GRID CODE

FOR ELECTRICITY TRANSMISSION & DISTRIBUTION SYSTEMS

ISSUE 1

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BELCO

This publication constitutes the full Grid Code for the Electricity Transmission and Distribution System in Bermuda

PREFACE

PREF1 Background

PREF1.1 The Electricity Act 2016 (Act) became operative on 28 October 2016 and introduced a new regulatory framework for electricity in Bermuda.

PREF1.2 The purposes of the Act are set out in section 6 of the Act and include:

a) ensuring the adequacy, safety, sustainability and reliability of electricity supply in Bermuda.

b) encouraging electricity conservation and efficient use of electricity.

c) promote the use of cleaner energy sources and technologies.

d) providing non-discriminatory interconnection to transmission and distribution systems.

e) protecting the interests of end-users with respect to prices and affordability and the adequacy, reliability and quality of electricity service.

f) promoting economic efficiency and sustainability in the generation, transmission, distribution and sale of electricity.

PREF1.3 The Act transferred responsibility for regulation of the electricity sector from the Energy Commission to the Regulatory Authority (Authority) and also established a framework by which future investments in the production and sale of electricity can be evaluated and regulated. Unlike the Energy Commission, which had a remit limited to the regulation of BELCO's customer rates, the Authority has extensive powers and functions relating to its role in monitoring and regulating the electricity sector.

PREF 1.4 The functions of the Authority include those necessary to achieve the purposes of the Act set out in section 6 of the Act. In addition, pursuant to section 12 of the RAA , the Authority is charged with promoting and preserving competition; promoting the interests of residents of Bermuda and consumers; promoting the development of the Bermudian economy, Bermudian employment and Bermuda ownership and promoting innovation.

The responsibilities of the Authority include:

a) Licensing Bulk Generation.

b) Licensing the transmission, distribution and retail sale of electricity.

c) Managing the new Integrated Resource Plan process, including public consultation.

d) Regulating rates and charges for wholesale purchase and retail sales of electricity.

e) Setting service and performance standards.

PREF2 Current Situation

PREF2.1 BELCO owns and operates the Transmission System and Distribution System, along with one of the Bulk Generation Facilities in Bermuda.

PREF2.2 The existing electricity systems in Bermuda have evolved in a conventional manner. A central power station generates the majority of electricity and supplies the Transmission System operating at voltages of 33 kilovolts (kV) and 22 kV. An extensive Distribution System operating at 4.16 kV and Low-Voltage (LV) supplies the majority of Customers. A limited number of Customers are connected directly to the Transmission System.

As of 2018, the electricity Grid System is comprised of some 255 miles of High-Voltage underground cables, 545 miles of High-Voltage overhead lines, 370 miles of Low-Voltage overhead lines and 34 transmission substations. The electricity systems supply 35,869 metered Customers. Peak demand is expected to be 111 MW and 635 gigawatt hours (GWh) of electricity supplied.

NOTE: The term ‘substation’ refers to a 22 kV/4.16 kV substation. 4.16 kV/Low-Voltage transformation sites are called ‘vaults’.

Currently, BELCO’s Bulk Generation Facility at the central power station (the ‘Bulk Generation Facility’) includes 17 individual Generation Units with a total aggregated Capacity of some 160 MW.

PREF2.3 The Authority granted a Transmission, Distribution and Retail Licence (TD&R Licence) and a Bulk Generation Licence to the Bermuda Electric Light Company Limited (BELCO) on 27 October 2017.

PREF2.4 Although only one TD&R Licence can be granted at any one time, any number of Bulk Generation Licences may be granted. As such, under the Act, other prospective Bulk Generation Licence Holders can consider the opportunities for Bulk Generation in Bermuda and apply for Bulk Generation Licences themselves.

PREF3 The Grid Code

PREF3.1 The TD&R Licence conditions require the TD&R Licensee to develop a Grid Code (this document) for approval by the Authority pursuant to condition 22 of the TD&R Licence. There is also a requirement on the TD&R Licensee to periodically review the Grid Code and its implementation, in consultation with those liable to be materially affected by its requirements, within two years from the granting of the TD&R Licence and, thereafter, every five years or less as determined by or upon the request of the Authority pursuant to condition 22 of the TD&R Licence.

PREF3.2 The Grid Code is intended to cover all foreseeable technical aspects arising from:

a) Connections to the Grid System.

b) Operation and use of the Grid System.

c) Dispatch and scheduling of generation connected to the Grid System.

d) Statutory requirement for the safe and reliable operation of the Grid System.

e) Statutory requirement for the safe and reliable operation of Bulk Generation.

f) Statutory requirement for the Grid System to be designed to ensure that all Bermuda residents have access to a supply of electricity.

PREF3.3 The Grid Code is intended to ensure that the purposes of the Act are met.

PREF3.4 The Grid Code has been developed to satisfy those requirements. It has been structured to facilitate ease of use and has been written to enable Users to interpret requirements unambiguously.

PREF4 Structure and Objectives of the Grid Code

General Conditions (GC)

The General Conditions section of the Grid Code (General Conditions) contains those rules and provisions that apply across all other sections of the Grid Code. Their use should ensure that all sections of the Grid Code are applied consistently and fairly to all relevant parties.

Planning Code (PC)

The objectives of the Planning Code are to:

a) enable the Grid System to be planned, designed and constructed to operate economically, securely, in a stable and safe manner.

b) facilitate the use of the Grid System by others and to specify a standard of supply to be provided.

c) provide sufficient information for a User to assess opportunities for connection and to plan and develop their Facility so as to be compatible with the Grid System.

d) formalise system planning data requirements.

NOTE: The Planning Code and data requirements are intended to cover both short-term and longer-term projection of loads, demand and generation that need to be taken into account in planning the Grid System.

Connection Code (CC)

The objective of the Connection Code is to specify the minimum technical, design and operational requirements to ensure that the basic rules for connection to the Grid System are the same for all Users of the same category and to enable the TD&R Licensee to comply with its obligations.

Operations Code (OC)

The objective of the Operations Code is to ensure that the TD&R Licensee has sufficient data from the Users to effectively operate the electricity system safely, effectively and economically. This includes demand forecasting.

Requirements for Generators (RFG)

The objective of the Requirements for Generators Code is to specify the minimum technical, design and operational requirements applicable to generation to ensure that the basic rules for connection of any Generator, of any type, to the Grid System are the same for all Users of the same category and to enable the TD&R Licensee to comply with its obligations.
These requirements are in addition to those of the Connection Code, which also apply to Generator connections.

Requirements for Energy Storage (RFES)

The objectives of the Requirements for Energy Storage Code are to:

a) define any specific requirements to be satisfied before Energy Storage Installations can be connected to the Grid System.

b) facilitate the use of Energy Storage Installations, where appropriate, to help reduce emissions of greenhouse gases, to improve security of supply and to maintain adequate supply standards.

These requirements are in addition to those of the Connection Code, which also apply to energy storage connections.

Definitions and Glossary

The Definitions and Glossary section defines the technical, formal and legislative terms used elsewhere in the Grid Code that require a particular interpretation.

Annexes

The Annexes contain detailed technical information and processes that are material to understanding requirements of the Grid Code.

The General Conditions, Definitions and Glossary and Annexes apply to all sections of the Grid Code.

GENERAL CONDITIONS

GC1 Introduction

Each individual section of the Grid Code contains the rules and provisions relating to that part of the Grid Code. These General Conditions (GC) specify those rules and provisions of a more general nature that apply across all Codes.

GC2 Objective

The objective of the General Conditions is to ensure that all sections of the Grid Code are applied consistently and fairly to all relevant parties.

GC3 Scope

The General Conditions of the Grid Code apply to:

a) all existing Users connected to the Grid System.

b) all prospective Users including those applying for connection to the Grid System.

c) the TD&R Licensee, in so far as the requirements are appropriate to meeting the conditions of its TD&R Licence and to operation of the Grid System.

GC4 Governance Arrangements

GC4.1 Grid Code

The TD&R Licensee is responsible for producing, implementing, reviewing and revising the Grid Code, in accordance with the requirements of its TD&R Licence.

GC4.2 Compliance and Enforcement

GC4.2.1 The TD&R Licensee shall monitor compliance with the Grid Code and shall take appropriate action to ensure compliance. Whilst acting in this capacity, the TD&R Licensee shall not unfairly discriminate against or favour any User.

GC4.2.2 The TD&R Licensee shall record any material breach of the Grid Code including: the nature of the breach, the circumstances leading to the need to take action, the rationale for and details of the action taken. The TD&R Licensee shall make available records to the Authority of any action taken.

GC4.2.3 Users shall provide any information, access and services/facilities required, which relate to their site, Facility or equipment, as the TD&R Licensee may reasonably request to carry out its responsibilities.

GC4.2.4 In the event of any inconsistency of requirements between the Grid Code and other related documents, the following order of precedence shall apply.

1. The Act.
2. Regulations and orders made by the Minister responsible for energy.
3. General or other administrative determinations made by the Authority.
4. Applicable licences issued pursuant to the Act.
5. Grid Code.
6. Grid Connections Policy.
7. Connection Agreement or Standard Contract (as applicable).
8. Power Purchase Agreement / Power Purchase Arrangement.

GC4.2.5 The standards referenced in the Grid Code are not intended to be applied retrospectively to a User's equipment/Facility that existed at the date of implementation or date of subsequent modification of the Grid Code, unless expressly stated otherwise in the relevant Grid Code Condition. A new connection, or material change(s) to any existing connection, to the Grid System shall comply with that issue of the Grid Code that is approved and being enforced at the date the connection / material change is accepted by the TD&R Licensee.

GC4.3 Modifications to the Grid Code

GC4.3.1 Any User or the TD&R Licensee may submit a proposal for modification of the Grid Code, which should include the justification and rationale for the proposed modification. The TD&R Licensee shall, within 90 days, consider the proposal and determine whether the proposed modification better facilitates the objectives of the Grid Code.

GC4.3.2 The TD&R Licensee shall consult with Interested Parties to seek their views on any proposed modification to the Grid Code. The consultation period shall not be less than 30 days.

GC4.3.3 The TD&R Licensee may establish a suitable working group of appropriate Interested Parties to consider, and where necessary, develop the proposed modification.

GC4.3.4 Where the TD&R Licensee considers that the proposal for modification does not better facilitate the objectives of the Grid Code and should not be actioned then it shall make its decision, including the reasons for the decision, known to the proposer and Interested Parties.

GC4.3.5 Where the TD&R Licensee considers that the proposal for modification better facilitates the objectives of the Grid Code then it shall send the proposed modification together with the likely impact on Users, without undue delay, to the Authority for approval.

GC4.3.6 Subject to the approval of the Authority the TD&R Licensee shall implement the modification within 60 days of the approval date or, if later, by a date

agreed with the Authority. Details of the Approved modification and date for proposed implementation will be posted on the TD&R Licensee's website and in the Royal Gazette.

GC4.3.7 Where an Interested Party does not agree with a decision or proposal for modification of the Grid Code by the TD&R Licensee, the Interested Party may raise a dispute with the TD&R Licensee without undue delay. The Interested Party shall submit its reasons for the dispute and, where appropriate, its revised proposal. The TD&R Licensee shall reconsider its decision or proposal in light of the dispute that has been raised with a view to resolving the dispute. In the event the dispute cannot be resolved, the TD&R Licensee shall refer the dispute to the Authority for resolution, as provided for in Section 57 or Section 58, as applicable, of the RAA.

GC5 Emergency Situations

GC5.1 Where the TD&R Licensee considers it necessary to ensure the safety or stability of the Grid System, or for other unforeseen Emergency situations, the TD&R Licensee may suspend all or part of the Grid Code but only for as short a period as necessary taking the circumstances into account.

GC5.2 Where reasonably practicable, the TD&R Licensee shall notify the Authority of its decision to suspend all or part of the Grid Code prior to taking such action. Where it is not reasonably practicable to provide prior notice, the TD&R Licensee shall notify the Authority as soon as practicable after the suspension has been applied.

GC6 Disconnection Under Certain Circumstances

GC6.1 The TD&R Licensee shall have the power to disconnect any User at any time, where the TD&R Licensee considers:

a) a User is non-compliant with the Grid Code.

b) a User's equipment/Facility poses a safety risk.

c) a User's equipment/Facility threatens the security or stability of the Grid System.

d) a User's connection is having an adverse impact on other Users.

GC6.2 Before undertaking any such disconnection, the TD&R Licensee shall endeavour to reach agreement with the User to correct any deficiency with the User's equipment/Facility within a reasonable timeframe, where practicable.

GC6.3 A User that fails to correct any deficiency with its equipment/Facility, when instructed by the TD&R Licensee, may be disconnected and may not be reconnected until the TD&R Licensee's Instructions have been complied with.

