDARDS

TC 6.1 Power Quality

For the purpose of this Interconnection Code, Power Quality shall be defined as the quality of the voltage, including its frequency and the resulting current, that are measured in the Transmission System during normal conditions. The standards applicable to Power Quality are set out in the System Operator s Power Quality Policy, and JPS System Operation Policy No 2 Operational Standards of Security of Supply which shall be approved by the OUR and amended from time-to-time. For ease of reference sections of the JPS System Operation Policy No. 2 are summarised below.

“A Power Quality problem exists when at least one of the following conditions is present and significantly affects the normal operation of the System:

a. The System Frequency has deviated outside the acceptable tolerance of the nominal value of 50–0.2 Hz
b. Voltage magnitudes are outside their allowable range of variation;

c. Harmonic Frequencies are present in the System;
d. The Magnitude of the phase voltages are unbalanced.
e. The phase displacement between the voltages is not equal to 120 degrees;
f. Voltage Fluctuations cause Flicker that is outside the allowable Flicker Severity limits; or
g. High-frequency Over-voltages are present in the Transmission System".

TC 6.2 Frequency Variations

The frequency of the Transmission System shall be nominally 50 – 0.2 Hz and consistent with JPS System Operation Policy No 2. The System Operator may reset the target frequency based on system conditions between 49.5 Hz and 50.5 Hz.

Under some conditions the System frequency could rise to 52.5 Hz or fall to 48.0 Hz and this shall be taken into account in the design of Plant and Apparatus.

TC 6.3 Voltage Variations

The voltage on the Transmission System at each Interconnection Site with a User shall normally remain within –5% of the nominal value. The minimum voltage is -10% and the maximum voltage is +10% but voltages between +5% and +10% shall not last longer than 15 minutes unless abnormal conditions prevail.

The voltage on the lower voltage side of transformers at Interconnection Sites with Users shall normally remain within the limits –5% of the nominal value unless abnormal conditions prevail.

TC 6.4 Voltage Waveform Quality

All Plant and Apparatus connected to the Transmission System, and that part of the Transmission System at each Interconnection Site, should be capable of withstanding distortions as outlined in the System Operator's Power Quality Policy

TC 6.5 Exceptional Conditions

Some events such as system faults which involve the HV network (Transmission System) or a generating plant or faults that lead to loss of more than one generating set in the System or where a Significant Incident has occurred or during constrained operating conditions such as light load conditions and shortage of Active/Reactive power, can result in variations outside the normal power quality standards as outlined in sections TC 6 and its sub-sections. During these events, the System Operator shall be relieved of its obligation to comply with the System conditions referenced in the aforementioned sections, subject to the approval or the OUR.

TC 7 PLANT AND APPARATUS RELATING TO INTERCONNECTION SITES

TC 7.1 General Requirements

All Plant and Apparatus relating to the User/System Operator at the Interconnection Point, shall be compliant with the conditions in TC 7 and its sub-sections

The design of connections between any Generating Unit and the Transmission System shall be as set out in Section 1 Interconnection Conditions of the Generation Code. The design of connections between the Transmission System and Large Customers shall be in accordance with Condition 24 of the Licence and this Code.

TC 7.2 Substation Plant and Apparatus

All circuit breakers, switch disconnectors, Earthing Devices, power transformers, Voltage Transformers, reactors, Current Transformers, surge arresters, bushings, neutral Equipment, capacitors, line traps, coupling devices, external insulation and insulation co-ordination at the User/JPS Interconnection Point shall be constructed, installed and tested in accordance with the current edition at the time of construction of the following codes and technical standards, or their international equivalents and Prudent Utility Practice:

ACI	American Concrete Institute
ANSI	American National Standards Institute
ASCE	American Society for Civil Engineers
ASME	American Society for Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASTM	American Society for Testing Materials
AWS	American Welding Society
BSJ	Bureau of Standards Jamaica
IEC	International Electromechanical Commission
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
NBCJ	National Building Code of Jamaica
NEC	National Electric Code
NEMA	National Electric Manufacturers Association
NEPA	National Environment and Planning Agency (Jamaica)
NESC	National Electric Safety Code
NETA	National Electric Testing Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratory

TC 7.2.2 Plant and Apparatus shall be designed, manufactured and tested in premises certified in accordance with the quality assurance requirements of ISO 9001 or equivalent.

TC 7.3 Generator Interconnection Points

The requirements for the design of Interconnection Points between Generators and the Transmission System are set out in the Generation Code. For information the following two sections are extracted from the Generation Code.

The voltage level at which the Generating Unit(s) are connected to the Transmission or Distribution System shall be dependent on but not limited to the size and number of units and the other factors that determine the

Interconnection Point. Subject to other technical considerations, Generating Units with a Rated Capacity of 10 MW or above shall be connected to the Transmission System at 69 kV or 138 kV. Generating Units with a Rated

Capacity of below 10 MW may be connected to either the Transmission System at 69 kV or 138 kV or the primary Distribution System at 24 kV or less. The chosen method of Interconnection shall be determined by the System Operator on the grounds of System security, stability and safety.

All Substations shall have the capability to disconnect or separate, from the Transmission System, any transmission line and/or Generating Unit which is interconnected to the Substation. For reasons of ensuring safety and reliability of operation, generating substations with more than three transmission lines or Generating Units interconnected to them shall be of a "breaker and a half' configuration. The Substation shall be equipped with all requisite protection measures necessary to meet the System Operator's System protection standards as set out in Sub-section 1.2.4 of this Code.

TC 7.4 Interconnection Points to Distribution System or Large Customers

TC 7.4.1 Protection Arrangements

Protection of Distribution Systems and Large Customers directly supplied from the Transmission System must meet the minimum requirements referred to below:

The clearance times for faults on the Transmission System or equipment directly connected to the Transmission System from fault inception to circuit breaker arc extinction, shall be set out in a Interconnection Agreement where applicable but shall not be slower than:

a. 100 ms for faults cleared by busbar protection at 69 kV and 138kV; and

b. 100 ms for faults cleared by ultra-high speed directional comparison protection on 69 kV and 138 kV overhead lines. Slower fault clearance times for faults may be agreed but only if System requirements permit.

For the event of failure of the protection systems provided to meet the above fault clearance time requirements, back-up protection shall be provided by the User. The System Operator shall also provide back-up protection on the System, which shall result in a fault clearance time slower than that specified for the User back-up protection so as to provide discrimination.

For connections with the Transmission System, the back-up protection shall be provided by the User with a fault clearance time not slower than 350ms for faults on the User Apparatus.

TC 7.4.5 Fault Disconnection Facilities

Where no System Operator circuit breaker is provided at the User Interconnection Point, the User must provide the System Operator with the means of tripping all the User circuit breakers necessary to isolate faults or System abnormalities on the Transmission System. In these circumstances, for faults on the User System, the User protection should also trip higher voltage System Operator circuit breakers.

TC 7.4.6 Automatic Switching Equipment

Where automatic reclosure of circuit breakers controlled or operated by the System Operator is required following faults on the User System, automatic switching equipment shall be provided as necessary.

TC 7.4.7 Relay Settings

Protection and relay settings shall be co-ordinated across the Interconnection Point to ensure effective disconnection of faulty Apparatus. The process for the coordination of relay settings shall be defined by the System Operator.

TC 7.4.8 Work on Protection Equipment

Where the System Operator owns the busbar at the Interconnection Point, no busbar protection, AC or DC wiring (other than power supplies or DC tripping associated with the Users Apparatus) shall be worked upon or altered by User personnel in the absence of a representative of the System Operator.

TC 7.4.9 Neutral Earthing

At 138 kV the higher voltage windings of three phase transformers and transformer banks connected to the Transmission System must be star connected with the star point suitable for Interconnection to earth. The earthing and lower voltage winding arrangement shall be such as to ensure that the Earth Fault Factor requirement shall be met on the Transmission System.

TC 7.4.10 Under Frequency Relays

As required under the Code, suitable arrangements shall be made to facilitate automatic low frequency disconnection of Demand. Technical requirements relating to Under Frequency Relays are listed in Appendix D.

TC 7.4.11 Configuration of Substations

All Substations shall have the capability to disconnect or separate from the Transmission System, any transmission line and/or Generating Unit which is interconnected to the Substation.

For reasons of ensuring safety and reliability of operation, Substations with more than three transmission lines or Generating Units interconnected to them shall be of a "breaker and a half' configuration. The Substation shall be equipped with all requisite protection measures necessary to meet the System Operator's System protection standards as set out in TC 7.6 and in the document Protective Relaying Philosophy and Practices issued by JPS Protection and Control Department.

TC 7.5 Protection Requirements

The protective systems to be applied to Generating Units are set out in the Generation Code Sub-section GC 2.2.4 and shall, as a minimum, have protection against the following incidents unless specifically agreed with the System Operator:

a. Loss of excitation;
b. Under excitation;
c. Unbalanced load operation;
d. Stator phase faults and earth faults;
e. Reverse power protection;
f. Main Generating Unit Step-up Transformer (GSU) phase and earth faults, HV and LV;
g. Station service transformer phase and earth faults, HV and LV;
h. Transformer tank sudden pressure;
i. Backup protection in the event that external phase and earth faults are not cleared by remote protection system;
j. Backup protection in the event of circuit breaker failure to operate;
k. Generating Unit over and under frequency;
l. Generator over speed;
m. Stator over temperature;
n. Rotor over temperature; and
o. Restricted earth fault.

The Protective systems to be applied to the User's Equipment at the Interconnection Point shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity in fault clearing and to minimize the impact of faults on the Transmission System.

The System Operator and the User shall be solely responsible for the protection systems of electrical equipment and facilities at their respective sides of the Interconnection Point.

The Fault Clearance Time shall be specified in the Interconnection Agreement.

The Fault Clearance Time for a fault on the Transmission System where the User s Equipment is connected, or on the User System where the System Operator s Equipment is connected, shall not be longer than: a. 100 ms for 138 kV; and 120 ms for 69 kV.

Where the Users Equipment is connected to the Transmission System and a circuit breaker is provided by the User (or by the System Operator) at the Interconnection Point to interrupt fault currents at any side of the Interconnection Point, a circuit breaker fail protection shall also be provided by the User (or the System Operator).