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GC7 Unforeseen Circumstances

GC7.1 Where unforeseen circumstances arise, for example a Force Majeure Event, and compliance with the provisions in the Grid Code is considered to be impracticable, the TD&R Licensee shall, where reasonably practicable in the circumstances, consult promptly and in good faith with all affected Users to reach agreement on what action should be taken. If the TD&R Licensee and the affected Users are unable to reach agreement in the time available, the TD&R Licensee shall determine what action is to be taken.

GC7.2 Where the TD&R Licensee makes such a determination under Grid Code Condition GC7.1, it shall do so taking into account the opinions expressed by the affected Users and what is reasonable under the prevailing circumstances.

GC7.3 Users shall comply with all Instructions issued by the TD&R Licensee following such a determination under Grid Code Condition GC7.1 provided that the Instructions are reasonable for the User's particular equipment/Facility.

GC7.4 The TD&R Licensee shall promptly advise the Authority of any unforeseen circumstances and of any determination made.

GC7.5 The TD&R Licensee shall consider matters concerning unforeseen circumstances thoroughly and determine whether or not a modification to the Grid Code should be proposed.

GC7.6 Where a dispute arises under Grid Code Condition GC7, the TD&R Licensee shall refer the dispute to the Authority for resolution, as provided for in Section 57 or Section 58, as applicable, of the RAA.

GC8 Communications Between Parties

GC8.1 Unless otherwise specified in the Grid Code, communication protocols (other than relating to the submission of data and notices) shall be agreed between the TD&R Licensee and User. For Bulk Generation, these protocols will be communicated in the Connection Agreement and/or Power Purchase Agreement/Arrangement.

GC8.2 The TD&R Licensee shall communicate the means by which third parties, including Users, report incidents associated with the Grid System and report interruptions in supply (see Grid Code Condition OC7.6).

GC9 Data and Notices

GC9.1 Unless otherwise specified in the Grid Code, the TD&R Licensee shall, from time to time, specify the data and information to be supplied by Users to the TD&R Licensee together with any required timeframes.

GC9.2 Unless otherwise specified in the Grid Code, the TD&R Licensee shall, from time to time, specify the data and information to be supplied by the TD&R Licensee to Users together with any required timeframes.

GC9.3 Unless specified otherwise in the Grid Code; i) Connection Agreements; ii) Power Purchase Agreements/Arrangements, iii) data or notices to be exchanged between the TD&R Licensee and a User; and iv) an agreement or approval to be obtained from the TD&R Licensee shall be in writing.

GC9.4 The TD&R Licensee and Users shall comply with any relevant sections of the Personal Information Protection Act 2016 (PIPA) and, until all provisions of PIPA are operative, shall comply with any data protection obligations imposed in any administrative determinations issued by the Authority.

GC10 Integrated Resource Plan

GC10.1 Grid Code provisions shall consider the criteria and constraints stated in the Integrated Resource Plan as appropriate.

GC11 Interpreting the Grid Code

GC11.1 In the event that any User requires additional interpretation of the intention and application of any provision of the Grid Code, they may apply to the TD&R Licensee for such interpretation. Provided that the request is reasonable, the TD&R Licensee shall provide the User with an interpretation of the relevant provision.

GC11.2 In the event that the User, acting reasonably, considers that an interpretation provided by the TD&R Licensee pursuant to GC11.1 is incomplete, the User may request additional clarification from the TD&R Licensee.

GC11.3 In the event that the User, acting reasonably, considers that an interpretation provided by the TD&R Licensee is unreasonable or incorrect, the User may require the TD&R Licensee to refer the matter to the Authority.

PLANNING CODE

PC1 Introduction

This Planning Code (PC) specifies the technical and design criteria and the rules and procedures to be complied with by the TD&R Licensee for the design, planning and development of the Grid System. It also applies to Users of the Grid System in the planning and development of their Facilities insofar as they affect the Grid System.

PC2 Objective

The objectives of the Planning Code are to:

a) enable the Grid System to be planned, designed and constructed to operate economically, securely, in a stable manner and safely.

b) facilitate the use of the Grid System by others and to specify a standard of supply to be provided.

c) provide sufficient information for a User to assess opportunities for connection and to plan and develop its Facility so as to be compatible with the Grid System.

d) formalise system planning data requirements.

PC3 Scope

The Planning Code specifies the planning and design requirements for the Grid System.

The Planning Code applies to those who use or intend to use the Grid System and comprise of the following:

a) Bulk Generation Licence Holders.

b) Distributed Generators.

c) Customers with load connections including those with non-metered supplies.

The Planning Code applies to the TD&R Licensee exclusively insofar as those requirements that are explicitly assigned to it.

PC4 Design Principles and Standards

PC4.1 General Requirements

Planning criteria shall take into account the requirements of Condition 14 of the TD&R Licence. Where no applicable standards are available in this Grid Code, the TD&R Licensee will advise on planning criteria, based on international practices that would be expected of a reasonable and prudent

Grid System operator. In the event that the TD&R Licensee proposes a planning criterion for new connections that is not covered in the Grid Code, a Grid Code modification may be proposed, as per Grid Code Condition GC4.3.

PC4.2 Standards of Supply

PC4.2.1 System Voltage

PC4.2.1.1 Grid System nominal voltages shall be:

a) Low-Voltage:

i) 120 V phase to neutral, 208 V phase to phase (three-phase connection).

ii) 120 V phase to neutral, 240 V phase to phase (two-phase connection).

iii) 277 V phase to neutral, 480 V phase to phase (three-phase connection).

b) High-Voltage distribution:

i) 2,402 V phase to neutral, 4,160 V phase to phase.

c) High-Voltage transmission:

i) 12,701 V phase to neutral, 22,000 V phase to phase.

ii) 19,052 V phase to neutral, 33,000 V phase to phase.

PC4.2.1.2 The declared supply voltage shall be the nominal voltage of the supply provided to the User.

PC4.2.1.3 The Grid System shall be designed so that under:

a) Normal Operating Conditions, Distribution System voltages at the User's Point of Supply are within ± 6% of the declared supply voltage.

b) Planned Contingency Conditions, Distribution System voltages at the User's Point of Supply are within ± 10% of the declared supply voltage.

c) Normal Operating Conditions, Transmission System voltages are within ± 10% of the declared supply voltage, with moments of variability to maintain system integrity.

PC4.2.2 System Frequency

PC4.2.2.1 The fundamental frequency of the supply voltage shall be 60 Hz.

PC4.2.2.2 Under Normal Operating Conditions the mean value of the fundamental frequency measured over 10 seconds shall be within the range of 60 Hz ±1%.

PC4.2.2.3 Under abnormal operating conditions the TD&R Licensee will endeavour to keep the fundamental frequency within the range 60 Hz -6% / +4%. As such the equipment/Facility shall be capable of sustained operation within this frequency range.

NOTE: In practice, under abnormal conditions, sustained operation of the Grid System can be generally expected at frequencies between 62.4 Hz and 58.3 Hz. If the fundamental frequency falls below 58.3 Hz then automatic load shedding will be initiated to assist with increasing the frequency of the Grid System. If the fundamental frequency continues to fall then at 56.4 Hz all remaining generation will be tripped.

PC4.2.2.4 Users shall ensure that any Generation Unit operating in parallel with the Grid System shall automatically disconnect from the Grid System within 0.5 seconds if the fundamental frequency falls below 56.4 Hz unless specified otherwise by the TD&R Licensee in accordance with Grid Code Condition PC4.2.2.7.

PC4.2.2.5 Users shall ensure that any Generation Unit operating in parallel with the Grid System shall automatically disconnect from the Grid System within 0.5 seconds if the fundamental frequency rises above 62.4 Hz.

PC4.2.2.6 The TD&R Licensee may specify different frequency limits to be applied for individual Generation Units. Where this is the case, these limits shall be specified in the Connection Agreement for that individual Generation Unit.

PC4.2.2.7 The TD&R Licensee shall specify specific values for under-frequency and over-frequency trip settings in the individual Connection Agreement for each Generator, where these differ from Grid Code Conditions PC4.2.2.4 and PC4.2.2.5.

NOTE: For User Installations comprising more than one Generation Unit, the TD&R Licensee may require individual Generation Units to disconnect at different frequencies to avoid the possibility of the Grid System becoming unstable due to the loss of all Generation Units tripping at the same values.

PC4.2.3 Power Quality

PC4.2.3.1 Harmonic currents, when measured at the Point of Common Coupling, shall not exceed the values listed within Table PC1 of this Grid Code.

PC4.2.3.2 Where detailed studies of the effects of harmonic distortion are required, measurement activities should follow the requirements of IEC 61000-4-30. Calculations should be undertaken in accordance with IEEE 519 and IEC 61000-4-30.

PC4.2.3.3 Users shall ensure that harmonic distortion arising from any domestic equipment sources within their own Facilities do not exceed the limits in IEC 61000-3-2.

Table PC1 – Planning Limits for Harmonic Distortion

Voltage	Total harmonic distortion (THD)	Individual harmonic distortion
Low-Voltage Nominal voltage ≤ 1,000 V	5 %	4 %
High-Voltage Nominal voltage > 1,000 V and ≤ 4,160 V	4 %	3 %
High-Voltage Nominal voltage > 4,160 V	3 %	2 %

PC4.2.3.4 Harmonic distortion or voltage fluctuations imposed by a User shall not cause any objectionable disturbance to any other User connections. Disturbances shall be considered objectionable when they cause a modulation of the light level of lamps sufficient to be irritating to humans (known as Flicker), cause mal-operation of equipment or cause any other unwanted effects.

PC4.2.3.5 Where the TD&R Licensee considers disturbance to be objectionable, the User may be required to undertake detailed studies/measurements and, where necessary, take reasonable steps to minimise the disturbance.

PC4.2.3.6. Planning limits for Flicker severity at the Point of Common Coupling shall not exceed the values listed in Table PC2 of this Grid Code.

PC4.2.3.7 Where detailed studies of the effects of Flicker are required, measurement activities should follow the requirements of IEC 61000-4-30. Calculations should be undertaken in accordance with IEEE 1453 and IEC 61000-4-30.

PC4.2.3.8 Where voltage fluctuations imposed by a User occur more frequently than twice per hour, voltage fluctuations at the Point of Common Coupling shall not exceed 3% of the nominal voltage.

PC4.2.3.9 Voltage fluctuations greater than 3% of the nominal voltage are permissible only with the prior agreement of the TD&R Licensee. Such voltage fluctuations shall occur no more frequently than twice per hour and no more frequently than four times per day. Subject to compliance with these frequencies of occurrence, the voltage fluctuations at the Point of Common Coupling shall not exceed 5% of the nominal voltage.

PC4.2.3.10 In exceptional situations, for very infrequent voltage fluctuations, the TD&R Licensee may permit voltage fluctuations at the Point of Common Coupling of greater than 5% of the nominal voltage, providing this is not expected to cause objectionable disturbance to any other User or risk of damage to equipment/Facilities.

PC4.2.3.11 The TD&R Licensee may, where necessary, impose more stringent requirements on voltage fluctuations at specific points of connection for new connections.

Table PC2 – Planning Limits for Flicker Severity Value

Voltage	Short-term severity value – P_{st}	Long-term severity value – P_{lt}
Low-Voltage Nominal voltage ≤ 1 000 V	1.0	0.8
High-Voltage Nominal voltage > 1 000 V	0.9	0.7

PC4.2.3.12 The TD&R Licensee may require a User to comply with more stringent emission limits for harmonic currents and voltage fluctuations emanating from within its own Facility to ensure planning levels in the Grid System do not exceed the limits in Table PC1 and Table PC2 of this Grid Code.

PC4.2.3.13 Where deemed necessary and instructed by the TD&R Licensee, the User shall take appropriate action to prevent disturbance to other Users and the Grid System from the effects of harmonic currents and voltage fluctuations emanating from within its own Facility.

PC4.2.3.14 Under Normal Operating Conditions the Voltage Unbalance in the Grid System will generally not exceed 3%.

PC4.2.3.15 A User having a multi-phase Facility shall ensure that its Facility is appropriately balanced across the phases such that Voltage Unbalance measured at its supply terminals does not exceed 2%.

PC4.2.3.16 A User having a multi-phase Facility and exporting onto the Grid System shall ensure that Voltage Unbalance measured at its supply terminals does not exceed 1%.

PC4.2.4 Power Factor

PC4.2.4.1 The Grid System will be planned so that the power factor at the Point of Supply is generally within the range of unity to 0.90 lagging. The User's equipment/Facility shall be planned and selected to obtain the highest practicable power factor. Where the User's equipment/Facility results in a low power factor, the User shall install suitable power factor correction equipment, when required by the TD&R Licensee, so the resultant power factor of the Facility as a whole, at the time of maximum demand, is not less than 0.90 lagging. The output from Generation Units shall comply with the requirements for power factor in Grid Code Condition RFG6.1.10.1.