The circuit breaker fail protection shall be designed to initiate the tripping of all the necessary electrically-adjacent circuit breakers and to interrupt the fault current within the next 250 milliseconds, in the event that the primary protection System fails to interrupt the fault current within the prescribed Fault Clearance Time.

Where the automatic reclosure of a circuit breaker is required following a fault on the User System, automatic switching Equipment shall be provided in accordance with the requirements specified in the Interconnection Agreement.

The reliability of the protection scheme to initiate the successful tripping of the circuit breakers that are associated with the faulty Equipment shall be consistent with Prudent Utility Practices

The System Operator may require specific Users to provide other protection schemes, designed and developed to maintain Grid Security, or to minimize the risk and/or impact of disturbances on the Grid.

TC 8 SITE RELATED CONDITIONS

TC 8.1 General

In the absence of agreement between the parties to the contrary, construction, commissioning, control, operation and maintenance responsibilities for the Plant and/or Apparatus follow ownership.

TC 8.2 Responsibilities for Safety

Before Interconnection to the Transmission System the System Operator and the User shall enter into a written agreement as to the Safety Rules to be used for work on Plant and/or Apparatus at the Interconnection Point.

TC 8.3 Site Responsibility Schedules

In order to inform site operational staff and the System Operator s Control Engineers of agreed responsibilities for Plant and/or Apparatus at the Operational Interface, a Site Responsibility Schedule shall be produced for System Operator and Users with whom they interface.

The format, principles and basic procedure to be used in the preparation of Site Responsibility Schedules are set down in Appendix A.

TC 8.4 Operation Diagrams

An Operation Diagram shall be prepared by the User for each Interconnection Site at which a Interconnection Point exists in accordance with Appendix B.

The Operation Diagram shall include all HV Apparatus and the connections to all external circuits and incorporate numbering, nomenclature and labelling, as set out in Section TC 15. At those Interconnection Sites where SF6 gas-insulated metal enclosed switchgear and/or other SF6 gas-insulated HV Apparatus is installed, those items must be depicted within an area delineated by a chain dotted line which intersects SF6 gas-zone boundaries. The nomenclature used shall conform with that used on the relevant Interconnection Site and circuit.

The Operation Diagram (and the list of technical details) is intended to provide an accurate record of the layout and circuit interconnections, ratings and numbering and nomenclature of HV Apparatus and related Plant.

TC 8.5 SF6 Gas Zone Diagrams

An SF6 Gas Zone Diagram shall be prepared for each Interconnection Site at which a Interconnection Point exists where SF6 gas-insulated switchgear and/or other SF6 gas-insulated HV Apparatus is utilised. They shall use, where appropriate, the graphical symbols shown in Appendix B. The nomenclature used shall conform with that used in the relevant Interconnection Site and circuit.

TC 8.6 Preparation of Operation and SF6 Gas Zone Diagrams

Each party shall provide to the other Party an Operation Diagram and details of the SF6 Gas Zones on its side of the Interconnection Point. The Party owning the Interconnection Site is then responsible for the preparation of a composite Operation Diagram and SF6 Gas Zone diagrams for the site.

TC 8.7 Changes to Operation and SF6 Gas Zone Diagrams

When either Party has decided that it wishes to install new HV Apparatus or it wishes to change the existing numbering or nomenclature of its HV Apparatus at a Interconnection Point it shall one month prior to the installation or change, send to the other Party a revised Operation Diagram of that Site, incorporating the new HV Apparatus to be installed and its numbering and nomenclature or the changes, as the case may be.

TC 8.8 Validity

The composite Operation Diagram prepared by the System Operator or the User shall be the definitive Operation Diagram for all operational and planning activities associated with the Interconnection Site. If a Dispute arises as to the accuracy of the composite Operation Diagram, a meeting shall be held at the Interconnection Site, as soon as

reasonably practicable, between System Operator and the User, to endeavour to resolve the matters in dispute.

TC 8.9 Site Common Drawings

Site Common Drawings shall be prepared for each Interconnection Site and shall include Interconnection Site layout drawings, electrical layout drawings, common protection/control drawings and common services drawings.

In the case of a User Interconnection Site, the System Operator shall prepare and submit to the User, Site Common Drawings for the System Operator side of the Interconnection Point in accordance with the requirements of the Interconnection Agreement.

The User shall then prepare, produce and distribute, using the information submitted by the System Operator Site Common Drawings for the complete Interconnection Site in accordance with the requirements of the Interconnection Agreement.

In the case of a System Operator Site, the User shall prepare and submit to the System Operator Site Common Drawings for the User side of the Interconnection Point in accordance with the requirements of the Interconnection Agreement.

The System Operator shall then prepare, produce and distribute, using the information submitted by the User, Site Common Drawings for the complete Interconnection Site in accordance with the requirements of the Interconnection Agreement.

TC 8.10 Changes to Site Common Drawings

When the System Operator or a User becomes aware that it is necessary to change any aspect of the Site Common Drawings at a Interconnection Site it shall notify the other Party and amend the common site drawings in accordance with the procedure set out in Sub-section TC 8.9

If the change can be dealt with by notifying the other Party in writing of the change and for each party to amend its copy of the Site Common Drawings then each party shall so amend.

TC 8.10.1 Validity of Site Common Drawings

The Site Common Drawings for the complete Interconnection Site prepared by the User or the System Operator as the case may be, shall be the definitive Site common drawings for all operational and planning activities associated with the Interconnection Site. If a Dispute arises as to the accuracy of the Site Common Drawings, a meeting shall be held at the Site, as soon as reasonably practicable, between the System Operator and the User, to endeavour to resolve the matters in dispute.

TC 8.11 Access

The provisions relating to access to System Operator Sites by Users, and to User Sites by the System Operator shall be set out in each Interconnection Agreement with the System Operator and each User.

In addition to those provisions, where a System Operator Site contains exposed HV conductors, unaccompanied access shall only be granted to individuals holding an Authority for Access issued by the System Operator.

TC 8.12 Maintenance Standards

All Plant and Apparatus at the Interconnection Point shall be operated and maintained in accordance with Prudent Utility Practice and in a manner that shall not pose a threat to the safety of any personnel or cause damage to the Plant and Apparatus of the System Operator or the User.

The User shall maintain a log containing the test results and maintenance records relating to its Plant and Apparatus at the Interconnection Point and shall make this log available when requested by the System Operator.

The System Operator shall maintain a log containing the test results and maintenance records relating to its Plant and Apparatus at the Interconnection Point and shall make this log available when requested by the User.

TC 8.13 Site Operational Procedures

The System Operator and Users at a Interconnection Point shall make available staff to take necessary Safety Precautions and carry out operational duties as may be required to enable work/testing to be carried out and for the Operation of Plant Connected to the Transmission System.

TC 8.13.1 Switching Instructions

High Voltage switching shall only be carried out with the permission of the System Control Engineer except for agreed routine switching or in case of System Emergencies. Persons required to carry out high voltage switching must be specifically certified and authorized by the System Operator to carry out such switching.

The following procedures shall be adhered to when carrying out complex switching operations:

When switchgear, normally operated to the instruction of the System Control Engineer has been operated without instruction from him, the operator

concerned shall notify the System Control Engineer immediately. Switchgear normally operated to the instruction of the System Control Engineer shall not be closed without his permission;

the System Control Engineer shall ensure that any instruction for switching issued by him is repeated phrase by phrase as received and at the termination of the message is read back to him in full by the recipient; and

Any instruction issued by the System Control Engineer relating to the operation of switchgear shall, be written down and every such instruction shall be repeated phrase by phrase as received. At the termination of the message it shall be read back in full to sender to ensure that the instruction has been accurately received.

Instructions from the System Control Engineer shall be carried out without delay and at the time of completing, the operation or sequence of operations shall be reported back to the System Control Engineer.

An operator shall inform the System Control Engineer immediately of any objection to any instruction. The System Control Engineer shall then investigate the matter and if necessary refer it to higher authority endowed with the necessary powers of authority, to make a determination on such matters.

TC 9 OPERATIONAL COMMUNICATIONS

TC 9.1 Introduction

Section TC 9 sets out the requirements for the exchange of information in relation to Operations on the Transmission System which have had (or may have had) or will have (or may have) an Operational Effect:

I. on the Transmission System in the case of an Operation on a User System; and
II. on a User System in the case of an Operation on the Transmission System;
III. where no requirement for communication is specified in any other section of the Transmission Code.

TC 9.1.2 Section TC 9 also sets out the procedure for issue of warnings in the event of a risk of serious and widespread disturbance of the whole, or part of, the Transmission System.

TC 9.2 Objective

The exchange of information is needed in order that the implications of the Operation can be considered and the possible risks arising from it can be assessed and appropriate action taken by the relevant party in order to maintain the

integrity of the System. TC 9 does not seek to deal with any actions arising from the exchange of information, but merely with the exchange of information.

TC 9.3 Requirement to notify Operations

The following are examples of situations where notification shall be required if they will have an Operational Effect:

I. the implementation of a planned outage of Plant and/or Apparatus;
II. the planned operation (other than, in the case of a User, at the instruction of the System Operator) of any circuit breaker or isolator or any sequence or combination of the two;
III. voltage control.
IV. where an Operational Instruction to be issued may have an effect on another User's System, Plant or Apparatus;
V. where Plant is expected to be operated in excess of its rated capability and may present a hazard to Persons;
VI. where there is an expectation of abnormal operating conditions;
VII. where there is increased risk of inadvertent operation of protection; and
VIII. in relation to major testing, commissioning and maintenance.

TC 9.4 Operations on the Transmission System

In the case of an Operation on the Transmission System that will have or has had an Operational Effect on the System of another User, the System Operator shall notify the User whose User System will be, is, or has been affected.

TC 9.5 Operations on a User System

In the case of an Operation on the User System that will have or has had an

Operational Effect on the Transmission System, the User shall notify the System Operator. Following notification by the User, the System Operator shall notify any other Users whose Systems will be, are, or have been affected.

TC 9.6 Nature of Notification for an Operation

In the case of an Operation on the Transmission System which will have or may have an Operational Effect on a User System, the System Operator shall notify the User whose System will or may be affected. The recipient may ask questions to clarify the notification and the notifying Party shall use its reasonable endeavours to provide the necessary information.

In the case of an operation on a User System which will have or may have Operational Effect on the Transmission System, the User shall notify the System

Operator. The recipient may ask questions to clarify the notification and the notifying party shall use its reasonable endeavours to provide the necessary information to the System Operator who shall notify any other Users on whose Users Systems the Operation will or may have an Operational Effect.

TC 9.7 Form of Notification

A notification and any response to any questions of an Operation which has arisen independently of any other Operation or of an Incident, shall be of sufficient detail to describe the Operation and to enable the recipient of the notification to reasonably consider and assess the implications and risks arising and shall include the name of the individual reporting the operation on behalf of the System Operator or the User. The recipient may ask questions to clarify the notification and the sender shall, insofar as it is able, answer any questions raised.

The notification shall, if either party requests, be recorded by the sender and dictated to the recipient, who shall record and repeat each phrase as it is received and on completion of the dictation shall repeat the notification in full to the sender who shall confirm that it has been accurately recorded.

TC 9.8.1 Timing

A notification under TC 9 must be given as far in advance as practicable and in any event shall be given in sufficient time as shall reasonably allow the recipient to consider and assess the implications and risks arising.

TC 9.8.2 Warnings

A warning shall be issued by the System Operator (usually by telephone or other electronic means) to Users who may be affected when the System Operator anticipates there is a risk of widespread and serious disturbance to the whole, or part of, the Transmission System. Where the warning is given by telephone or other electronic means, the System Operator shall issue a written confirmation as soon as reasonably practicable thereafter.

The warning shall contain such information as the System Operator reasonably considers to be necessary in order to explain the nature and extent of the anticipated disturbance to the User provided that sufficient time is available to the System Operator prior to the issue of the warning and that such information is available to the System Operator

For the duration of a warning each User in receipt of the warning shall take the necessary steps to warn its operational staff and maintain its Plant and/or Apparatus in the condition in which it is best able to withstand the anticipated disturbance.

Scheduling and Dispatch in accordance with the Dispatch Code may be affected during the period covered by a warning. Further provisions on this are contained in the Dispatch Code.

TC 9.9 System Control

Where a Generator's system (or part thereof) is, by agreement, under the control of the System Operator, then for the purposes of communication and co-ordination in operational timescales the System Operator may (for those purposes only) treat that Generator's s System (or part thereof) as the System Operator s System but between the System Operator and Generator, it shall remain to be treated as the User s system.

TC 10 DEMAND CONTROL

TC 10.1 Introduction

This Section TC 10 is concerned with the provisions made by the System Operator and procedures to be followed by the System Operator and Users to permit a reduction in Demand in the event that there is insufficient Generation available to meet Demand in all or any part of the Transmission System and/or in the event of problems on the Transmission System, including, without limitation, in the event of both a steady state shortfall of generation and a transient shortfall of generation following a sudden loss of generation.

TC 10.2 Objectives

The objectives are as follows;

To identify different methods of Demand Control and the procedures governing their implementation; and to clarify the obligations of the System Operator and Users as regards the development of procedures, and exchange of information, required for the implementation of Demand Control.

The System Operator shall ensure that all parties affected by Demand Control are treated equitably and that Demand Control is used as a last resort.

TC 10.3 Methods of Demand Control

Demand Control is implemented in a number of ways, including;
Shedding of Demand by automatic Under-Frequency Relays;
Emergency Manual Demand Shedding; and
Planned rota Demand Shedding.
Interruptible loads
The obligations of the System Operator and Users in respect of these means of Demand Control are set out below in DSC 5.4, DSC 5.5 and DSC 5.6. All plans and

implementation of Demand de-energisation shall give due consideration to critical Customers

TC 10.3.1 Shedding of Demand by Automatic Under-Frequency Relays

The System Operator shall use Automatic Demand shedding by Under Frequency Relays to address short-term imbalances in the Generation Capacity and Demand situation, following the tripping of Generation beyond the Spinning Reserve value. It is a method of safeguarding the stability of the Transmission System when other actions, such as the use of the Operating Margin, have failed to stabilize or hold the Frequency within required Operating Limits.

TC 10.3.2 Emergency Manual Demand Shedding

The System Operator may implement Emergency Manual Demand Shedding to maintain the stability of the Transmission System, to cover a developing Generation shortfall or to relieve overloads or depressed voltages in the Transmission System or a part of it.

TC 10.3.3 Planned Rota Demand Shedding

In the event of a sustained period of shortfall in the Generation and Demand balance, either for the Transmission System as a whole or for significant parts of the System, the System Operator shall implement manual shedding of Demand on a rota basis.

When implementing Planned Rota Demand Shedding the System Operator shall use reasonable measures to ensure that available power is shared among affected parties on an equitable basis subject to consideration of critical customers. Groups of Customers can be de-energized for periods of up to [4] hours, after which their supplies shall be re-energized and another group of Customers de-energized.

TC 10.4 Procedures

The procedures for manual load shedding and the settings for Under Frequency Relays are set out in the following documents:

Engineering Instruction No 1.6 Load Shedding associated with Generating Plant Deficiency (Appendix B); and System Operation Policy and Procedure No 11 Controlled Load Shedding (Appendix C).

TC 11 SYSTEM CONTROL

TC 11.1 Control responsibilities

The System Operator and Users shall jointly agree and outline in writing schedules specifying the responsibilities for control of Equipment. These shall ensure that only one party is responsible for any item of Plant or Apparatus at any one time.

The System Operator and each User shall at all times have nominated a Control Person or persons responsible for the co-ordination of safety from the System pursuant to this Sub-section TC 11.1

TC 11.2 Control Documentation

The System Operator and Users shall maintain a suitable system of documentation which records all relevant operational events that have taken place on the System or any other User System connected to it and the co-ordination of relevant safety precautions for work.

All documentation relevant to the operation of the System, and safety precautions taken for work or tests, shall be held by the System Operator and the appropriate User for a period of not less than five years.

TC 11.3 System Diagrams

Diagrams illustrating sufficient information for Control Persons to carry out their duties shall be exchanged by the System Operator and the appropriate User.

TC 11.4 Communications

Where the System Operator reasonably specifies the need, suitable communication systems shall be established between the System Operator and other Users to ensure the control function is carried out in a safe and secure manner.

Where the System Operator reasonably decides a backup/alternative routing of communication is necessary to provide for the safe and secure operation of the System the means shall be agreed with the appropriate Users.

Schedules of telephone numbers/call signs shall be exchanged by the System Operator and the appropriate User to enable control activities to be efficiently co-ordinated.

The System Operator and appropriate Users shall establish 24 hour availability of personnel with suitable authorisation where the joint operational requirements demand it.

Where a Generator's system (or part thereof) is, by agreement, under the control of the System Operator, then for the purposes of communication and co-ordination in operational timescales the System Operator may (for those purposes only) treat that Generator's s System (or part thereof) as the System Operator s System but between the System Operator and Generator, it shall remain to be treated as the User s system.

TC 12 CONTINGENCY PLANNING

TC 12.1 Introduction

This Transmission Code requires the System Operator to develop a strategy to be implemented in Emergency Conditions of Major System Failure.

The System Operator shall have adequate policies and procedures in place to respond to a Total System Shutdown or major System Incident that will have widespread implications for electricity supply to the population. Users shall be aware of these policies and procedures, and cooperate fully in their implementation, through which the System Operator can return the System to normal operating conditions.

TC 12.2 Objective

The objectives of Section TC 12 are:

to require the System Operator to develop a general restoration strategy to adopt in the event of Total System Shutdown or major System Incident;

to require the System Operator to produce and maintain comprehensive System restoration procedures covering Total System Shutdowns and major System Incidents;

to provide for the cooperation of Users with the formulation and execution of System restoration procedures;

to provide for the development and implementation of communications between the System Operator and Users when dealing with a System Incident; and

to ensure the System Operator and User personnel who will be involved with the implementation of System Restoration Procedures, are adequately trained and familiar with the relevant details of the procedures.

TC 12.3 Scope

In addition to the System Operator, Section TC 12 applies to:

Generators;
Large Customers.

TC 12.4 System Restoration Strategy

The System Operator shall develop a System Restoration Strategy to be implemented in Emergency Conditions such as Total System Shutdown and other major System Incidents. The overall objectives of the System Restoration Strategy shall be as follows:

Restoration of the Transmission System and associated Demand in the shortest possible time, taking into account Generator capabilities, and Transmission System operational constraints;

Re-synchronisation of parts of the Transmission System which have lost synchronism with each other; and

to provide for effective communication routes and arrangements to enable senior management representatives of the System Operator and Users, who are authorised to make binding decisions on behalf of the System Operator or a User to communicate with each other during a System Incident.

The System Restoration Strategy shall provide for the detailed implementation of the following:

Notification by the System Operator to Users that a Total System Shutdown or a Major System Incident has occurred and that the System Operator intends to implement System restoration procedures;

Identification of separate groups (Power Islands) of Generators together with complementary local Demand; and step by step integration of these Power Islands into larger sub-Systems to return the Transmission System to normal operating conditions.

The System Restoration Strategy shall also provide for the issue of any dispatch instructions necessitated by the System conditions prevailing at the time of the System Incident.

TC 12.5 System Restoration Procedures

In the event of emergency conditions such as a Total System Shutdown of the Transmission System, the System Operator shall issue an Alert as set out in to notify Users that it intends to implement System Restoration Procedures. The System Operator shall notify Users prior to the commencement of the System Restoration Procedures of the particular System Restoration Strategy to be implemented for that System Incident.

The System restoration procedures shall be developed and maintained by System Operator in consultation with other Users as appropriate in accordance with Prudent Utility Practice.

The Code Review Panel shall ensure that appropriate System restoration procedures are in place.

The System Restoration Procedures shall provide for:

procedures to establish an Emergency Operation Centre immediately following a major System Incident;

a decision on the location of the Emergency Operation Centre; and

the operational responsibilities and requirements of an Emergency Operation Centre, noting that such an Emergency Operation Centre shall be the focal point for communication and the dissemination of information between System Operator and senior management representatives of relevant Users.

The complexities and uncertainties of recovery from a Total System Shutdown of the Transmission System require the System restoration procedures to be sufficiently flexible so as to accommodate the full range of prevailing Generator and Transmission System operational possibilities and constraints.

TC 12.6 Major System Failure Procedures

Major System Failures are unpredictable both with respect to timing and the resulting implications. The System Operator shall establish procedures for determining when an incident on the System shall be considered a Major System Failure and also establish outline procedures for handling these Major System Failures as required under the Electricity Act 2015, Part VII..