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PC4.3 Security of Supply

PC4.3.1 Individual Users

PC4.3.1.1 Any specific requirements for security of supply shall be requested by the User with its connection application and will be considered on an individual connection basis by discussion between the User and the TD&R Licensee.

PC4.3.1.2 The User shall decide, during the connection application process and following discussions with the TD&R Licensee, the level of security of supply required for its equipment/Facility.

PC4.3.1.3 The costs of providing a specific level of security of supply for a User connection will be partly dependent upon the nature of the Grid System at the proposed Connection Point and the location and nature of the User equipment/Facility. In general, the greater the level of security of supply required by the User, the greater the cost of the connection to the User will be. The User shall be responsible for paying any additional costs for providing enhanced levels of security of supply above those inherent in the Grid System for the standard Connection Point.

PC4.3.2 Transmission System

PC4.3.2.1 Interconnection to the Transmission System will normally be designed for an 'N-1' level of security of supply under Normal Operating Conditions, where it is considered appropriate and reasonably practicable to meet this level of security.

NOTE: 'N-1' security of supply means that the system is designed such that, under Normal Operating Conditions for any credible Outage/fault of a single item of equipment/feeder, all Customer supplies can be restored by reconfiguring the system.

PC4.3.2.2 Restoration times will generally be within switching times to reconfigure the Transmission System. Where supplies cannot be restored by straightforward reconfiguration of the Transmission System then restoration times will generally be within 24 hours from the initial loss of supply with the exception of adverse weather conditions, Emergency situations and faults with underground cables, where restoration times could be longer.

PC4.3.3 Distribution System

PC4.3.3.1 Planning and design of the Distribution System is currently such, that reliability standards and restoration times are not fully prescribed.

PC4.3.3.2 This does not mean that security of supply at the Distribution System level is discarded but rather the Distribution System is planned and designed taking into account:

a) Geographic location.

b) Feeder connectivity.

c) Customer type and demand.

d) Serviceability of load.

e) Cost of service delivery.

PC4.3.4 High-Voltage Distribution System

PC4.3.4.1 Given the situation detailed in Grid Code Condition PC4.3.3, the High-Voltage Distribution System will generally have 'N-0' security of supply levels. Restoration of supply following an unplanned Outage/fault shall be within the restoration time of the Outage or repair time for the fault. In these cases, the TD&R Licensee shall endeavour to restore supplies without undue delay.

PC4.3.5 Low-Voltage Distribution System

PC4.3.5.1 The Low-Voltage Distribution System will generally have 'N-0' security of supply levels. Restoration of supply following an unplanned Outage/fault shall be within the restoration time of the Outage or repair time for the fault. In these cases, the TD&R Licensee shall endeavour to restore supplies without undue delay.

NOTE: 'N-0' security of supply means that the system is designed such that, for any credible Outage/fault of a single item of equipment/feeder, Customer supplies are liable to interruption. Customers fed from a single transformer generally cannot be restored until the Outage is restored or the fault is repaired.

PC4.4 System Earthing

PC4.4.1 The TD&R Licensee shall ensure that every Grid System neutral conductor is effectively connected to earth.

a) For system conductors the connection with earth shall be at, or as near as reasonably practicable to, the source of voltage.

b) At a Customer connection, the neutral conductor shall be effectively connected to earth at, or as near as practicable to, the service entrance switch.

PC4.4.2 The TD&R Licensee shall ensure that, so far as is reasonably practicable, the Grid System neutral conductor does not become disconnected from earth in the event of any foreseeable fault current.

PC4.4.3 The TD&R Licensee shall ensure that no impedance is inserted in any connection between the neutral of the Low-Voltage Distribution System and earth other than that required for the operation of switching devices, instruments or other equipment for control, telemetry or metering.

PC4.4.4 A User shall not combine neutral conductors and protective earthing conductors within its Facility. Requirements for neutral conductors and protective earthing conductors shall conform to the National Electrical Code (NEC), as applicable to the Facility.

PC4.4.5 A Generator shall ensure that, so far as is reasonably practicable, its Facility does not become disconnected from earth in the event of any foreseeable current due to a fault.

PC4.4.6 A Generator shall, in respect of any High-Voltage equipment/Facility it owns or operates, ensure that:

a) the equipment/Facility is connected with earth at, or as near as is reasonably practicable to, the source of voltage but where there is more than one source of voltage in that Facility, the connection with earth need only be made at one such point.

b) the earth electrodes are designed, installed and used in such a manner so as to prevent danger occurring in any Low-Voltage Facility as a result of any fault in the High-Voltage Distribution System.

c) where the equipment/Facility is connected with earth through a continuously rated arc suppression coil, an automatic warning is given to the Generator of any fault which causes the arc suppression coil to operate.

d) neutral earthing requirements conform to Grid Code Condition RFG6.3.

e) when high-impedance earthing systems are used, they are routinely tested and maintained, as appropriate.

The TD&R Licensee may require specific tests/measurements of ground conditions, where equipment/Facilities are to be connected with earth, to facilitate the planning and design of an effective earth electrode installation/system.

PC4.4.7 A Generator shall, in respect of any Low-Voltage equipment/Facility it owns or operates, ensure that the outer conductor of any electric line which has concentric conductors is connected with earth.

PC4.4.8 The requirements in PC4.4.5, PC4.4.6 and PC4.4.7 shall not apply to a network which is situated within a generation Facility if, and only if, adequate alternative arrangements are in place to prevent danger, which conform with relevant requirements of the National Electrical Code (NEC) or other Approved construction standard.

PC5 Planning Data

PC5.1 Data to be Exchanged

PC5.1.1 General

PC5.1.1.1 In order to develop the Grid System in an efficient, coordinated and economic manner, the TD&R Licensee requires data from certain Users of the system.

All Users connected at High-Voltage, including Distributed Generation and Bulk Generation shall submit data as required by the TD&R Licensee.

Where required by the TD&R Licensee, other Users may be required to submit limited information to the TD&R Licensee. This will be defined by the TD&R Licensee on an individual basis.

PC5.1.1.2 The actual data requirements will vary depending upon the circumstances and the size and complexity of the connection.

Users are required to submit appropriate data, as detailed by the TD&R Licensee, promptly and in sufficient detail to allow the TD&R Licensee to undertake its licence obligations.

PC5.1.1.3 It is acknowledged that, for many Facilities, not all required data will be accurately known at the start of a project. In the early stages, therefore, it is recognised that some data will consist of generic or estimated values. The User is required to continually update the data to ensure that the TD&R Licensee has the most up to date information.

PC5.1.1.4 Data is categorised as:

a) General details.

b) Installation details.

c) Installation design parameters.

d) Generator details.

e) Operational forecasts.

PC5.1.1.5 For a new connection, the required data should be submitted, in varying levels of accuracy, at various phases during the provision of a new connection. The Connection Agreement will then specify on-going data submission requirements.

Typically, for a new connection, preliminary data should be submitted during the enquiry / feasibility phase. As the project moves into detailed design and then to the delivery phase, the data should be updated with detailed, accurate, information. At the Commissioning phase, any estimated data should be replaced with as-installed data. Finally, at or immediately after the final Commissioning phase, any remaining data should be confirmed by the User to the TD&R Licensee.

PC5.1.1.6 The TD&R Licensee will advise existing Installations of any data submission requirements.

PC5.1.1.7 Grid Code Annex 1, Schedules 1-5, specify the data requirements to be provided by all Users, so far as the requirements are applicable to their Installation.

PC5.1.1.8 Schedule 1 – General details

General data consists of details of the User and the site in question. It will include the contact details of any consultant appointed by the User.

PC5.1.1.9 Schedule 2 – Installation details

Installation data consists of the basic technical parameters for the equipment/Installation including load and / or generation characteristics. In conjunction with Schedules 3 and 4, it should provide data in sufficient detail to allow the TD&R Licensee to design a connection for the proposed equipment/Installation and to make a formal connection offer.

PC5.1.1.10 Schedule 3 – Installation design parameters

Installation design parameter data includes the technical parameters of the equipment/Installation in greater detail. It is expected that, for complex Installations, the submission of Installation data may involve a number of

phases – indicative or estimated data at the early stages with actual data being submitted as it becomes available.

PC5.1.1.11 Schedule 4 – Generator details

Generator details type data provides the technical parameters of individual Generation Units. This allows the TD&R Licensee to accurately model the performance of each Generation Unit and to assess the impact on the Grid System.

PC5.1.1.12 Schedule 5 – Operational forecasts

Operational data consists of load and / or generation short-term forecasts (days ahead), medium-term forecasts (weeks ahead) and long-term forecasts (months ahead). Certain Users will also be required to provide retrospective information comparing actual values with forecast values. The TD&R Licensee will use this data to operate the Grid System in an efficient and economic manner, including the Dispatch of generation.

PC5.1.1.13 Timeframe for submission of data:

General data and Installation data shall be supplied prior to an Installation being connected to the Grid System. This data shall be regularly updated as more accurate information becomes available.

Updated Installation data shall be supplied prior to, or immediately after, final Commissioning of the equipment/Installation.

Operational data shall be supplied on a regular and frequent basis in accordance with the timeframes specified in Schedule 5 of Grid Code Annex 1.

PC5.1.1.14 When warranted, in order to allow Users to manage their own Installation in a similar manner, the TD&R Licensee will provide suitable information to individual Users.

PC5.1.1.15 Appropriate information will be exchanged on an annual basis unless the TD&R Licensee determines otherwise.

PC5.1.2 Planning Information to be Provided by the User

PC5.1.2.1 Existing and prospective Users of the Grid System shall provide sufficient information as can reasonably be made available when requested by the TD&R Licensee to enable the TD&R Licensee to fulfil its obligations, including but not limited to, that specified in Grid Code Annex 1. Users shall not intentionally withhold requested information on the basis of confidentiality. The TD&R Licensee shall only release any planning information to third parties where required to do so under its TD&R Licence conditions or for other statutory or legal reasons.

PC5.1.2.2 Where requested by the TD&R Licensee, Users with a demand or export Capacity greater than or equal to 500 kW shall prepare an annual submission detailing demand forecasts for at least three subsequent years. Where accurate data is not available, estimated data shall be used for demand forecasts. Where the User holds information allowing long-term demand forecasts, these should be submitted for a further four subsequent years.

Data beyond the seven-year period will only be requested in exceptional circumstances. Where there are forecast changes in demand, export Capacity, Generator Capacity or electricity storage Capacity, this information shall be included in the submission.

PC5.1.2.3 In addition to the periodic demand forecasts, Users shall give adequate notice of any material planned changes to their equipment, their Installations or the operating regime for the forthcoming 5 years to enable the TD&R Licensee to prepare its capital plan.

This is to ensure the TD&R Licensee has sufficient time to plan, budget for and implement any necessary modifications to the Grid System to accommodate the planned changes to Users' systems and/or to seek additional generating Capacity, if required. Such information should include any changes to demand or Generator Capacity.

PC5.1.2.4 In the event of an unplanned change to a User's equipment/Installation or operating regime, the User shall notify the TD&R Licensee as soon as reasonably practicable to ensure any necessary contingency measures can be implemented.

NOTE: Unplanned changes to a User's equipment/Installation would typically include: installing a potentially Disturbing Load, installing a large motor or reactive load; exceeding the Capacity of the connection and installing Distributed Generation or an Energy Storage Installation.

PC5.1.3 Planning Information to be Provided by the TD&R Licensee

PC5.1.3.1 Where the TD&R Licensee has received any information or data from a User that, in the reasonable opinion of the TD&R Licensee, may have an impact upon the equipment or Installation of any other User, the TD&R Licensee shall notify that other User of any relevant information or data, subject to any confidentiality requirements that apply.

PC5.1.3.2 Where the TD&R Licensee proposes to make any modifications to the Grid System that, in the reasonable opinion of the TD&R Licensee, may have an impact upon the equipment or Installation of any User, the TD&R Licensee shall notify that User of the proposals subject to any confidentiality requirements that apply.

PC5.1.3.3 The TD&R Licensee shall be responsible for advising minimum electrical clearances that need to be maintained from Grid System conductors to the ground and to adjacent buildings, equipment and other objects to ensure the safety of persons and the satisfactory operation of the Grid System. Overhead conductors and wires connected to the Grid System shall not be less than the minimum clearances from ground level, at the lowest point of sag, required by the Public Lands Act 1984, unless permission for a lower clearance has been specifically granted by the Minister responsible.

PC5.1.3.4 At the request of the Authority, the TD&R Licensee will submit a capital plan that sets out the capital projects and expenditures deemed necessary in future years for the sustainable operation of the Grid System. The capital plan will provide information about the development of the Grid System that will assist any person contemplating a future connection to the Grid System. The capital plan will be generally updated annually.

PC5.1.4 Reactive Compensation Plant

PC5.1.4.1 A User shall provide the TD&R Licensee with information concerning any reactive compensation equipment to be directly or indirectly connected to the Grid System (as per Annex 1 Schedule 3), other than at Low-Voltage. The information shall include:

a) the Mvar capacitive or inductive rating of the equipment.

b) the operating range and details of any automatic control logic for variable devices such that the operating characteristics of the equipment can be determined.

c) the Connection Point to the Grid System.

PC5.1.5 Short-Circuit Infeed to the Grid System

PC5.1.5.1 The TD&R Licensee and Users shall exchange information concerning the short-circuit levels at the Connection Point to the Grid System.

PC5.1.5.2 The minimum information to be exchanged shall include the following.

a) Maximum and minimum three-phase symmetrical and phase-earth short-circuit current infeeds.

b) X/R ratio (or Time-Constant) under short-circuit conditions.

c) Equivalent system information, including running arrangements.

PC5.1.5.3 Unless expressly agreed in writing by the TD&R Licensee to the contrary, the User shall not install short-circuit current limiting equipment, where the failure of that equipment could cause any part of the Grid System to operate outside its short-circuit rating.

PC5.1.6 Additional Information

In certain circumstances, additional information may be needed for planning of the Grid System, which shall be provided by Users upon the reasonable request of the TD&R Licensee. Examples of such information may include:

a) interconnection impedance; or

b) such information as is necessary to assess transient over-voltage effects.

PC5.2 Planning Studies

PC5.2.1 The TD&R Licensee will undertake planning studies as required to determine the Interconnection requirements for any User's Installation submitted in accordance with the Interconnection application process (set out in the Grid Connection Policy). This shall include any potential reinforcement, protection or power quality improvement requirements.

PC5.2.2 In assessing the technical requirements of a User's connection, the TD&R Licensee shall not unreasonably discriminate between Users of a similar

category, location or size, although it will not be technically or economically practicable to achieve uniformity of method of connection at all times.

PC5.3 Load Flow Studies

PC5.3.1 The TD&R Licensee will periodically undertake load flow studies using appropriate modelling tools.

PC5.3.2 Load flows will be modelled using peak feeder loads forecast forward to ensure that all Grid System components will operate within their design parameters for the forecast period.

PC5.3.3 Values for load flows shall be based on feeder metering data or SCADA data, where metering data is not available, with forecasts at a feeder level based on regression analysis and forecast forward for an appropriate period.

PC5.3.4 Load flows will be modelled for the contingency scenarios planned for in the Grid System design and will be undertaken to ensure that all Grid System components are operating within their design parameters for all plausible scenarios of supply system reconfiguration.

PC5.3.5 Short-term and emergency ratings of Grid System components may be used if it is considered that the timeframe for restoration to normal operation will be within that for these ratings or within other parameters determined by the TD&R Licensee.

PC5.4 Voltage Studies

PC5.4.1 The TD&R Licensee will undertake voltage studies to determine the voltages at appropriate nodes on the Grid System using appropriate modelling tools. Such studies will be used to determine the impact of any load or generation connections and to determine the need for any extension or reinforcement of the Grid System to ensure system voltages remain within the declared limits stated in this Grid Code.

PC5.4.2 Voltage drops and rises will be modelled at maximum and minimum peak feeder loads to ensure that the design voltage at the Customer supply terminals remains within the declared limits stated in the Grid Code. Values for the load flows shall be based on the feeder metering data, or SCADA data where metering data is not available.

PC5.4.3 Voltage drops will be modelled for the contingency scenarios planned for in the Grid System design and will be undertaken to ensure that the design voltage at appropriate nodes in the Grid System remain within the declared limits stated in this Grid Code for all plausible scenarios of supply system reconfiguration.

PC5.4.4 Any extension or Interconnection shall be designed in such a way that it does not adversely affect the voltage control employed on the Grid System.

PC5.5 Short-Circuit Studies

PC5.5.1 The TD&R Licensee will undertake short-circuit studies at all switching points on the Grid System, where fault interrupting devices are located, and at other appropriate nodes. The studies will determine the three-phase and single-phase to earth short-circuit levels. Studies will be carried out under maximum and minimum plant conditions.

PC5.5.2 The Grid System should normally be designed to ensure that the short-circuit fault current does not exceed 80% of the rated short-circuit current of any switch, fuse, Circuit-Breaker or other protective devices in terms of both breaking and making capacity.

PC5.5.3 Where it is identified that the short-circuit fault current does exceed 80% of the rated short-circuit current of any equipment/device, the situation shall be documented and, if necessary, the affected equipment/device shall be subject to appropriate operational restrictions to preclude switching in excess of its breaking or making capacity.

PC5.5.4 Where it is identified that the design breaking or making capacity is likely to be exceeded, the non-compliance should be documented and the equipment/device shall be subject to appropriate operational restrictions until compliance is achieved. Plans shall also be prepared to ensure the situation is resolved in a timely manner.

PC5.6 Reliability Studies

PC5.6.1 The TD&R Licensee shall determine the levels of reliability of the Grid System using a SAIFI and SAIDI. SAIDI and SAIFI shall have the definitions as described in IEEE Standard 1366-1998.

PC5.6.2 SAIDI is the average Outage duration for each Customer served. It will be declared in minutes for a calendar year period. It will be calculated by summating the duration of all Customer interruptions for the period and dividing by the total number of connected Customers.

PC5.6.3 SAIFI is the average number of interruptions for each Customer served. It will be declared as the number of interruptions per Customer over a calendar year period. It will be calculated by summating the total number of Customer interruptions for the period and dividing by the total number of connected Customers.

PC5.6.4 System reliability studies shall be carried out at the design stage to determine the theoretical reliability levels of the electrical system using average fault rates for the components of the Grid System.

PC5.6.5 System reliability studies will be used to determine the optimum configurations of the electrical system when undertaking any Interconnection, diversion, extension or reinforcement of the Grid System.

PC5.6.6 The TD&R Licensee shall, on an annual basis, calculate and make available the actual reliability of the Transmission System and Distribution System in terms of SAIFI and SAIDI. Where requested by the Authority, the TD&R

Licensee shall calculate and make available the CAIDI and the ASAI. The TD&R Licensee will comply with any determinations issued in relation to the calculation and making available of the levels of reliability of the Grid System pursuant to the Act.

CONNECTION CODE

CC1 Introduction

CC1.1 Certain requirements must be met for connection of User equipment to the Grid System to ensure that the system continues to operate satisfactorily for all Users and that User equipment is protected.

CC1.2 This Connection Code establishes principles and standards that relate to the provision of connections, the method of connection and the technical and performance standards that apply to connections.

CC1.3 Prospective Users of the system, referred to as ‘applicants’, shall make a connection application to the TD&R Licensee. The form of connection application shall be defined in the Grid Connection Policy.

CC1.4 The process for connecting applicants to the Grid System is specified in the Grid Connection Policy.

CC1.5 The Connection Code specifies the information to be provided by Users, including load and generation, in relation to applications for new connections or changes to existing connections. Users shall provide all required information within timeframes defined in the Grid Connection Policy.

CC1.6 The Connection Agreement between the TD&R Licensee and each User shall define specific requirements for connection to and for use of the Grid System. Connection Agreements shall require the TD&R Licensee and the User to comply with the Grid Code.

CC2 Objective

CC2.1 The Connection Code defines minimum requirements for the connection to and for the continued use of the Grid System, including the method of connection and the technical, design and operational standards that Users shall comply with.

CC2.2 The Connection Code specifies the technical arrangements that apply at the interface between the User and the Grid System to ensure the objectives of the Grid Code are met.

CC2.3 The Connection Code defines the types of signals and indications that shall be provided by the Users to the TD&R Licensee.

CC3 Scope

CC3.1 The Connection Code applies to an application for a new connection to the Grid System or a change to an existing connection to the Grid System by Users at any system voltage level(s) covered by the Grid Code.

CC3.2 A standard connection process, as detailed in the Grid Connection Policy, will apply to connections with the following capacity.

Low-Voltage

a) Standard residential and small commercial connections supplied at a nominal voltage of 120 V phase to neutral, 240 V phase to phase (two-phase connection) up to 200 A per phase.

b) Standard Distributed Generation connections (typically for residential and small commercial) supplied at a nominal voltage of 120 V phase to neutral, 240 V phase to phase (two-phase connection) up to 200 A per phase.

c) Standard large commercial connections supplied at a nominal voltage of 120 V phase to neutral, 208 V phase to phase (three-phase connection) up to 600 A per phase.

d) Standard small commercial connections supplied at a nominal voltage of 120 V phase to neutral, 208 V phase to phase (three-phase connection) up to 200 A per phase.

NOTE: Connections supplied at a nominal voltage of 277 V phase to neutral, 480 V phase to phase (three-phase connection) are considered non-standard connections, regardless of being a declared supply voltage, and requirements will be determined by the TD&R Licensee and agreed with the User on a connection by connection basis.

High-Voltage

e) Commercial and Distributed Generation connections at a nominal voltage of 4,160 V three-phase three-wire, typically up to 70 A per phase, for a maximum specified load or export Capacity (as determined during the design of the connection).

CC3.3 Connections with capacities above those in CC3.2 shall be treated as non-standard connections and requirements will be determined by the TD&R Licensee and agreed with the User on a connection by connection basis.

CC4 General Requirements for Connections

CC4.1 Connection Process

CC4.1.1 Prospective Users shall contact the TD&R Licensee in advance when considering any new connection to the Grid System. Users shall contact the TD&R Licensee in advance when considering or making any material change(s) to any existing connection to the Grid System, including changes in Capacity.

CC4.1.2 The TD&R Licensee will request information from the User, as is necessary, to assess the connection and to determine whether it is to be treated as a standard or non-standard connection under the connection process detailed in the Grid Connection Policy.

CC4.1.3 The User shall provide the information within the timeframes requested by the TD&R Licensee for assessing the connection.

CC4.1.4 The User will be required to pay the charges advised by the TD&R Licensee for carrying out such assessments and for providing such information, as

required. Charges will be calculated by the TD&R Licensee in accordance with the Grid Connection Policy.

CC4.1.5 The TD&R Licensee shall make a connection offer to the User detailing the method of connection to the system and any technical requirements that apply to the connection.

CC4.1.6 The provision of a new connection or change to an existing connection shall require a Connection Agreement between the TD&R Licensee and the User.

CC4.1.7 The export of the whole or part of any available Capacity from Bulk Generation to the Grid System shall require a Power Purchase Agreement/Arrangement between the TD&R Licensee and the Generator for purchase of that power.

CC4.1.8 Equipment/Installations shall not be connected to the Grid System until:

a) all Commissioning, so far as are necessary for connection, has been satisfactorily completed.

b) all information and documentation required by the TD&R Licensee has been submitted by the User.

c) the equipment/Installation to be connected has been completed, so far as is necessary for the correct operation, safety and reliability of the Grid System.

d) all necessary approvals, agreements and certificates have been obtained by the TD&R Licensee and User, including those required under regulations made pursuant to the Bermuda Building Code 2015, where applicable.

CC4.2 Information Requirements

CC4.2.1 Low-Voltage Connections

CC4.2.1.1 For Low-Voltage connections, the User shall provide the minimum information requested on the TD&R Licensee's connection application form and/or Connection Agreement, so far as it is applicable to their installation.

NOTE: Grid Code Annex 1 and the Grid Connection Policy provides additional details about the information required.

CC4.2.1.2 In most cases the TD&R Licensee should be able to determine the acceptability and necessary supply arrangement from this information.

CC4.2.2 High-Voltage Connections

CC4.2.2.1 For High-Voltage connections, the User shall provide the following information as a minimum in addition to that required in Grid Code Condition CC4.2.1 and Grid Code Annex 1.

a) Load connections

i) Maximum Active Power requirements.

ii) Maximum and minimum Reactive Power requirement.

iii) Load control arrangements (e.g. type of motor start, controlled rectifier or large motor drives).

iv) Maximum load in each phase.

v) Maximum harmonic currents that may be imposed on the Grid System.

vi) Details of cyclic load variations or fluctuating loads.

b) Generator connections

Information as requested in the generation connection application form and/or the Connection Agreement.

NOTE: Grid Code Annex 1 and the Grid Connection Policy provide additional details about the information required.

CC4.2.3 Disturbing and/or Fluctuating Loads

CC4.2.3.1 The User shall provide information about the type and characteristics of any Disturbing Load and/or fluctuating load to be connected to assess any harmonics, voltage fluctuations, i.e. Flicker or rapid voltage changes, or phase unbalance that could be introduced in the Grid System.

CC4.2.3.2 Disturbing Loads include motors, welders, non-linear loads, e.g. power converters/regulators etc., and other loads with a widely fluctuating demand.

CC4.2.3.3 For fluctuating loads, the User shall provide information about the cyclic variation and duty cycle of each load to determine the magnitude of the largest step voltage change, the rate of change of voltage and the frequency (period) of repetitive voltage changes.