In certain circumstances, the System Operator may require an Emergency Operation Centre to be established to coordinate the response to a Major System Failure and to avoid placing further stress on existing System Operator and User operational control arrangements.

The System Operator shall inform Generators promptly that an Emergency Operation Centre is to be established and request all relevant Generators to implement System Incident Communications Procedures. The System Operator shall specify the responsibilities and functions of the Emergency Operations Centre and the relationship with existing operational and control arrangements.

The Emergency Operation Centre established in accordance with the System Operator s instructions shall have any responsibility for the Operation of the Transmission System and shall be the focal point for communication and the

dissemination of information between the System Operator and senior management representatives of relevant Users, the OUR and Government.

During a Major System Failure, normal communication channels for operational control communication between the System Operator and Users shall continue to be used.

The System Operator shall decide when conditions no longer justify the need to use the Emergency Operation Centre and shall inform all relevant Generators within 30 minutes by facsimile or other agreed electronic means accordingly.

TC 12.7 Major System Failure Communications

The System Operator and Generators shall ensure that there are suitable communication channels available and established protocols, including the responsibilities of senior members of staff, to facilitate the co-ordination of activities after a Major System Failure.

The System Operator and all Users shall maintain lists of telephone contact numbers at which, or through which, senior management representatives nominated for this purpose and who are fully authorised to make binding decisions on behalf of the System Operator or the relevant User can be contacted day or night.

The lists of telephone contact numbers shall be provided in writing prior to the time that a Generator connects to the Transmission System and must be up-dated and circulated to all relevant parties, in writing, whenever the

Information changes. Notifications and responses shall be made normally by telephone but must be confirmed in writing within 30 minutes.

All Major System Failure communications between the Senior Management representatives of the relevant parties with regard to the System Operator's role in the Major System Failure shall be made via the Emergency Operation Centre if such a centre has been established.

TC 12.7.1 System Alerts/Warnings

In the event of Major System Failures, such as Total System Shutdown or a System separation, the System Operator shall issue promptly an alert warning to all Users.

The form of the Alert Warning will be:

This is an Alert timed at hours;

There is a (Major System Failure) at .. (place); A System Normalisation Procedure is being implemented; Standby for further instructions .

TC 13 INCIDENT INFORMATION SUPPLY

TC 13.1 Introduction

This Section of the Code requires the System Operator and Generators to issue notices of all Incidents on their respective Systems that have or may have implications for the Transmission System or a User's System.

The System Operator shall determine that if Incident should be classified as a Major System Failure in accordance with Section VII of the the Electricity Act 2015.

Sub-section TC 12.7 sets out the procedures for reporting and subsequent assessment of Major System Failures.

Where a Significant Incident has been declared the System Operator may request an investigation be carried out.

The composition of such an investigation panel shall be appropriate to the Incident to be investigated.

Where there has been a series of Significant Incidents (that is to say, where a Significant Incident has caused or exacerbated another Significant Incident) the System Operator may determine that the investigation should include some or all of those Significant Incidents.

Any investigation under Sub-section TC 13 is separate from any inquiry which may be carried out under legal or statutory requirements.

Sub-section TC 13.4. requires the System Operator or a Generator to prepare:

a preliminary written Incident report within 24 hours of the Incident;

For a Major System Failure, a written report is required within 30 days of the Incident.

In addition, Sub-section TC 13 contains requirements governing the content of Major System Failure reports, the circulation of these reports, and their subsequent assessment and review by the Code Review Panel.

TC 13.2 Objective

The objectives of Section TC 13 are:

I. to specify the obligations of the System Operator and Generators regarding the issue of notices of Incidents on their respective Systems;
II. to ensure notices of Incidents provide sufficient detail to allow recipients of such notices to fully assess the likely implications and risks and take the necessary actions required to maintain the security and stability of the Transmission System or a Generator' s System;

III. to specify the arrangements for reporting Incidents that the System Operator has determined to be a Major System Failure; and

IV. to provide for the review of all Major System Failure reports by the Code Review Panel to assess the effectiveness of policies adopted in accordance with this Dispatch Code and the other Grid Codes.

TC 13.3 Notification of Incidents

The System Operator and Generatorss shall issue notifications of Incidents on their respective Systems that have had or may have implications for the Transmission or Distribution System in the case of the Generator, or a Generator's System in the case of both the System Operator and Generator notifications. Where information is requested in writing throughout this Code, facsimile transmission or other electronic means as agreed with System Operator in writing may be used.

Without limiting the requirements of this Code, Incident notifications shall be issued for the following, subject to TC 13.3.1; where Plant has been Operated in excess of its rated capability and presented a hazard to Persons;

The activation of any alarm or indication of any abnormal operating condition; adverse weather conditions being experienced; breakdown of, faults on or temporary changes in the capabilities of Plant; breakdown of or faults on control, communication and Metering equipment; and increased risk of inadvertent operation of protection devices, relays or Equipment

TC 13.3.1 Incidents on the Transmission System

In the case of an Incident on the Transmission System, which has had or may have an Operational Effect on a Generator's System, the System Operator shall notify the Generator whose Generation System will be, is, or has been affected.

TC 13.3.2 Incidents on a Generator's System

In the case of an Incident on a Generator's System, which has had or may have an

Operational Effect on the Transmission System, the Generator shall notify the System Operator. Following notification by the Generator, the System Operator shall notify any other Users whose systems will be, or have been affected.

TC 13.3.3 Form of notification

Incident notifications must be issued promptly. Notifications and responses to notifications may be made by telephone or the mass media, but shall be confirmed in writing within one (1) hour or as soon as it is practical to do so.

The appropriate party shall issue a notification (and any response to questions asked) of any Incident that has arisen independently of any other Incident.

The notification shall;

be of the Incident (but is not required to state its cause);

be of sufficient detail to enable the recipient of the notification to reasonably consider and assess the implications, and risks arising; and include the name of the individual reporting the Incident on behalf of the Grid Operator or the User.

The recipient of a notification may ask questions to clarify the notification and the provider of the notification shall, insofar as they are able, answer any questions raised.

An Incident notification shall be given as soon after the Incident as possible to allow the recipient to consider and assess the implications and risks arising from the Incident.

TC 13.4 Major System Failure Reporting

The System Operator may determine that an Incident reported by it or a Generator shall be classified as a Major System Failure.

The System Operator shall promptly notify all potentially affected Users by telephone or other media that such a determination has been made and that procedures governing Major System Failure reporting are to be followed. The

System Operator shall confirm such notice within 30 minutes by facsimile or other electronic means. All affected Users shall acknowledge receipt of the notification within 15 minutes of receipt by facsimile or other electronic means.

TC 13.4.1 Timing of Major System Failure reporting

Preliminary report

The System Operator or must produce a preliminary written Incident report within 24 hours.

Full report

The System Operator or must produce a full written Major System Failure report within 30 business days a Major System Failure

A Generator shall produce a Major System Failure Report within 20 days of a Major System Failure caused by its Generation System. This is to facilitate the System Operator preparing its Major System Failure Report within 30 days for submission to the Office and the Minister as required under the Electricity Act 2015.

Written reporting of Major System Failures by the System Operator to Generators.

In the case of a Major System Failure reported by the System Operator to a Generator , the System Operator shall provide a full written Major System Failure report to the OUR.

Upon the request of the System Operator, a Generator shall provide a report of the Incident to the System Operator. The System Operator may use the information contained from an Incident report from a Generator therein in preparing the written report.

Written reporting of Major System Failures by Generators to the System Operator.

In the case of an Incident, that has been reported by a Generator to the System Operator and determined by the System Operator as a major System Failure,the Generator shall provide a full written Major System Failure report to the System Operator. The System Operator shall not pass this report to other affected Users but may use the information contained therein in preparing a Major Sytem Failure report to the OUR.

TC 13.5 Form of Significant Incident report

A full Major System Failure report prepared by the System Operator shall be sent to the Minister and the OUR. The full Major System Failure report shall contain confirmation of the Major System Failure notification together with full details relating to the Major System Failure.

The Major System Failure report should, as a minimum, contain the following:

a. Date and time of Significant Incident;
b. Location;
c. Apparatus involved;
d. Brief description of the Major System Failure
e. Causes of the Failure
f. Details of any Demand Control undertaken.
g. Effect on other System Users including where appropriate:- duration of Incident and estimated date and time of return to normal service.
h. Effect on generation includinggeneration interrupted; frequency response achieved; MVAr performance achieved; and estimated date and time of return to normal service
i. measures and procedures taken to restore the system
j. measures that should be taken to avoid a recurrence of the failure
k. An assessment of the cost associated with the failure.

The above list is not intended to be exhaustive to this Section TC 13 of the Code

TC 14 COMMUNICATIONS AND CONTROL

In order to ensure control of the Transmission System, telecommunications between Users and the System Operator must be established if required by the System Operator.

Control Telephony is the method by which a User Responsible Engineer/Operator and the System Operator s Control Engineers speak to one another for the purposes of control of the Transmission System in both normal and emergency operating conditions. At any Interconnection Point where the User telephony equipment is not capable of providing the required facilities or is otherwise incompatible with the System Operator s control telephony, the User shall install appropriate telephony equipment to the specification of the System Operator. Details of and relating to the control telephony required shall be set out in the Interconnection Agreement.

The System Operator shall provide Supervisory Control and Data Acquisition (SCADA) outstation interface equipment. The User shall provide such voltage, current, frequency, Active Power and Reactive Power measurement outputs and plant status indications and alarms to the System Operator SCADA outstation interface equipment as required by the System Operator in accordance with the terms of the Interconnection Agreement. The manner in which information is required to be presented to the outstation equipment is set out in Section GC 5 of the Generation Code.

TC 15 NUMBERING AND NOMENCLATURE OF HV APPARATUS

TC 15.1 Introduction

This Section sets out the requirements that:

I. Transmission Apparatus on Users' Sites ; and
II. User Apparatus on Transmission Sites

shall have numbering and nomenclature in accordance with the System used from time to time by the System Operator.

The numbering and nomenclature of each item of Apparatus shall be included in the Operation Diagram prepared for each Interconnection Site. Further provisions on Operation Diagrams are contained in TC Appendix B.