CC4.2.3.4 The User may be required to install compensating equipment when required by the TD&R Licensee to ensure emissions from its Disturbing Load and/or fluctuating load do not exceed the planning levels specified in Grid Code Condition PC4.2.3.

CC4.2.4 Detailed Information

CC4.2.4.1 The User shall provide any additional detailed information, in addition to that in Annex 1, when requested by the TD&R Licensee, where this is reasonably required to complete an assessment of the User's connection.

CC4.2.4.2 Detailed information could be typically requested by the TD&R Licensee for assessment of the following:

a) Non-standard load connections.

b) Distributed Generator connections.

c) Disturbing Load and/or fluctuating loads.

CC4.2.4.3 Detailed information could include load patterns, Commissioning programmes, etc., which should be provided by the User within a reasonable time period, as requested by the TD&R Licensee.

CC4.2.5 Further Information

A User shall provide any information about the nature or use of electrical equipment in their Installation that the TD&R Licensee may reasonably require including specifications for equipment.

CC4.2.6 Information to Users

CC4.2.6.1 The TD&R Licensee shall, when required, provide information about the Grid System necessary for Users to identify and evaluate prospective new connections and changes to existing connections. This may include the following:

a) Short-circuit levels.

b) Voltage regulation and control arrangements.

c) Security of supply.

d) Protection arrangements and settings.

e) Specification of major equipment.

f) Maximum demand / available capacity of network assets.

CC4.2.6.2 The TD&R Licensee shall provide any required information to Users as soon as practicable following a written request by the User.

CC4.3 Determination of Connection Point & Method of Connection

CC4.3.1 Users will be connected to the Grid System at a Connection Point determined by the TD&R Licensee.

CC4.3.2 Determination of the Connection Point and the associated Grid System voltage level will consider the following factors.

a) Prospective power requirements.

b) Operational requirements for the Installation.

c) Avoidance of interference to/from other Users.

d) Cost of providing the connection.

e) Ongoing costs of maintaining the connection.

f) Security of supply requirements.

CC4.3.3 Where required, the TD&R Licensee will conduct planning studies to confirm the suitability of the Connection Point and method of connection.

CC4.3.4 The TD&R Licensee will determine the optimum Connection Point and method of connection having considered the technical and economic factors in Grid Code Condition CC4.3.2 & CC4.3.3.

CC4.3.5 Connections shall be designed to comply with requirements in the Planning Code (PC).

CC4.3.6 The Connection Point will be from a single point on the Grid System unless agreed otherwise by the TD&R Licensee and the User. Connections with multiple Connection Points may require special consideration.

CC4.3.7 The User shall be responsible for requesting any additional security of supply requirements. The TD&R Licensee will advise the User whether the required security of supply can be provided at the proposed Connection Point or any other practicable Connection Point.

CC4.3.8 The method of connection to the Grid System will be provided via connection of the User's equipment to an underground cable, an overhead line or item of switchgear owned by the TD&R Licensee.

CC4.3.9 Specific requirements apply to the connection of Distributed Generators as provided in the Requirements for Generators (RFG).

CC4.4 Ownership Boundaries

CC4.4.1 Recording of Ownership Boundary

CC4.4.1.1 The Point of Supply and Ownership Boundary shall be stated in the Connection Agreement. Any changes to the Point of Supply and/or Ownership Boundary shall require a new Connection Agreement.

CC4.4.2 Responsibility and Ownership

CC4.4.2.1 For Low-Voltage connections the Point of Supply will be the outgoing terminals of the metering equipment, where the User shall own and be responsible for the cable(s) between the metering equipment and the User's incoming/outgoing switchgear.

CC4.4.2.2 Low-Voltage metering equipment shall be supplied, installed and owned by the TD&R Licensee and will be located as close to the User's incoming/outgoing switchgear as is technically and practically possible.

CC4.4.2.3 For High-Voltage connections the TD&R Licensee's ownership and responsibility for equipment connected to the Grid System will generally extend to the terminals of the cable connected to the User's incoming/outgoing switchgear.

CC4.4.2.4 High-Voltage metering equipment shall be supplied, installed and owned by the TD&R Licensee and will be located as close to the TD&R Licensee's switchgear terminals, which supplies the User's Installation, as is technically and practically possible.

CC4.4.3 Means of Disconnection

CC4.4.3.1 The TD&R Licensee shall provide a means to disconnect the User's Installation from the Grid System.

CC4.4.3.2 The User shall provide a means to disconnect any source(s) of electricity that it owns and/or is responsible for, from the Grid System.

CC4.5 Scheme for Connection

CC4.5.1 In response to the information provided by the User, the TD&R Licensee shall prepare a scheme and statement of charges for connecting the User to the Grid System in accordance with its Grid Connection Policy.

CC4.5.2 The following information relating to the scheme and connection will be made available to the User on request.

a) Nominal voltage.

b) Method of connection.

c) Source impedance.

d) Method of earthing.

e) Maximum connection capacity.

f) Customer limits for:

i) Total Harmonic Distortion.

ii) Flicker.

iii) Voltage Unbalance.

g) Estimated lead time for providing the connection upon notice and confirmation that the Customer's site is prepared and ready for connection.

CC4.5.3 Charges and timeframes for preparing the scheme / providing the connection shall be calculated in accordance with the Grid Connection Policy.

CC4.6 Commissioning

CC4.6.1 General

CC4.6.1.1 The User shall be responsible for ensuring all appropriate checks and tests are completed by a suitable competent person following Installation or changes to its equipment/Installation prior to connection, which confirm it is safe to be connected to the Grid System.

CC4.6.1.2 When requested by the TD&R Licensee, the User shall provide evidence of the checks and tests completed on the equipment/Installation.

CC4.6.2 Low-Voltage Connections

CC4.6.2.1 Low-Voltage connections shall meet all relevant safety and performance standards in the National Electrical Code (NEC), as modified by the TD&R Licensee.

CC4.6.3 High-Voltage Connections

CC4.6.3.1 High-Voltage connections shall be commissioned to confirm all relevant safety and performance requirements in applicable IEEE, NEC, IEC or other relevant international standards have been met. The TD&R Licensee may state any specific standards to be met in the Connection Agreement.

CC4.6.3.2 The User shall provide the TD&R Licensee with a programme of checks/tests to be completed on its equipment/Installation in advance of any Commissioning. Where necessary, the TD&R Licensee shall advise any additional or amended checks/tests to be carried out, which it deems necessary to demonstrate conformance to the Grid Code.

CC4.6.3.3 The TD&R Licensee shall advise the User of any check/tests that it wishes to witness.

CC5 Technical Requirements for Connections

CC5.1 Equipment Standards

CC5.1.1 The User's equipment/Installation shall conform to all relevant legislation, relevant IEEE standards and any other equivalent international standards for manufacture, design, installation and testing consistent with the following.

a) Those standards specifically referenced in this Grid Code.

b) Prudent Utility Practice.

c) Climatic, environmental and other relevant conditions in Bermuda and specifically in which the equipment will be located.

The TD&R Licensee may reference any specific equipment standards that a User needs to comply with in the Connection Agreement.

CC5.1.2 When requested by the TD&R Licensee, the User shall provide evidence that its equipment/Installation conforms to all relevant legislation and standards.

CC5.1.3 The User's equipment/Installation to be connected to the Grid System shall be suitable for the frequencies, voltages and short-circuit ratings at the Connection Point.

CC5.1.4 All equipment/Installations connected to the Grid System shall be:

a) sufficient for the purpose and for the circumstances in which it will be used, including operation in accordance with the TD&R Licensee's Safety Management System.

b) constructed, installed, protected (both electrically and mechanically), used and maintained as to prevent danger, interference with or interruption of supply, so far as is reasonably practicable.

c) operated within thermal ratings.

CC5.1.5 The TD&R Licensee shall be satisfied that the User's equipment/Installation at the Ownership Boundary conform to the relevant requirements of the Grid Code before entering into a Connection Agreement.

CC5.2 Protection Requirements

CC5.2.1 Users shall ensure faults on their equipment/Installation do not cause unreasonable disturbances to the Grid System, which shall include Installation of appropriate protection equipment.

CC5.2.2 Users shall have the responsibility and shall take action to protect their equipment/Installation against the effect of faults in the Grid System (e.g. loss of phase, under-voltage, over-voltage). The User's protection scheme and equipment shall be compatible with that of the Grid System.

CC5.2.3 Minimum protection requirements for a User's equipment/Installation shall be as follows.

a) For standard Low-Voltage load connections:

i) Overcurrent protection.

ii) Earth fault protection.

b) For Distributed Generation connections:

i) See Grid Code Annex 2 and the Standard Contract.

c) For standard High-Voltage load connections:

i) Overcurrent protection.

ii) Earth fault protection.

iii) Intertripping with Grid System protection, where specified by the TD&R Licensee.

CC5.2.4 Any Circuit-Breakers at the interface with the Grid System shall be fitted with protection equipment that is acceptable to the TD&R Licensee. The TD&R Licensee shall advise the User on the required discrimination, sensitivity and maximum operating times of protection equipment for application to Circuit-Breakers at the interface so as to discriminate with the Grid System protection.

CC5.2.5 The process for agreeing and coordinating protection requirements at the interface with the Grid System shall be detailed in the Grid Connection Policy.

CC5.2.6 In order to ensure that faults on the User's equipment are cleared in the event of a failure of the User's Circuit-Breaker or main protection equipment, back up protection shall be provided. This back up protection shall, where the network configuration permits, be provided via protection equipment and Circuit-Breakers on the TD&R Licensee’s system, with suitable time and current grading to allow the User's main protection system and Circuit-Breaker to operate first. Should the network configuration prevent the application of back up protection in this way, the TD&R Licensee will advise the User and an alternative method shall be agreed.

CC5.2.7 Unless agreed otherwise by the TD&R Licensee, Users shall not use fault current limiting devices if failure of such a device would result in the short-circuit rating of the Grid System being exceeded.

CC5.2.8 Protection equipment shall be commissioned in accordance with Grid Code Condition CC4.6.

CC5.2.9 The User shall carry out periodic checking/testing of its protection equipment and/or fault clearance device at the interface with the Grid System to confirm it will operate satisfactorily at the agreed protection setting(s) in the event of a system fault.

CC5.2.10 Any Low-Voltage fuses for use with the Grid System shall be guided by the TD&R Licensee's fusing guidelines to aid in correct discrimination.

NOTE: The TD&R Licensee's fusing guidelines can be made available upon request.

CC5.2.11 The User shall be responsible for ensuring its Installation has adequate earth fault protection, which is sensitive enough to protect persons and the Installation. The sensitivity of earth fault protection for Low-Voltage domestic Users shall be consistent with relevant requirements in the National Electrical Code (NEC). The TD&R Licensee will state the earthing system to be provided in the Connection Agreement.

CC5.2.12 The TD&R Licensee will advise Users where automatic switching equipment is to be fitted.

CC5.3 Earthing

CC5.3.1 Users' Installations shall be compatible with the TD&R Licensee's standard earthing arrangements. The TD&R Licensee will provide details of its standard earthing arrangements for a particular type of connection at the request of a User.

CC5.3.2 Earthing of a User's Installation connected at High-Voltage shall be Approved. The User shall provide suitably detailed information at the connection application stage to ensure compatibility of their earthing arrangements with that of the Grid System. The adequacy of the User's earthing arrangements will be confirmed at commissioning.

CC5.3.3 In some circumstances, the TD&R Licensee may permit non-standard earthing arrangements. Notwithstanding, non-standard earthing systems that may be permitted shall provide effective earthing of the User's equipment/Installation and the User shall comply with any additional conditions stipulated by the TD&R Licensee.

CC5.3.4 Users' Installations may have their own independent earthing system and earth fault protection for three-phase Low-Voltage supplies above standard fuse ratings.

CC5.3.5 Users shall take precautions to limit the occurrence and effects of circulating current in neutrals from multiple sources of supply.

CC5.3.6 The impedance of the earth-fault current path of any new or altered Low-Voltage connection shall be sufficiently low to cause operation of the overcurrent protective device installed at the User's supply terminals for an earth fault on the User's equipment/Installation. The requirements of the National Electrical Code (NEC) shall apply with respect to earthing of Low-

Voltage equipment/Installations connected to the Grid System and operation of protective devices.

CC5.3.7 Users shall ensure that all persons working on their earthing system should be adequately trained to perform such work in a safe manner.

CC5.4 Voltage Regulation and Control

CC5.4.1 Any voltage regulation and control schemes associated with Generators' connections shall not adversely impact the control of voltage on the Grid System.

CC5.4.2 Generators shall provide details of any voltage regulation and control schemes to the TD&R Licensee for assessment of compatibility with the associated Grid System voltage control.

CC5.5 Short-Circuit Levels

CC5.5.1 All Apparatus/equipment shall be capable of withstanding the peak short-circuit currents at the relevant point(s) in the Grid System. The short-circuit rating of User equipment at the Connection Point shall not be less than the design short-circuit levels in Table CC1 of this Grid Code.

CC5.5.2 The choice of equipment for load connections at Low-Voltage may take into account the attenuation of short-circuit level in the service lines from the Connection Point to the Point of Supply.

CC5.5.3 The TD&R Licensee shall take into account any short-circuit infeed from the User's equipment/Installation into the design of its system.

CC5.5.4 The User's main incoming Circuit-Breaker shall be in accordance with a recognised international standard acceptable to the TD&R Licensee.

Table CC1 – Design Short-Circuit Levels

System Voltage	Short-Circuit Level (Three-Phase[1])	Short-Circuit Level (Single Phase to Earth)
120 V phase to neutral, 208 V phase to phase (three-phase connection)	20 kA RMS (3 seconds)	20 kA RMS (3 seconds)
120 V phase to neutral, 240 V phase to phase (two-phase connection)	20 kA RMS (3 seconds)	20 kA RMS (3 seconds)
277 V phase to neutral, 480 V phase to phase (three-phase connection)	26 kA RMS (3 seconds)	26 kA RMS (3 seconds)
2,402 V phase to neutral, 4,160 V phase to phase	25 kA RMS (3 seconds)	25 kA RMS (3 seconds)
12,701 V phase to neutral, 22,000 V phase to phase	25 kA RMS (3 seconds)	25 kA RMS (3 seconds)
19,052 V phase to neutral, 33,000 V phase to phase	25 kA RMS (3 seconds)	25 kA RMS (3 seconds)
[1] Also includes two-phase connections, where applicable		

CC5.6 Insulation Levels

CC5.6.1 Equipment/Installations connected to the Grid System shall be designed and manufactured to meet the maximum voltages (power frequency and impulse) in Table CC2 of this Grid Code that may arise.

Table CC2 – Insulation Levels for Equipment to be Connected to the Grid System

System voltage	Highest voltage for installation U_m r.m.s.	Rated short-duration power-frequency withstand voltage U_d r.m.s.	Rated lightning impulse withstand voltage U_p 1.2 / 50 µs peak
120 V phase to neutral, 208 V phase to phase (three-phase connection)	≤ 1 000 V	5 kV	15 kV
120 V phase to neutral, 240 V phase to phase (two-phase connection)			
277 V phase to neutral, 480 V phase to phase (three-phase connection)			
2,402 V phase to earth, 4,160 V phase to phase	4.76 kV	19 kV	60 kV
12,701 V phase to neutral, 22,000 V phase to phase	24 kV	50 kV	150 kV
19,052 V phase to neutral, 33,000 V phase to phase	36 kV	70 kV	200 kV

NOTE: The withstand voltage for High-Voltage systems align with IEC 61936-1:2010+A1:2014 *Power installations exceeding 1 kV a.c. - Part 1: Common rules.*

CC5.7 Voltage Disturbances

CC5.7.1 Users shall not generate voltage disturbances (voltage Flicker, harmonics distortion and Voltage Unbalance), at levels that adversely affect other Users connected to the Grid System.

CC5.7.2 A User's equipment/Installation shall be capable of withstanding the voltage disturbances defined in Grid Code Condition PC4.2.

CC5.7.3 The fundamental frequency component of the system voltage can vary transiently under fault and switching conditions, which is dependent upon the method of Grid System earthing. Under fault conditions the system voltage may fall to zero at the point of fault. User's equipment shall be of an appropriate standard and specification to withstand these types of voltage disturbances.

CC5.7.4 This Grid Code does not address wider electromagnetic compatibility (EMC) requirements. However, Users may be required to ensure their equipment complies with any relevant legislation governing electromagnetic compatibility.

CC5.8 Communication & Control

CC5.8.1 Generators shall provide and maintain communication equipment necessary for control and monitoring by the TD&R Licensee of the Grid System.

CC5.8.2 The TD&R Licensee shall define its requirements for control and monitoring of Generator equipment in the Connection Agreement.

CC5.8.3 When requested by the TD&R Licensee, the Generator shall provide telemetry outputs and status indications from its equipment necessary for adequate monitoring of the Grid System.

CC6 Site Related Conditions

CC6.1 General Requirements

CC6.1.1 Where required, the User shall provide adequate provision for Installation of and access to any equipment to be owned and/or operated by the TD&R Licensee.

CC6.1.2 The User shall comply with specific operational requirements for the site, equipment/Facility stated in the Operations Code.

CC6.1.3 The TD&R Licensee shall ensure that warning signs are fitted to Grid System Apparatus as required by the Occupational Safety and Health Regulations 2009.

All Users shall ensure that warning signs are fitted to their electrical Apparatus/Installation as required by the Occupational Safety and Health Regulations 2009.

CC6.1.4 The height above ground of any conductor, wire or cable of an overhead line connected to the Grid System passing over a road accessible to vehicular traffic, at the maximum likely temperature of that conductor, wire or cable, shall not be less than the dimension specified by the TD&R Licensee taking into account the requirements of the Public Lands Act 1984 Section (9) sub-clause (2)(f) and Grid Code Condition PC5.1.3.3. The height above ground of any conductor, wire or cable of an overhead line connected to the Grid System that is not passing over a road accessible to vehicular traffic, at the maximum likely temperature of that conductor, wire or cable, shall not be less

than the dimension specified by the TD&R Licensee taking into account the requirements of Grid Code Condition PC5.1.3.3.

CC6.1.5 The TD&R Licensee will provide suitable guidance advising minimum safety clearances that need to be maintained from Grid System Apparatus. The TD&R Licensee will, where requested, provide safety advice to persons working, or intending to work, in the vicinity of Grid System Apparatus. The TD&R Licensee shall be permitted to recover reasonable costs for the provision of such safety advice in accordance with its Grid Connection Policy.

CC6.1.6 Where a User installs a trench or duct for installation of underground cables connected to the Grid System, the depth of the trench/buried cable or duct shall meet or exceed the minimum depth specified by the TD&R Licensee.

NOTE: The depth of a buried cable or duct is that from ground level to the top of the cable or duct.

CC6.2 Site Responsibility Schedules

CC6.2.1 Where the TD&R Licensee and a User share an operational site and/or interface then the responsibilities of the respective parties shall be defined and agreed in a Site Responsibility Schedule.

CC6.3 Site Common Drawings

CC6.3.1 Where common drawings are required to ensure the safe operation and maintenance of the shared operational site/interface, the requirements for the preparation, circulation and updating of such common site drawings shall be adequately defined in the Connection Agreement.

CC6.4 Site Access

CC6.4.1 Requirements for access to shared operational sites shall be defined and documented in the Connection Agreement. The TD&R Licensee shall specify any specific competency and authorisation requirements that need to be met by the User's staff or agents.

CC7 Metering

CC7.1 General Requirements

CC7.1.1 For the purposes of metering, the term "TD&R Licensee" applies to employees and authorised agents of the TD&R Licensee, as applicable.

CC7.1.2 Specific requirements for metering specified in the TD&R Licensee's Service Rules and other related documents shall apply.

CC7.1.3 With the exception of supplies to public street lighting and public street furniture, all User connections to the Grid System shall be metered unless specifically agreed in writing by the TD&R Licensee.

CC7.2 Responsibilities for Metering

CC7.2.1 The TD&R Licensee shall be responsible for supply, installation, maintenance and ownership of any metering equipment.

CC7.2.2 The User shall be responsible for arranging connection of its equipment/Installation to the Customer side of the metering equipment.

CC7.2.3 Only the TD&R Licensee or its authorised agent shall make any adjustments or changes to metering equipment owned by the TD&R Licensee.

CC7.2.4 Users shall be responsible for marking the meter box inside and out to identify the particular equipment/Installation being metered.

CC7.3 Metering Points

CC7.3.1 Where practicable, metering equipment shall be installed as close as technically and physically possible to the User's supply terminals.

CC7.3.2 High-Voltage metering equipment shall be at or electrically close to the terminals of the TD&R Licensee's switchgear or interconnecting cable unless otherwise Approved.

CC7.3.3 Each User Installation shall be separately metered.

CC7.3.4 The User shall be responsible for providing a suitable place in which to install the TD&R Licensee's meter service entrance equipment, where the meters can be readily accessed and read by the TD&R Licensee or its authorised agents. Users shall ensure there is unobstructed access at all times for the TD&R Licensee or its authorised agents to read, maintain or, where necessary, replace metering equipment.

CC7.3.5 Where two or more meter installations are required in one building, the TD&R Licensee shall require these to be grouped in one location for readily available inspection and testing.

CC7.4 Metering Equipment

CC7.4.1 Meters

CC7.4.1.1 The TD&R Licensee shall ensure meters are suitably Approved and calibrated for the connection provided.

CC7.4.2 Low-Voltage Equipment

CC7.4.2.1 Low-Voltage connections will be metered using whole current metering, where practicable. For large capacity Low-Voltage connections and High-Voltage connections the TD&R Licensee will provide, install, commission and maintain measurement transformers and associated equipment for metering the connection.

CC7.4.2.2 Where required, the User shall provide space in its switchgear to accommodate the TD&R Licensee's metering current transformers.

CC7.4.3 High-Voltage Equipment

CC7.4.3.1 Any additional requirements for metering of High-Voltage equipment/Installations will be stated in the Connection Agreement or, where applicable the Power Purchase Agreement/Arrangement.

CC7.5 Meter Data & Registration

CC7.5.1 The TD&R Licensee will keep a register of metering equipment and meter data for each metered connection sufficient for accurate billing of Users.

CC7.5.2 The TD&R Licensee shall provide information recorded by the metering equipment when requested by the User.

CC7.6 Commissioning Procedures

CC7.6.1 The TD&R Licensee shall check for correct connection of metering equipment and for correct metering details after metering equipment is installed or changed to ensure accurate recording of a User's import and/or export of electrical energy from/to the Grid System.

CC7.7 Security of Metering Systems

CC7.7.1 The TD&R Licensee will secure metering equipment to prevent unauthorised tampering. This will normally be achieved by applying seals to doors, covers, terminals and other necessary points.

CC7.7.2 Where applicable, meter seals will provide traceability of the TD&R Licensee employee or agent that secured the metering equipment.

CC7.7.3 Where there is an indication or evidence of tampering with metering equipment by the User, the TD&R Licensee may disconnect the service and take steps to recover any direct/indirect dues owed as a result of the tampering.

CC7.8 Meter Reading & Collection Systems

CC7.8.1 Meters will normally be read on a monthly basis by the TD&R Licensee.

CC7.8.2 The TD&R Licensee will check, at an appropriate frequency and by appropriate means, that the metering equipment is safe and has not been tampered with.

CC7.8.3 Where the TD&R Licensee cannot obtain an actual meter reading, it will provide an estimated reading based on previous data or, where fitted, check metering equipment. No more than two estimated readings shall be provided per year and the Customer shall be responsible for providing access, when requested, for the TD&R Licensee to obtain an actual meter reading.

CC7.9 Metering Disputes

CC7.9.1 The TD&R Licensee shall communicate its arrangements for raising, handling and closing out metering disputes. In the event the metering dispute cannot be resolved, the TD&R Licensee shall refer the dispute to the Authority for resolution, as provided for in Section 57 or Section 58, as applicable, of the RAA.

CC7.9.2 Where necessary, the accuracy of a disputed meter may be verified by an independent body acceptable to the TD&R Licensee and the User. Where the meter is found to be within accuracy limits then the User may be required to pay the costs of the independent verification. Where the meter is found to be inaccurate the TD&R Licensee will pay the costs.

CC7.10 Inspection & Accuracy Testing

CC7.10.1 The TD&R Licensee will employ every practicable means to maintain the commercial accuracy of its meters including inspection and testing the calibration of meters in line with the methods, procedures and calibration prescribed by industry standards and the manufacturer of the equipment.

CC7.10.2 The TD&R Licensee will apply billing adjustments, where meters are found to be inaccurate.

OPERATIONS CODE

OC1 Introduction

OC1.1 This Operations Code covers a number of specific requirements relating to information exchange and detailed Operating Procedures that apply to the interface between the TD&R Licensee and Users.

OC1.2 The TD&R Licensee is required to schedule and issue direct Dispatch Instructions to available Bulk Generation to provide adequate electrical supply to meet demand. Bulk Generation rated at 500 kW or greater is subject to Dispatch by the TD&R Licensee.

OC1.3 The TD&R Licensee shall be responsible for the safe and efficient operation of the Grid System. The TD&R Licensee shall have ultimate authority and accountability for the operation of the Grid System, in accordance with the conditions of its TD&R Licence.