The term Apparatus includes any associated SF6 Gas Equipment

TC 15.2 Objective

The overall objective is to ensure, so far as possible, the safe and effective operation of the Total System and to reduce the risk of human error by requiring, in certain circumstances, that the numbering and nomenclature of User's Apparatus shall be in accordance with the system used from time to time by the System Operator.

TC 15.3 Transmission Apparatus on Users' Sites

Transmission Apparatus on Users' Sites shall have numbering and nomenclature in accordance with the system used from time to time by the System Operator.

When the System Operator is to install its Apparatus on a User's Site , the System Operator shall notify the relevant User of the numbering and nomenclature to be adopted for that Apparatus at least eight months prior to proposed installation.

The notification shall be made in writing to the relevant User and shall consist of both a proposed Operation Diagram incorporating the proposed Transmission Apparatus to be installed, its proposed numbering and nomenclature, and the date of its proposed installation.

The relevant User shall respond in writing to the System Operator within one month of the receipt of the notification, confirming receipt and confirming either that any other Apparatus of the relevant User on such User Site does not have numbering and/ or nomenclature which could be confused with that proposed by the System Operator, or, to the extent that it does, that the relevant other numbering and/ or nomenclature shall be changed before installation of the Transmission Apparatus.

The relevant User shall not install, or permit the installation of, any Apparatus on such User Site which has numbering and/ or nomenclature which could be confused with Transmission Apparatus which the System Operator has advised the User to be installed on that User Site or is already on that User Site shall.

TC 15.4 User Apparatus on Transmission Sites

User Apparatus on Transmission Sites shall have numbering and nomenclature in accordance with the system used from time to time by the System Operator.

When a User is to install its Apparatus on a Transmission Site, or it wishes to replace existing Apparatus on a Transmission Site and it wishes to adopt new numbering and nomenclature for such Apparatus, the User shall notify the System Operator of the details of the Apparatus and the proposed numbering and nomenclature to be adopted for that Apparatus, at least eight months prior to proposed installation.

The notification shall be made in writing to the System Operator and shall consist of both a proposed Operation Diagram incorporating the proposed new Apparatus of the User to be installed, its proposed numbering and nomenclature, and the date of its proposed installation.

The System Operator shall respond in writing to the User within one month of the receipt of the notification stating whether or not the System Operator accepts the User's proposed numbering and nomenclature and, if they are not acceptable, it shall give details of the numbering and nomenclature which the User shall adopt for that Apparatus.

TC 15.5 Changes

Where the System Operator in its reasonable opinion has decided that it needs to change the existing numbering or nomenclature of Transmission Apparatus on a User Site or of User Apparatus on a Transmission Site :

The provisions of this Sub-section TC 15.5 shall apply to such change of numbering or nomenclature of Transmission Apparatus with any necessary amendments to those provisions to reflect that only a change is being made; and

in the case of a change in the numbering or nomenclature of User Apparatus on a Transmission Site, the System Operator shall notify the User of the numbering and/ or nomenclature the User shall adopt for that Apparatus (the notification to be in a form similar to that envisaged under TOC10.4) at least eight months prior to the change being needed and the User shall respond in writing to the System Operator within one month of the receipt of the notification, confirming receipt.

In either case the notification shall indicate the reason for the proposed change

Users shall be provided upon request with details of the System Operator's then current numbering and nomenclature system in order to assist them in planning the numbering and nomenclature for their Apparatus on Transmission Sites.

When a User installs Apparatus in accordance with TC 15, the User shall be responsible for the provision and erection of clear and unambiguous labelling showing the numbering and nomenclature.

Where a User is required by TC 15 to change the numbering and/ or nomenclature of Apparatus, the User shall be responsible for the provision and erection of clear and unambiguous labelling by the required date.

When the System Operator installs Apparatus which is the subject of TC 15, the System Operator shall be responsible for the provision and erection of a clear and unambiguous labelling showing the numbering and nomenclature. Where the System Operator changes the numbering and/or nomenclature of Apparatus which is the subject of this Section TC 15, the System Operator shall be responsible for the provision and erection of clear and unambiguous labelling showing the numbering and nomenclature by the required date.

TC 16 TESTING, MONITORING AND INVESTIGATION

TC 16.1 Introduction

Section TC 16 sets out the authorization required and the procedures to be followed by the System Operator, and Users wishing to conduct Operational Tests or Site Investigations involving Plant and Apparatus connected to or part of the Transmission System.

The Code stipulates that prior authorisation from the System Operator is required before conducting Operational Tests or Site Investigations.

TC 16.2 Objective

The objectives are to ensure that Operational Tests and Site Investigations;

a. are authorized by the System Operator and are carried out in accordance with appropriate procedures;
b. are carried out in a coordinated manner to avoid unnecessary risk or damage to Plant and to minimise costs to the System Operator and affected Users;
c. do not threaten the safety of personnel or the general public;
d. do not threaten the security or stability of the Transmission System;
e. and are properly evaluated on completion and, where appropriate, subject to predefined reporting arrangements.
f. A further objective is to allow sufficient tests to be conducted to enable predictive fault finding.

TC 16.3 Categories of tests

This Sub-section covers the following categories of test:

a. Operational tests to commission or test the compliance of Generating Units with the requirements of a Power Purchase Agreement or for other purposes specified in the Generation Code.
b. Site Investigation tests in relation to Plant, Apparatus and operational procedures at Generator and User sites.
c. Other tests required, in certain circumstances, whether by means of a formal test or verification by inspection, to ascertain whether Operating Parameters and/or the Interconnection Code are being complied with in respect of the User s Plant and Apparatus.

TC 16.4 Authorisation and Test Procedures

Prior authorisation from the System Operator is required before conducting an Operational Test, Site Investigation or other test.

Users seeking to conduct an Operational Test or Site Investigation shall submit a Test Request to the System Operator giving at least 8 weeks minimum notice before the date of the proposed test. A Test Request shall include a detailed test proposal including:

a. a brief description of the proposed test;
b. the preferred time or times for the test and the potential duration;
c. the reason for the proposed test indicating whether the test is required for compliance with Licence conditions, statutory regulations or Safety Rules. This shall assist in determining the priority to be given to the test;
d. an indication of any potential adverse effects if the Test is cancelled at short notice or delayed; and

e. an indication of any Dispatch Instructions or operational switching required to facilitate the test.

The System Operator shall consider the following factors when evaluating a Test Request:

a. The impact of the requested test on Transmission System stability and security;
b. the impact of the requested test on Transmission System economics;
c. the impact of the requested test on other Users; and
d. the effect of the requested test on the continuity and quality of electricity Supply.

If the System Operator approves a Test Request, it shall inform the test proposer accordingly in writing.

If the System Operator requests additional information from the test proposer to evaluate the impact of a Test Request the System Operator shall stipulate the time within which the information shall be provided. If the information is not provided in the timescale indicated by System Operator the Test Request shall automatically lapse.

If the System Operator does not approve a Test Request, it shall set out its reasons for rejecting the application and consult with the Test proposer on any changes to the Test proposal required to secure approval for the Test. The Test proposer may update a Test proposal in accordance with guidance provided by the System Operator and submit a revised Test Request.

The System Operator shall not withhold approval of a Test Request unless it considers it has reasonable grounds for doing so. If a User is not satisfied that a Test request was rejected on reasonable grounds it can refer the matter to the OUR for determination.

The System Operator shall not disclose any information received as part of a Test Request application without the consent of the User who submitted the Test Request if it reasonably believes the information to be commercially sensitive or otherwise potentially sensitive.

TC 16.5 Test Panel

If a Test Request is approved, the System Operator shall decide if a Test Panel is required. If the System Operator decides that a Test Panel is required, the test proposer shall convene a Test Panel, subject to the approval of the System Operator.. The number of Test Panel members shall be kept to the minimum number of persons compatible with affected User representation.

The Chairman of a Test Panel shall be appointed by the System Operator. . The System Operator and all directly affected Users shall be represented on the Test Panel.

The duties and responsibilities of the Test Panel are as follows:

iii. to prepare a detailed programme for the conduct of the test, including the start and end date of the test, and any Dispatch requirements and operational switching required to facilitate the test;

iv. to identify the detailed management requirements of the test;
v. to ensure that all affected parties are properly informed of and have access to all relevant information;
vi. to schedule the resources required to conduct the test; and
vii. to prepare a Test Document that shall include all the elements listed above.

The Test Document shall be copied to all members of the Test Panel at least 2 weeks before the start date of the test. Members of the Test Panel may provide comments on the Test Document to the Chairman of the Test Panel no later than 1 week before the scheduled start date of the Test.

The test shall proceed only on the condition that the Test Panel has approved the Test Document. If a member of the Test Panel is not satisfied with the test proceeding and they have fully discussed the issues within the Test Panel, they may make representation to the OUR.

The System Operator shall not disclose information provided to a Test Panel without the consent of the person who submitted the information if it reasonably believes the information to be commercially sensitive or otherwise potentially sensitive.

TC 16.6 Post Test Reporting Requirements

At the conclusion of an Operational Test or Site Investigation the test proposer shall prepare a written report on the test that shall be available within 4 weeks of the conclusion of the Operational Test. The report shall be copied to the System Operator and the OUR.

The Test Report shall not be submitted to any other person who is not a representative of the System Operator or the test proposer unless the System Operator and the test proposer having reasonably considered the confidentiality issues arising, and shall have unanimously approved such submission.

The Test Report shall include a detailed description of the completed Test, the Plant or Apparatus to which the Test relates, together with the results, conclusions and recommendations as they relate to the Test proposer, System Operator and all Users operationally affected by the Test, where applicable.

The Test Panel shall be disbanded after the final test report has been approved

. TC 16.7 Operational tests

The System Operator shall cooperate with the implementation of all Operational Tests.

Where the System Operator considers the impact of an Operational Test to be significantly greater than originally estimated, the System Operator may at any time contact the Test proposer to discuss a revised Test procedure or schedule.

The System Operator shall, where it considers it necessary to do so, cancel, interrupt, or postpone an Operational Test at any time.

If the Test proposer wishes to cancel an Operational Test before commencement of the Test or during the Test, the Test proposer must notify the System Operator immediately and the notice must be confirmed in writing within 1 hour by facsimile or other electronic means.

TC 16.8 Operational Tests Required by the System Operator

The System Operator may from time to time need to conduct Operational Tests in order to maintain and develop operational procedures, to train staff, and to acquire information in respect of Transmission System behaviour under abnormal System conditions.

The System Operator shall endeavour to keep the frequency of occurrence, scope, and impact of Operational Tests to the minimum necessary.

Where the System Operator intends to carry out an Operational Test and in the System Operator s reasonable opinion, such a test will or may have an Operational Effect on a User s System, the System Operator shall give [8] weeks notice and provide sufficient information to the affected Users to enable the affected Users to assess any risks to their Systems.

The information provided by System Operator shall include;

a. a brief description of the Operational Test;
b. the probable effects of the Operational Test; and
c. the scheduled time and duration of the Operational Test.

Affected Users may contact the System Operator to request additional time or information to consider the impact of the Operational Test on their Systems and shall respond to the System Operator within 2 weeks of receipt of the System Operator s notice of the test.

TC 16.9 Operational Tests Required by Users

Operation of Users Plant and Apparatus in accordance with Prudent Utility Practice requires testing to maintain and develop operational procedures, develop and measure Plant performance, comply with statutory or other industry obligations and contracts, and to train staff.

Each User shall endeavour to limit the frequency of occurrence of Operational Tests and to limit the effects of such Operational Tests on the Transmission System.

Users shall submit a Test Request to the System Operator in accordance with the requirements of Sub-section TC 16.5.

TC 16.10 Operational Tests of Generating Units

The procedure to be adopted for the Operational testing of Generating Units is set out in the Generation Code and summarised below:

The Generator shall provide to the System Operator a timetable and list of all tests to be performed on the Generating Units, and such tests shall be subject to approval by the

System Operator. The System Operator shall be given five (5) days notice of any testing and shall reserve the right to have a representative present during any such tests.

Testing and monitoring of Generating Units is generally performed for the purpose of determining available Capacity and, if relevant, operating characteristics in accordance with the commercial and technical conditions of Power Purchase Agreements.

Prior to the Synchronization of each new Generating Unit, the Generator shall carry out a number of tests as set out in the Generation Code. These tests cover such aspects as Automatic Voltage Regulator Setting, governor control checks, open and short circuit tests etc.

After the Pre-Synchronization tests as defined in TC 16.10.4 and prior to the commissioning date, and under such subsequent conditions as defined by Power Purchase Agreements, Generator shall carry out the following tests:

i. Dependable Capacity
ii. Reliability Run
iii. Automatic Voltage Regulator (AVR) Droop
iv. Governor Operation
v. Reactive Capacity
vi. Short-term Load Capability
vii. Response of Unit to Step Load Changes
viii. Full Load Rejection
ix. Thermal Performance Tests

Fully detailed requirements for Generator Testing are set out in Section GC 12 Testing and Monitoring of the Generation Code.

TC 16.11 Other Operational Tests

Any Operational Test proposal accompanying a Test Request shall indicate whether Dispatch Instructions and operational switching instructions are required to facilitate the test.

The System Operator shall, subject to any amendments it may require to be made, incorporate the Dispatch Instructions and operational switching instructions required to facilitate the test..

The System Operator shall issue Dispatch Instructions for Operational Tests in accordance with the procedures set out in the Generation Code.

In accordance with the Generation Code the Generator shall provide to the System Operator a timetable and list of all tests to be performed on the Generating Units, and such tests shall be subject to approval by the System Operator. The System Operator shall be given five (5) days notice of any testing and shall reserve the right to have a representative present during any such tests.

The System Operator shall inform other Users of the scheduled time and nature of the test, if in the opinion of System Operator those Users will or may be affected by the test.

The Operational Test shall proceed in accordance with normal operational practices but with particularly close communication between the system control engineer and the person responsible for the execution of the Test . Where the Operational Test is complex or time consuming, the System Operator shall provide additional support at the System Control Centre, if necessary.

TC 16.12 Site Investigation Tests

The System Operator may, if it reasonably considers that there may be an issue of non-compliance with an agreement by the User, carry out a Site Investigation to acquire or verify information relevant to Users Plant and/or

Apparatus design, Operation or Interconnection requirements under the Transmission Code, Interconnection Agreements and other agreements between Users and the System Operator.

The System Operator may, having given reasonable notice, send a representative or agent to a User s site in order to investigate any equipment or operational procedure applicable to the User site insofar as the condition of that equipment or operational procedure is relevant to compliance with a the Transmission Code, a Interconnection Agreement, or other relevant agreements.

TC 16.13 Other Tests

The System Operator can, at any time, request a test. Where an Agreement exists (with appropriate test procedures) these shall form the basis of the test.

Testing, including tests carried out under any relevant agreement may involve attendance by the System Operator or their representatives at User sites in order to carry out or observe such tests.

Where required, a test shall be carried out in accordance with Dispatch

Instructions and operational switching instructions issued by the System Operator or by such alternative procedures as is required or permitted by the Transmission Code.

Where a test is required at short notice, the System Operator shall use reasonable endeavours to accommodate the test in the requested timescale provided that in the System Operator s reasonable opinion the test would not compromise the security and stability of the Total System, or pose a risk to the safe and secure operation of Plant, or compromise the safety of related personnel and the general public.

TC 17 TRANSMISSION METERING

TC 17.1 Purpose

This Section of the Transmission Code sets out the way in which power and energy flows shall be measured at an Operational Interface.

The Metering Code is required to establish the requirements for metering the Active and Reactive Energy and Demand from its entry to the Transmission System to its exit to the Distribution System and Large Customers.

The Code also sets out appropriate procedures for meter reading; and

Ensures that procedures are in place to manage disputed readings.

TC 17.2 Scope

This Chapter applies to:

The System Operator
Large Customers
Generators
The requirements for the metering of Generators are set out in the Generation Code. An outline of the requirements is set out in Sub-section TC 17.3

For Large Customers the metering requirements follow those of a User connected to the Distribution System as set out in the Distribution Code. An outline of these requirements is set out in Sub-section TC 17.6.

TC 17.3 Metering Requirements - Generators

Adequate Metering Systems consistent with the technical specifications of this clause shall be installed by the Generator. The Metering System shall comprise a Primary and Backup Metering System and shall be designed, financed and installed by the Generator. The System Operator shall own and maintain the Primary Metering System while the Generator shall own and maintain the Backup Metering System

TC 17.3.1 Overall Accuracy

The overall accuracy of Generator metering is to be designed to give a tolerance of +/- 0.5% on an ongoing basis.

TC 17.3.2 Relevant Metering Policies, Standards and Specifications

Both Primary and Backup Metering Systems shall be installed to accumulate the outputs and/or inputs at the High Voltage side bushing of the Generating Unit step up transformer.

The System Operator shall own and maintain the Primary Metering System while the Generator shall own and maintain the Backup Metering System.

Each meter shall have its own Current Transformer (CT) and Voltage Transformer (VT) and necessary independent systems to function effectively.

Instrument transformers shall conform to ANSI Standard C12.11 and C57.14 Class 03 and shall have sufficient capacity to handle the attached equipment. The ANSI standards refer to the physical characteristics of meters and the procedures and practices related to type and pattern approval. The detailed use of these standards in the testing of meters are set out in OUR Document ELE 2005/07 Electricity Meter Testing in Jamaica - Protocol on Administrative Meter Testing.

The Current Transformers secondary winding used for metering purposes shall supply only the metering equipment and associated systems. Notwithstanding the foregoing each Current Transformer may have other secondary windings that may be used for purposes other than metering.

Potential transformers' secondary windings may be used for metering and other purposes provided that the total loading does not exceed one half burden of the rating of the transformer.

TC 17.4 Parameters for Meter Reading

The Generator shall provide and install meters equal or equivalent to the specification provided by the System Operator and shall make a continuous recording on appropriate magnetic media or equivalent of the Net Energy Output of the Generating Unit(s).

The parameters to be metered shall be subject to the Interconnection Agreement between the Generator and the System Operator, and may consist of but are not limited to any or all of the following parameters:

a. Active Energy (Wh) OUT;
b. Active Energy (Wh) IN;
c. Reactive Energy (VARh) First Quadrant;
d. Reactive Energy (VARh) Fourth Quadrant;
e. Active Power Demand (W) OUT;
f. Active Power Demand (W) IN;
g. Reactive Power Demand (VAR) First Quadrant; and
h. Reactive Power Demand (VAR) Fourth Quadrant.

All units shall be expressed at appropriate multiples determined by the maximum expected demand.

TC 17.5 Frequency of Reading

The Demand Interval shall be fifteen (15) minutes and shall be set to start at the beginning of the hour. Demand shall be calculated by averaging the respective parameters over the stated Demand Interval.

The System Operator shall read the appropriate meters to prevent clock drift, the clocks shall be checked and reset as agreed by the parties. If readings are obtained remotely,

copies of the data produced by the computer which initiates the reading protocol can be made and provided to the Generator if requested.

TC 17.6 Metering Requirements - Large Customers

TC 17.6.1 Overall Accuracy

The overall accuracy of the metering for revenue purposes is to be designed to give a tolerance of +/- 1% when tested in the laboratory and +/- 2 when tested in the field.

TC 17.6.2 Relevant Metering Policies, Standards and Specifications

The meters, and associated installations, used on the System Operator's Transmission System shall comply with the following documents which are identified in Transmission in Sub-section TC 7.6.2.

a. JPS Engineering Instruction 4.7

b. OUR Document ELE 2005/07 Electricity Meter Testing in Jamaica - Protocol on Administrative

c. Meter Facilities Policy as set out in JPS Engineering Bulletin TSD 007/3

The meters shall be designed, constructed and operated to comply with the latest revision of the relevant ANSI standards or international equivalents in particular:

a. ANSI C12.1 2008 The Electric Meters code for Electricity Metering;
b. ANSI C12:10 2004 Physical aspects of watt-hour meters - safety standard; and
c. ANSI C12:20 2002 Electricity meters 0.2 and 0.5 accuracy Classes.

TC 17.7 Requirement for Metering

All Interconnection Points to the Transmission System shall have appropriate metering in accordance with this Transmission Metering Code. The position of the metering shall be set out in the Interconnection Agreement between the System Operator and the Large Customer.

TC 17.8 Metering Responsibility

The System Operator shall ensure that all Interconnection Points with Large Customers are metered in accordance with this Code.

It is the responsibility of Large Customers and Generators to cooperate with the System Operator in the execution of its responsibilities under this Code and, where applicable, under the Generation Code.