OC2 Objective

OC2.1 The objectives of the Operations Code are to:

a) Set out information required from Users to enable the TD&R Licensee to balance supply and load demand in the Grid System.

b) Set out the requirements for operational planning and coordination of Outages to ensure security of supply of the Grid System.

c) Set out requirements for reducing demand, where required, to maintain the stability and safety of the Grid System.

d) Set out the requirements for liaising and exchanging of information between the TD&R Licensee and Users with respect to operation of the Grid System.

e) Set out the requirements for monitoring, testing and investigating the effect of User's equipment on the operation of the Grid System.

f) Set out requirements to ensure the safety of persons carrying out work or testing at the operational interface between the TD&R Licensee and Users.

OC3 Scope

The Operations Code applies to the respective roles and responsibilities that Users and the TD&R Licensee must fulfil for the safe, secure and economic operation of the Grid System.

OC4 Demand Forecasting

OC4.1 General Requirements

OC4.1.1 In order for the TD&R Licensee to operate the Grid System efficiently and to maintain system security and stability, Users shall provide information relating to their demand and/or Generation Unit output when requested by the TD&R Licensee.

OC4.1.2 Demand and Generation Unit output information shall be used by the TD&R Licensee to compile demand forecasts necessary for planning, scheduling and Dispatch of Generation Units (see Grid Code Condition OC4.3). Longer term load forecasts will be included in the Integrated Resource Plan.

OC4.1.3 Demand and Generation Unit output shall be the MW demand or output of electricity at the User's metering point with the Grid System. The TD&R Licensee may also, in certain cases, request MVA demand or Generation Unit output.

OC4.1.4 Information shall be provided by Users in an appropriate electronic format, which is compatible with the TD&R Licensee's systems and data management requirements.

OC4.2 Information Flow and Coordination

OC4.2.1 The TD&R Licensee shall coordinate demand forecast information to enable the Grid System to be operated safely, securely and economically.

OC4.3 Demand Forecast Data

OC4.3.1 All Bulk Generation shall provide information about forecast available output and any Scheduled Outages on a year ahead, month ahead and week ahead basis or when required by the TD&R Licensee. Information shall be provided in the form given in Grid Code Annex 1 Schedule 5. In addition, Bulk Generation subject to short-term Dispatch Instructions shall provide information about forecast output and any Scheduled Outages on a day ahead basis.

OC4.3.2 Demand Users with High-Voltage connections shall provide information about any significant planned change in forecast demand, where that change is expected to exceed 1 MW, on an annual basis or when required by the TD&R Licensee.

OC5 Operational Planning

OC5.1 General Requirements

OC5.1.1 The objective of Grid Code Condition OC5 is to set out the operational planning procedure and timetable for the coordination of Outage requirements for plant and Apparatus, which Users need to comply with so the TD&R Licensee can maintain the security of the Grid System.

OC5.1.2 The scope of Grid Code Condition OC5 shall apply to all Generators and those High-Voltage demand Users where the TD&R Licensee deems it

appropriate and/or where such a provision applies in the Connection Agreement.

OC5.1.3 Scheduled Outages of plant and Apparatus, which affect the operation of the Grid System or require the commitment of TD&R Licensee resources, shall be coordinated.

OC5.1.4 Operation planning information shall be provided in writing or any other suitable means of electronic transfer that enables the information to be retained.

OC5.1.5 The information provided will be used to enable the TD&R Licensee to fulfil its requirements under this Operations Code (OC).

OC5.2 Provision of Information

OC5.2.1 Information on all generating plant shall be provided by the Generator directly to the TD&R Licensee. The information to be provided shall be as shown in Grid Code Annex 1 Schedule 5.

OC5.3 Timeframes and Data

OC5.3.1 The TD&R Licensee shall determine the timeframes and detailed data to be provided by relevant Users for operational planning purposes. This shall recognise that requirements may differ depending on the system voltage and Capacity of generation/demand concerned.

OC5.3.2 Information requirements may be determined by the TD&R Licensee's planning needs.

OC5.4 Information from Generators

OC5.4.1 Generators with plant rated at greater than or equal to 500 kW shall not synchronize onto the Grid System without the TD&R Licensee's permission, unless they have prior agreement as per Grid Code Condition OC5.4.3, and shall provide Reactive Power / Active Power output as per the TD&R Licensee Instructions. Generators subject to Dispatch shall inform the TD&R Licensee of operations and events in accordance with Grid Code Condition OC7.

OC5.4.2 Information from Generators with plant rated greater than or equal to 500 kW but not subject to Daily or Short-Term Dispatch shall include details of any Scheduled Outages of generation plant and associated expected Return to Service times in accordance with the Outage forecast requirements in Schedule 5 of Grid Code Annex 1 and shall provide Reactive Power / Active Power output as per the TD&R Licensee's Instructions. Grid Code Condition OC11.1.2 specifies which Generation Units connected to the Grid System shall be subject to Dispatch.

OC5.4.3 No Generation Unit rated at greater or equal to the licence threshold (as defined in the Act) shall be synchronized to the Grid System without permission or prior agreement from the TD&R Licensee. Prior agreement may be stated by the TD&R Licensee in the Connection Agreement or Power Purchase Agreement/Arrangement.

OC5.5 Information to Users

OC5.5.1 The TD&R Licensee shall advise High-Voltage Users and Generators in advance of the times and dates of any Scheduled Outages of the Grid System plant that may significantly impact them. Any objections from Users and Generators shall be considered and the TD&R Licensee shall, where practicable, take steps to reduce the impacts.

OC6 Demand Control

OC6.1 General Requirements

OC6.1.1 OC6 is concerned with provision to be made by the TD&R Licensee, in certain circumstances, to permit reductions in demand in the event of:

a) insufficient generating plant to meet demand.

b) break down and/or operating problems on any part of the Grid System, where demand reduction is needed to avoid wider scale disconnection of Users.

OC6.1.2 Demand reduction shall be done in a manner that is proportionate, appropriate in terms of urgency and is fair to Customers given the circumstances. Reductions in demand shall be shared equitably, where reasonably practicable.

OC6.1.3 The TD&R Licensee will endeavour not to apply demand reduction to critical supplies, such as hospitals, or large commercial Users unless this is deemed absolutely necessary.

OC6.2 Methods of Demand Control

OC6.2.1 The TD&R Licensee may disconnect Users in the event of a sudden or persistent fall in system frequency in order to maintain stability of the Grid System. Disconnection shall be carried out in a coordinated manner, such as Load Shedding, taking into account operational requirements and the need to maintain essential loads.

OC6.2.2 Deliberate voltage reduction and/or Demand Side Management resources may be used by the TD&R Licensee to achieve a temporary reduction in demand.

The TD&R Licensee may utilise a variety of Demand Side Management resource options consistent with those proposed in the Integrated Resource Plan, which may include: management/control of aggregated demand, time-of-use tariffs and/or similar price signals for Users to voluntarily reduce demand when required, or control of individual loads using advanced meter functions.

OC6.2.3 Users may be required to provide facilities for manual disconnection of their supply and shall use these facilities without delay when instructed by the TD&R Licensee. In these circumstances, reconnection should only take place following Instruction from the TD&R Licensee.

OC6.2.4 Emergency Load Shedding may be initiated by the TD&R Licensee without prior notice where there is an unexpected loss of significant generation or in an Emergency, where there is a need to reduce demand quickly in order to protect the Grid System and/or Users' equipment/Installations. The TD&R Licensee, in the first instance, will generally shed load by opening the High-Voltage Circuit-Breaker of non-critical feeder(s) via remote control.

OC6.2.5 In the event of a sustained period of demand control, the TD&R Licensee may implement a rota of Load Shedding to share the available power. The TD&R Licensee will take reasonable steps to keep Customers informed of these arrangements.

OC6.2.6 The TD&R Licensee shall set the requirements for automatic and manual load shedding. Users shall make available loads and schemes to comply with these requirements.

OC7 Operational Communications and Liaisons

OC7.1 General Requirements

OC7.1.1 Grid Code Condition OC7 sets out the requirements for communication in relation to operations and/or events on the Grid System and Users' equipment/Installations which can have an operational effect on the Grid System.

OC7.1.2 The objective is to define clear responsibilities and procedures for operational communication and liaison between the TD&R Licensee and Users so that:

a) implications of operations and/or events can be considered.

b) possible risks can be assessed.

c) appropriate actions can be taken by the relevant party in order to maintain the integrity of the Grid System.

OC7.1.3 The requirements in Grid Code Condition OC7 apply to:

a) those Users connected to the Grid System where the TD&R Licensee considers operational communication necessary because of their Capacity, nature of equipment/Installation or nature of operations.

b) Bulk Generation.

c) Bulk Energy Storage Installations.

d) Demand Side Management resources with a capacity ≥ 500 kW.

OC7.2 Contact Persons

OC7.2.1 The TD&R Licensee and User shall nominate contact persons, provide contact details and agree the communication channel(s) for operational communication.

OC7.3 SCADA Information

OC7.3.1 The TD&R Licensee shall specify what operational information and SCADA equipment is required at a User's site for operational communication and liaison. These requirements will be generally stated in the Connection Agreement or Standard Contract.

OC7.4 Exchange of Information

OC7.4.1 Information may be exchanged at the reasonable request of a party, in relation to a specific operation or for circumstances having prior agreement. Information deemed relevant may be exchanged voluntarily by a party in accordance with Prudent Utility Practice.

OC7.4.2 Communications shall be through nominated contact persons, agreed communication channels using agreed protocols.

OC7.4.3 Communications shall, where practicable, be direct between Users and the TD&R Licensee.

OC7.5 Notifications

OC7.5.1 Whenever possible, the TD&R Licensee shall notify a User in advance of any Grid System operation(s) that will or could affect the operation of the User's equipment/Installation.

OC7.5.2 A User shall notify the TD&R Licensee in advance of any operations on its equipment/Installation that will or could affect the operation of the Grid System.

OC7.5.3 Notifications shall have sufficient detail to allow the recipient to assess the implications of the operation(s) and what action it may need to take. The User making the notification shall provide their contact details for the recipient to raise any clarifications or issues.

OC7.5.4 Notifications shall be given as far in advance as possible to allow parties sufficient time to consider and assess the implications of the operation(s).

OC7.6 Significant Event Reporting

OC7.6.1 General Requirements

OC7.6.1.1 A User shall notify the TD&R Licensee, as soon as practicable, of any Significant Event arising from the operation of their equipment/Installation.

OC7.6.1.2 Where an incident/event has had or could have had a significant effect on either the operation of the Grid System or the User's equipment/Installation, it shall be declared to be a Significant Event. Significant Events shall include those events which have resulted or could result in the following.

a) System voltage being outside statutory limits.

b) System frequency being outside statutory limits.

c) System instability.

d) Loss of control of generation including unstable power swing.

OC7.6.1.3 When requested, the User shall provide the TD&R Licensee with a report, in writing or suitable electronic format, with all relevant information relating to the Significant Event, as soon as reasonably practical after the Significant Event.

OC7.6.2 Joint Investigation

OC7.6.2.1 Any relevant party may request a joint investigation after a Significant Event in writing to the TD&R Licensee.

OC7.6.2.2 Where the TD&R Licensee deems a joint investigation into the Significant Event necessary, the terms of reference and composition of the investigation panel shall be appropriate to the nature of the event and agreed by the relevant parties.

OC7.6.2.3 Joint investigations shall only be carried out where there is agreement on the need for and terms of reference of the investigation by the relevant parties.

OC7.6.3 Matters to be Included in a Written Report of a Significant Event

OC7.6.3.1 The following details shall be included in the report of a Significant Event.

a) Matters applicable to the TD&R Licensee and the effect on Users including:

i) Date and time of the event.

ii) Location.

iii) Equipment involved.

iv) Brief description of the event.

v) Details of any demand control undertaken.

vi) Duration of event.

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

viii) Conclusions and recommendations if applicable.

b) Additional matters applicable to Generators and the effect on generation including, where appropriate:

i) Generation interrupted.

ii) Frequency response achieved.

OC8 Monitoring, Testing and Investigation

OC8.1 General Requirements

OC8.1.1 In order to properly discharge its TD&R Licence responsibilities, in respect of safe, secure and economic operation of the Grid System, the TD&R Licensee shall organize and carry out monitoring, testing and investigation on the effect of a User's electrical equipment/Installation on the Grid System.

OC8.1.2 The objective of monitoring, testing and investigation is to ensure the TD&R Licensee is operating the Grid System within the technical parameters of the Grid Code.

OC8.1.3 The requirements in Grid Code Condition OC8 apply to all Users including Generators.

OC8.2 Monitoring Supply Standards

OC8.2.1 The TD&R Licensee shall carry out monitoring and testing of the following parameters at various points of the Grid System including at the User's supply terminals.

a) System voltage.

b) System frequency.

c) Harmonic voltage distortion.

d) Voltage fluctuations and Flicker severity.

e) Voltage Unbalance.

f) Power factor (Watts, Vars).