The costs for installation and replacement of meters shall be outlined in the

User s Interconnection Agreement or the Generator s Power Purchase Agreement or Standard Offer Contract

TC 17.9 Metering Equipment

The metering equipment shall consist of :

a. Revenue Meters;
b. Current and Voltage Transformers where applicable;
c. All interconnecting cables, wires and associated devices, seals and protection; and
d. All equipment associated with Advanced Metering Infrastructure.

TC 17.9.1 Revenue Meters

The revenue meter shall have the appropriate rating for the Interconnection requirements to be supplied and shall conform to the terms of the Interconnection Agreement between the System Operator and the Large Customer.

Meters shall have an accuracy in accordance with ANSI class 0.5 or international equivalent.

At the System Operator s discretion Advanced Metering Infrastructure may be installed at some Customers Sites. This metering infrastructure enables two way communication with the metering systems. These devices shall comply with the specifications in TC 19.2.2. The accuracy shall be equivalent to ANSI Class 0.5.

The relevant metered parameters, as required by the System Operator for billing purposes, shall be stored cumulatively on the meter and shall be able to be accessed by the Large Customer.

Where required these parameters may include any or all of the following depending on the Interconnection and the tariff schedule:

a. KW Hours (delivered and received);
b. KVAr Hours (delivered and received);
c. KVA Hours (delivered and received);
d. Ampere Squared Hours;
e. Volt Squared Hours;
f. Maximum Demand (15 minute period);
g. Power Factor;

The above parameters shall be measurable over intervals from 1 minute to 60 minutes.

TC 17.9.2 Voltage and Current Transformers

All Voltage and Current Transformers shall comply with IEC Standards or their equivalents and shall have an accuracy class of 0.5.

The burden in each phase of Voltage and Current Transformers shall not exceed the specified burden of the said Transformers.

TC 17.10 Metering Points

TC 17.10.1 Whole Current Metering

The Metering Point should be as close as possible to the Interconnection Point.

TC 17.11 CT Metering

The Metering Point shall be at the position of the Current Transformers (CT) used for the metering system. This should be designed to be as close as possible to the Interconnection Point.

Current Transformers should be installed in a separate chamber and must be before the main switch (on the line side). They shall be housed in suitable metal enclosures, and be able to be secured.

Where the Interconnection Point is declared on the outgoing side of a high voltage circuit breaker the metering transformers may be accommodated in that circuit breaker unit.

Where appropriate the Metering Point should be at the same voltage as the

Interconnection Point. Where the Metering Point is at a lower voltage than the Interconnection Point then appropriate loss factors should be calculated to ensure any additional loss is appropriately accounted for.

TC 17.12 Meter Reading and Collection Systems

TC 17.12.1 Meter Reading and Recording Responsibility

It is the responsibility of the System Operator to ensure that meters are read in accordance with the requirements of overall Standard EOS7 in the System Operator s Licence. Meter reading and recording shall be undertaken by a suitable authorised representative of the System Operator.

It is the responsibility of Generators and Large Customers to cooperate with the System Operator in the execution of its responsibilities under this Code.

The Customer shall be provided with access to its billing and consumption records on request.

TC 17.13 Approval of meters

Only meters that have received pattern approval from the Bureau of Standards, Jamaica (BSJ) in accordance with OUR ELE 2005/07 Electricity Meter Testing in
Jamaica - Protocol on Administrative and Testing Procedures, may be used on the System Operator's Transmission System.

TC 17.14 Calibration and Sealing

TC 17.14.1 Calibration

All meters (new meters and repaired meters) rated above 12kVA shall be calibrated and the tolerance adjusted to ensure that it measures as close to zero tolerance as possible prior to field installation.

All meters rated above 12kVA shall be recalibrated every10 years unless they have a manufacturers guaranteed calibration period in which case this period shall be used.

All laboratory calibration shall be undertaken in laboratories accredited by the Bureau of Standards, Jamaica (BSJ).

TC 17.14.2 Traceability

The kilowatt hour standard used to calibrate electricity meters shall be traceable to the 'Systeme Internationale (SI)' at the 'Bureau Internationale des Pois et Measures'. This extends to the calibration of Equipment used to calibrate meters.

TC 17.14.3 Sealing

All meters shall be constructed to enable the meter unit to be sealed to prevent unauthorised access or interference with the operation of the meter or the input terminals of the meter.

Seals applied after calibration shall be marked with the date that recalibration is required. All seals shall include marks that identify the authorised person that sealed the meter.

TC 17.15 Metering Disputes

TC 17.15.1 Meter Inaccuracy

If the metering system is found to be inaccurate more than the allowable error, and the System Operator and the User or Generator fail to agree upon an estimate for the correct reading within a reasonable time (as specified in the relevant PPA) of the Dispute being raised, then the matter may be referred for arbitration by either party in accordance with the relevant PPA.

TC 17.15.2 Meter Accuracy Check

The User has a right to request a meter accuracy check when they consider that the meter may be reading incorrectly, in accordance with the meter testing protocol.

Should a User request more than one accuracy check in a single calendar year and the accuracy is within +/-2% then the System Operator may charge for the additional checks.

TC 17.16 Inspection and Testing

TC 17.16.1 Maintenance Policy

The System Operator shall put in place and implement policy for the inspection and testing and recalibration of all metering Equipment. This policy shall be in accordance with the procedures set out in Sub-section TC 17.3.2 above.

TC 17.16.2 Maintenance Records

The System Operator shall keep all test results, maintenance programme records and sealing records.

TC 17.17 Generator Metering

The Generator shall abide by the conditions of the Generation Code that details the maintenance procedures to be applied in the case of Generator meters. The Generation Code includes provisions on the use of Back-up meters when metering inaccuracies are suspected and on the resolution of metering disputes.

TC 18 TRANSMISSION SYSTEM DATA REGISTRATION

TC 18.1 Data to be Exchanged Between System Operator and User

The following Table provides details of the Schedules covering the data to exchanged between the System Operator and the Users of the Transmission System

Schedule	Data Type	Description	User	Code Section	JPS Procedure
I	User System Data	Electrical parameters relating to Plant and Apparatus connected to the Transmission System	JPS	TC 7.4.11 TC 5.3	EI 3.1 SOPP 4 SOPP 7 SOPP 9
II	Load Characteristics	The estimated parameters of loads in respect of, for example, harmonic content, frequency response.	JPS	TC 3.3 TC 3.17	
III	Demand profiles and Active Energy	Total demand and Active Energy taken from the Transmission System	JPS	TC 3.3 TC 3.17 TC 5.3 DSC 3.3 GC 8.1	
VI	Fault Infeed	Information on Short Circuit contribution to the Transmission System.	JPS **DC** GEN	TC 3.3 TC 3.17	

Schedule I – Users System Data

The data in this Schedule I is required from all Users interconnected directly to the Transmission System.

Data Description	Units	Code Section	JPS Instruction/Procedure
Operation Line Diagram Single Line Diagram showing all existing and proposed equipment and Apparatus and Interconnections together with equipment rating	Drawing	TC 5.3	SOPP 9
Site Responsibility Schedules	Schedule	TC 5.3	
Safety Coordinators	Text	**DSC 12**	
Reactive Compensation Equipment For all reactive compensation equipment connected to the User System at [12kV] and above, other than Power Factor correction equipment associated directly with a Customer Plant, the following details Type of equipment (e.g. fixed or variable) Capacitive rating Inductive rating Operating range Details of any automatic control logic to enable operating characteristics to be determined Point of Interconnection to the User System in terms of electrical location and System voltage	Text MVar Mvar Mvar Text and/or Diagrams Text	TC 5.3	SOPP 4 SOPP 7
Switchgear For all switchgear (i.e. circuit breakers, switch disconnectors and isolators) on all circuits Directly Connected to the Interconnection Point including those at Production Facilities Rated voltage	kV kV kA kA	TC 5.3	SOPP 7

Operating voltage Rated short-circuit breaking current Single phase Three phase				
Rated load brreaking current Single phase Three phase		 kA kA		

Data Description	**Units**	**Code Section**	**JPS Instruction/ Procedure**
HV Motor Drives Following details are required for each HV motor drive connected to the User System Rated VA Rated Active Power Full Load Current Means of starting Starting Current Motor torque/speed characteristics Drive torque/speed characteristics Motor plus drive inertia constant	 MVA MW kA Text kA	TC 5.3	SOPP 7
User Protection Data Following details relates only to protection equipment which can trip, inter-trip or close any Interconnection Point circuit breaker or any System Operator circuit breaker A full description including estimated settings, for all relays and Protection systems installed or to be installed on the User System A full description of any auto-reclose facilities installed on the User System, including type and time delays The most probable fault clearance time for electrical faults	 Text Text Ms	TC 5.3	SOPP 7

on any part of the User System Directly Connected to the			
Trasmission System			
Transient Over-Voltage Assessment Data			
When requested by JPS, each User is required to submit			
data with respect to the Interconnection Site as follows			
(undertaking insulation co-ordination studies)			
Busbar layout, including dimensions and geometry	Diagram		
together with electrical parameters of any associated			
current transformers, voltage transformers, wall bushings,			
and support insulators			
Physical and electrical parameters of lines, cables,	Text	TC 5.3	SOPP 7
transformers, reactors and shunt compensator equipment			
Connected at that busbar or by lines or cables to the			
busbar (for the purpose of calculating surge impedances)			
Specification details of connected directly or by lines and	Text		
cables to the busbar including basic insulation levels			
Characteristics of over-voltage protection at the busbar	Text		
and at the termination of lines and cables connected at the busbar			

Schedule VI – Fault Infeed Data

The following information is required from each User who is connected to the Transmission System via a Interconnection Point where the User System contains Embedded Generating Unit(s) and/or motor loads. The data is required for the three following years

Data Description	Units	Update Time	Data Category

Short Circuit Infeed to Transmission System from User System at a Interconnection Point

Name of Interconnection Point: _____

Symmetrical three-phase short circuit current infeed:

o At instant of fault

After sub-transient fault current contribution has substantially decayed

Zero sequence source impedance values as seen from the Interconnection Point consistent with the maximum infeed above:

Resistance (R)

Reactance (X)

Positive sequence X/R ratio at instant of fault

Schedule VIII – Generator Planning Parameters Data

Generating Facility Name: _____

The following details are required from each Generating Facility directly connected, or to be directly connected, to the Transmission System and/or an existing, or proposed, Embedded Generating Facility. The data shall be supplied for the following 3 years.

The data in the following table shall be supplied for each generating unit.

Data Description	Units	Update Time	Data Category
9. Generator Performance Chart at stator terminals	Chart		
11. Short circuit ratio			
13. Rated field current at Rated MW and MVAr output and at rated terminal voltage	A		
14. Field current open circuit saturation curve as derived from appropriate manufacture's test certificate			
o 120% rated terminal voltage	A		
o 110% rated terminal voltage	A		
o 100% rated terminal voltage	A		
o 90% rated terminal voltage	A		
o 80% rated terminal voltage	A		
o 70% rated terminal voltage	A		

o 60% rated terminal voltage	A		
o 50% rated terminal voltage	A		

	Daata Description	Units	Update Time	Data Category
	Generator Transformer			TC 7.5
1	Rated Apparent Power	MVA		
2	Rated voltage ratio			
3	Winding arrangement			
4	Vector group			
5	Positive sequence resistance			
	@ maximum tap	% on MVA		
	@ minimum tap	% on MVA		
	@ nominal tap	% on MVA		
6	Positive sequence reactance	Positive sequence reactance		
	@ maximum tap	% on MVA		
	@ minimum tap	% on MVA		
	@ nominal tap	% on MVA		
7	Zero phase sequence reactance	% on MVA		
8	Tap changer range	%		
9	Tap changer step size	%		
10	Tap changer type (i.e on-load or off-load)	On/Off		

	Data Description	Units	Update Time	Data Category
	Excitation Control System Parameters			TC 7.5
1	Exciter category (e.g. rotating or static)	Text		
	Details of Excitation System described in block diagram Diagram showing transfer functions of individual elements (including Powr System Stabiliser if fitted).			
5	Excitation System on-load positive ceiling voltage	V		
	Data Description	Units		
6	Excitation System no-load negative ceiling voltage	V		
7	Power System Stabiliser fitted?	Yes/No		
8	Details of over excitation limiter described in block diagram showing transfer functions of individual elements.	Diagram		
9	Details of under excitation limiter described in block diagram showing transfer functions of individual elements	Diagram		

TC APPENDIX A - SITE RESPONSIBILITY SCHEDULES

SITE RESPONSIBILITY SCHEDULES

At all Interconnection Sites the following Site Responsibility Schedules shall be drawn up using the pro-forma attached or with such variations as may be agreed between the System Operator and Users, and in the absence of agreement the pro-forma attached shall be used: i) Schedule of HV Apparatus ii) Schedule of Plant, LV Apparatus, services and supplies; iii) Schedule of telecommunications and measurements Apparatus.

Other than at Generating Unit and Power Station locations, the schedules referred to in (ii) and (iii) above may be combined.

Each Site Responsibility Schedule for a Interconnection Site shall be prepared by the System Operator in consultation with other Users at least 2 weeks prior to the Completion Date under the Interconnection Agreement for that Interconnection Site. Each User shall, in accordance with the timing requirements of the Interconnection Agreement, provide information to the System Operator to enable it to prepare the Site Responsibility Schedule.

Each Site Responsibility Schedule shall detail for each item of Plant and Apparatus;

i. Item of Equipment Using the agreed Numbering and Nomenclature in accordance with Sub-section TC 15.

ii. Equipment Owner identifies the party that owns the Equipment under common law;

iii. Safety Rules identifies whether the System Operator s or User s Safety Rules shall be applied to the Equipment.

iv. Operational Procedures identifies whether System Operator or Users personnel shall be responsible for Operations on the Equipment. Note that if this is System Operator, it does not preclude the System Operator from authorising Users personnel from acting on it behalf and vice versa.

v. Control Responsibility. This identifies whether the System Control used shall be the System Operators or the Users.

vi. Maintenance Responsibility. This identifies whether the System Operator or the User is responsible for the inspection and maintenance of the Equipment.

vii. Access and Security. This identifies whether the System Operator or the User shall be responsible for the establishment and maintenance of perimeter fencing and any manned access security for the protection of the public and to prevent malicious entry. Access to operational areas of the site shall be restricted to persons duly authorised in accordance with the prevailing Safety Rules.

The HV Apparatus Site Responsibility Schedule for each Interconnection Site must include lines and cables emanating from the Interconnection Site.

Every page of each Site Responsibility Schedule shall bear the date of issue and the issue number.

When a Site Responsibility Schedule is prepared it shall be sent by System Operator to the Users involved for confirmation of its accuracy.

The Site Responsibility Schedule shall then be signed on behalf of System Operator by the Manager responsible for the area in which the Interconnection Site is situated and on behalf of each User involved by its Responsible Manager, by way of written confirmation of its accuracy. Once signed, two copies shall be distributed by System Operator, not less than two weeks prior to its implementation date, to each User which is a party on the Site

Responsibility Schedule, accompanied by a note indicating the issue number and the date of

implementation.

Attachment to Appendix A: PRO FORMA for SITE RESPONSIBILITY SCHEDULE

COMPANY :

INTERCONNECTION SITE :

Item of Equipment	Equipment Owner	Safety Rules	Operational Procedures	Control Responsibility	Maintenance Responsibility	Access and Security	Comments

Signed on behalf of the System Operator Date ..

Signed on behalf of the User

TC APPENDIX B - PROCEDURES RELATING TO OPERATION DIAGRAMS

Basic Principles

a. Where practicable, all the HV Apparatus on any Interconnection Site shall be shown on one Operation Diagram. Provided the clarity of the diagram is not impaired, the layout shall represent as closely as possible the geographical arrangement on the Interconnection Site.

b. Where more than one Operation Diagram is unavoidable, duplication of identical information on more than one Operation Diagram must be avoided.

c. The Operation Diagrams must show accurately the current status of the Apparatus, e.g whether commissioned or decommissioned. Where decommissioned, the associated switch bay shall be labelled "spare bay".

d. Provision shall be made on the Operation Diagram for signifying approvals, together with provision for details of revisions and dates.

Apparatus to be shown on Ownership Diagrams.

1. Busbars
2. Circuit Breakers
3. Disconnector (Isolator) and Switch Disconnectors (Switching Isolators)
4. Disconnectors (Isolators) - Automatic Facilities
5. Bypass Facilities
6. Earthing Switches
7. Maintenance Earths
8. Overhead Line Entries
9. Overhead Line Traps
10. Cable and Cable Sealing Ends
11. Generating Unit
12. Generator Transformers
13. Generating Unit Transformers, Station Transformers, including the lower voltage circuit-breakers
14. Synchronous Compensators
15. Static Var Compensators
16. Capacitors (including Harmonic Filters)
17. Series or Shunt Reactors
18. Grid Transformers
19. Tertiary Windings
20. Earthing and Auxiliary Transformers
21. Three Phase VTs

22. Single Phase VT & Phase Identity
23. High Accuracy VT and Phase Identity
24. Surge Arrestors/Diverters
25. Neutral Earthing Arrangements on HV Plant
26. Fault Throwing Devices
27. Quadrature Boosters
28. Arc Suppression Coils
29. Current Transformers (where separate Plant items)
30. Wall Bushings

Use of Approved Graphical Symbols

All graphical symbols to be used in the Operation Diagrams shall be approved by the System Operator.

TC APPENDIX C TECHNICAL REQUIREMENTS FOR UNDER FREQUENCY RELAYS

Technical Requirements for Under Frequency Relays

The Interconnection Agreement shall specify the manner in which Demand at the User s Site, subject to Automatic Load Disconnection (separate from the System Operator s under frequency load shedding scheme), shall be actuated by Under-frequency Relays.

[1] Under Frequency Relays shall have a frequency setting range of 46.0 to 52.0Hz and be suitable for operation from a nominal AC input of 63.5, 110 or 240V.

[2] The following general parameters on the requirements of approved Frequency Relays for automatic installations is given as an indication to the provisions that may be included in a Interconnection Agreement:

a. Frequency settings: 46-52Hz in steps of 0.01Hz;

b. Measurement period: Within a minimum selectable settings range of 3 to 7 cycles;

c. Operating time: Between 100 and 160ms dependent on measurement period setting;

d. Voltage lock-out: 20 to 90% of nominal voltage;

e. Facility stages: Four stages of frequency operation;

f. Output contacts: Two output contacts per stage.

[3] The voltage supply to the Under Frequency Relays shall be derived from the Transmission System at the supply point concerned so that the frequency of the Under Frequency Relays input voltage is the same as that of the primary System. This requires either:

a. the use of a secure supply obtained from voltage transformers directly associated with the Transmission System interconnection transformer(s) concerned, the supply being obtained where necessary via a suitable automatic voltage selection scheme; or

b. the use of the substation 110V phase-to-neutral selected auxiliary supply, provided that this supply is always derived at the Interconnection Point concerned and is never derived from a standby generator or from another part of the User System.

[4] The tripping facility should be engineered in accordance with the following reliability considerations:

a. Dependability: Failure to trip at any one particular demand shedding point shall not harm the overall operation of the scheme. However, many failures would have the effect of reducing the amount of Demand under low frequency control. An overall reasonable minimum requirement for the dependability of the Demand shedding scheme is 96%, i.e. the average

probability of failure of each Demand shedding point should be less than 4%. Thus the Demand under low Frequency control shall not be reduced by more than 4% due to relay failure.

Outages: Low frequency Demand shedding schemes shall be engineered such that the amount of Demand under control is as specified by the System Operator and is not reduced unacceptably during equipment outage or maintenance conditions.

TC APPENDIX D FORM OF SIGNIFICANT INCIDENT REPORT

Form of Significant Incident Report

[1] Time and date of Significant Incident;

[2] Location;

[3] Pant or Apparatus directly involved (not merely affected by the Incident) including numbers and nomenclature;

[4] Description of Significant Incident including probable causes and any damage to Plant or Apparatus;

[5] Demand in MW and/or Generator output in MW interrupted and duration of interruption;

[6] Generator change in availability;

[7] Generator Frequency response (MW correction versus time achieved subsequent to the Significant Incident);

[8] Generator Mvar performance (change in output subsequent to the Significant Incident);

[9] Estimated or actual time and date of return to service and/or return to preIncident availability; and

[10]Any other relevant material.