OC8.3 Testing and Results

OC8.3.1 The TD&R Licensee may monitor the User's protection system and settings to confirm they meet Grid System requirements. The User shall provide any necessary information concerning its protection system/settings, including routine test results, when requested by the TD&R Licensee.

OC8.3.2 When reasonably required by the TD&R Licensee, the User shall test its protection system for correct operation. The TD&R Licensee will advise the User whether it wishes to witness any testing. The User shall provide the TD&R Licensee with a copy of the tests performed and the test results.

OC8.3.3 Where the TD&R Licensee proposes to carry out monitoring or testing on the Grid System that could materially affect the operation of a User's equipment/Installation then the TD&R Licensee shall advise the User and shall make the results available to the User on request.

OC8.4 Investigation of Power Quality Complaints

OC8.4.1 Where a specific complaint is received from a Customer concerning its quality of supply, the TD&R Licensee shall investigate. The investigation may require the TD&R Licensee to carry out specific monitoring, testing and enquiries to determine the nature, extent and cause of the complaint, if upheld.

OC8.4.2 Where a User's equipment/Installation forms part of the investigation, the User shall provide all reasonable information and assistance to the TD&R Licensee necessary to complete the investigation.

OC8.5 Non-Compliance

OC8.5.1 When a User's electrical equipment/Installation is found to be the cause of non-compliance with standards of supply requirements specified in the Grid Code and/or the Connection Agreement, the User shall rectify the cause of non-compliance within a reasonable timeframe determined by the TD&R Licensee.

OC8.5.2 Where the User fails to rectify the cause of non-compliance within the determined timeframe, the TD&R Licensee shall have the right to disconnect the User's equipment/Installation from the Grid System. In the event that there is disagreement on the assessment of non-compliance, the dispute

shall, if requested by either the TD&R Licensee or the User, be referred to the Authority.

OC8.5.3 Where a User is importing and/or exporting more power than defined in its Connection Agreement and or the quantity of power transferred is the cause of disturbance to other Users, the TD&R Licensee may instruct the User to restrict its power transfer.

OC9 Safety Coordination

OC9.1 General Requirements

OC9.1.1 Grid Code Condition OC9 specifies the Safety Management System criteria to be applied by the TD&R Licensee to meet its TD&R Licence conditions. Other Users shall have equivalent safety standards and criteria for operations at the Grid System interface.

OC9.1.2 The objective of safety coordination is to establish common safety standards and criteria to ensure the safety of persons who carry out operations, work and testing on the Grid System and at/across operational and Ownership Boundaries.

OC9.1.3 The requirements in Grid Code Condition OC9 apply to:

a) the TD&R Licensee and its agents.

b) those Users, including Generators, connected to the Grid System where the TD&R Licensee considers operational safety coordination necessary because of their Capacity, nature of equipment/Installation or nature of operations.
NOTE: Those Users will generally be Bulk Generation Licence Holders and Users connected at High-Voltage to the Grid System.

OC9.2 Responsibilities for Safety

OC9.2.1 Work shall be carried out on the Grid System or any shared operational sites under the TD&R Licensee's Safety Rules unless stated otherwise in the Connection Agreement or in a joint agreement between the User and the TD&R Licensee, where the safety arrangements are of an equivalent or better standard than those of the TD&R Licensee's Safety Rules.

OC9.2.2 The TD&R Licensee's Safety Rules shall apply for work carried out by the TD&R Licensee or its agents on a User's site, unless stated otherwise in the Connection Agreement or there is a joint agreement between both parties beforehand to adopt the User's Safety Rules.

OC9.2.3 The TD&R Licensee shall not be responsible for the safety of a User's site, equipment, Facility and personnel. The User is responsible for ensuring the safety of its own site, equipment, Facility and personnel and Installation at all times.

OC9.3 Safety Management System

OC9.3.1 The TD&R Licensee shall specify the Safety Management System which must be followed by anyone working or intending to work on the Grid System.

OC9.3.2 Any joint agreement that defines the Safety Management System at/across operational boundaries between the TD&R Licensee and the User shall be agreed beforehand by both parties in writing.

OC9.3.3 Persons who are required to carry out control functions, operation, work and testing on the Grid System or on equipment at/across operational boundaries shall be suitably competent. Users or other third parties will not be generally permitted to control or operate the TD&R Licensee's Grid System equipment.

OC9.3.4 Only one party at any one time shall be responsible for managing the safety of persons working on an item of equipment. The TD&R Licensee and the User shall jointly agree and document who that party will be prior to work commencing.

OC9.3.5 The TD&R Licensee and each User shall ensure they each have a nominated person responsible for safety coordination at all times. In the case of the TD&R Licensee this will generally be the control engineer for that part of the Grid System.

OC9.3.6 The TD&R Licensee and each User shall use a suitable system of documentation to manage and record all operations and safety precautions to be taken for work on the Grid System and at/across operational boundaries.

OC9.3.7 System Diagrams shall be prepared, maintained and exchanged that define operational boundaries, the Interconnection of equipment and provide sufficient detail for the TD&R Licensee and the User to safely coordinate operations and work on the Grid System and at/across operational boundaries.

OC9.4 Safety at the TD&R Licensee / User Interface

OC9.4.1 The procedures specified in Grid Code Condition OC9.4 establish the basic safety requirements that shall be followed to ensure the safety of any person working at the operational interface between the TD&R Licensee and the User.

OC9.4.2 Safety Rules for safe working and for communicating safety requirements shall be made available to and be used by all persons who are required to work or use facilities provided at the interface.

OC9.4.3 Electrical equipment at the interface shall be controlled by a nominated party. Each item of equipment at the interface shall be controlled by only one identifiable person at a time. Arrangements for transferring control of equipment at the interface shall be defined in the Connection Agreement or a joint agreement.

OC9.4.4 Adequate means of isolation shall be used to allow work to be safely carried out at the interface.

OC9.4.5 Where necessary to prevent danger, adequate earthing facilities shall be provided at the interface to allow work to be carried out.

OC9.4.6 Adequate access/egress, working space and lighting shall be provided for work on electrical equipment at the interface.

OC9.4.7 All electrical equipment shall be suitably identified to prevent danger. Identification of electrical equipment shall be shown on the System Diagram(s).

OC9.5 Safety Rules

OC9.5.1 Safety Rules prepared by the TD&R Licensee detail the general Safety Procedures to be followed by all persons working on or in proximity to the Grid System. The TD&R Licensee shall make these Safety Rules available to any party that has a legitimate requirement for them. The party in receipt of the Safety Rules shall be responsible for ensuring its copy of the Safety Rules is current.

OC9.5.2 Before Commissioning equipment to be connected to the Grid System, any specific Safety Rules and Operating Procedures necessary shall be prepared by the User and agreed with the TD&R Licensee.

OC9.5.3 Where the TD&R Licensee is required to operate User equipment at the interface with the Grid System, operating instructions shall be clearly displayed on the equipment or in the associated switchroom/control room. The User shall be responsible for the safe operation and maintenance of equipment on its side of the operational interface.

OC9.6 Maintenance Standards

OC9.6.1 All equipment connected to the Grid System shall be maintained in accordance with Prudent Utility Practice.

OC9.6.2 Maintenance shall be carried out in a manner that ensures the safety of maintenance persons and does not cause damage to equipment owned by the TD&R Licensee or Users.

OC9.6.3 A record of all relevant test results and maintenance activities relating to equipment interconnected to the Grid System shall be kept by the operator of the equipment.

OC10 Contingency Planning

OC10.1 General Requirements

OC10.1.1 Grid Code Condition OC10 sets out requirements and contingency planning procedures for dealing with the following abnormal situations.

a) Black Start.

b) Re-synchronising Islands.

c) Civil Emergencies.

d) Natural disasters.

e) Weather-related incidents.

OC10.1.2 Contingency planning procedures shall require coordination between the TD&R Licensee and all Users and shall provide a common approach to:

a) operating the Grid System in abnormal situations.

b) deciding priorities for Black Start.

c) specifying requirements during declared Civil Emergencies and weather-related incidents.

OC10.1.3 The requirements in OC10 apply to:

a) the TD&R Licensee.

b) all Generators.

c) all High-Voltage Users.

d) those Users connected to the Grid System where the TD&R Licensee considers coordination of contingency planning is necessary because of their capacity, nature of equipment/Installation or nature of operations.

OC10.2 Black Start

OC10.2.1 Shutdown

OC10.2.1.1 Black Start procedures shall be prepared and maintained by the TD&R Licensee for implementation following a Shutdown.

OC10.2.1.2 Black Start procedures shall provide for prompt recovery of the Grid System taking into account Bulk Generation capabilities and the operational constraints of the Grid System.

OC10.2.1.3 During Shutdown and subsequent recovery, the Grid System may be operated outside normal system voltage and normal system frequency limits.

OC10.2.1.4 Generators that do not require a supply from the Grid System to restart following Shutdown will be designated as “Black Start Units” by the TD&R Licensee.

OC10.2.1.5 The TD&R Licensee shall put in place contingency plans for restarting Black Start Units following Shutdown to establish Power Islands.

OC10.2.1.6 The TD&R Licensee shall maintain an initial generation Dispatch plan for Black Start, which will be available to all Bulk Generation Licence Holders.

OC10.2.2 Black Start Situation

OC10.2.2.1 The TD&R Licensee shall, as soon as reasonably practicable, inform Users who need to be informed under Black Start procedures that a Shutdown has occurred.

OC10.2.2.2 The TD&R Licensee shall implement Black Start procedures, with the main objective of restoring an integrated whole Grid System, as soon as possible, bearing in mind the need to restore supplies to Users. The procedure for recovery after a partial Shutdown will be the same as that for a total Shutdown except for the extent of the Grid System affected.

OC10.2.2.3 The complexities and uncertainties of recovery from a Shutdown of the Grid System require that Black Start is sufficiently flexible in order to accommodate

the full range of generation sets, Grid System characteristics and operational possibilities. This may preclude setting out precise chronological restoration sequences. The overall recovery strategy will be, in general, the establishment/overlapping of isolated Power Islands and step-by-step integration of these Islands into larger sub-systems and eventually to re-establish a complete system.

OC10.2.2.4 Where the TD&R Licensee, as part of Black Start procedures, has given an Instruction to a Black Start Unit to initiate start-up, the Generator shall confirm back to the TD&R Licensee when start-up has been completed. Following confirmation of start-up completion, the TD&R Licensee will endeavour to stabilise that Generation Unit by the establishment of appropriate demand to create a Power Island.

OC10.2.2.5 The conclusion of the Black Start situation and the time normal operation of the Grid System has been re-established will be determined by the TD&R Licensee, who will inform Users appropriately.

OC10.3 Re-synchronising Islands

OC10.3.1 Where parts of the Grid System are out of synchronism with each other but there is no Shutdown, the TD&R Licensee will instruct Users to regulate generation or demand, as the case may be, to enable Power Islands to be re-synchronised.

OC10.4 Civil Emergency, Natural Disaster and Weather-Related Incidents

OC10.4.1 The TD&R Licensee shall prepare and maintain procedures for responding to a Civil Emergency or weather-related incident that has disrupted or is likely to disrupt electricity supplies.

OC10.4.2 In a Civil Emergency or weather-related incident it may become necessary to restrict User demand and consumption of electricity, which may be achieved by one or more of the following methods.

a) Appeals by the Government to the public for voluntary restraint.

b) The issue of orders requiring restrictions on consumption by industry and commerce.

c) The issue of directions by the TD&R Licensee requiring rota disconnections and associated restrictions.

OC10.4.3 In the event that the TD&R Licensee implements rota disconnections, the TD&R Licensee will establish, as soon as possible, communications with relevant Users, as is necessary, to ensure operational liaison.

OC10.4.4 The procedures to be implemented will be similar to those outlined for Load Shedding in Grid Code Condition OC6.2.

OC11 System Dispatch

OC11.1 Introduction

OC11.1.1 Grid Code Condition OC11 specifies the rules and procedures for governing Dispatch as required by the TD&R Licence.

OC11.1.2 The TD&R Licensee shall specify which Generation Units connected to the Grid System shall be subject to Dispatch.

a) Distributed Generation will not be subject to Dispatch and will be able to export up to their agreed Capacity without notice to the TD&R Licensee, unless instructed otherwise by the TD&R Licensee.

NOTE: Standby Generation does not operate in parallel with the Grid System and is not subject to Dispatch.

b) Bulk Generation with a Power Purchase Agreement/Arrangement will be subject to Dispatch under Non-Daily or Long-Term Dispatch Instructions issued by the TD&R Licensee and will be able to export up to their agreed Capacity during the Dispatch Period, unless instructed otherwise by the TD&R Licensee.

NOTE: The Dispatch Period will generally be the period stated in the Connection Agreement/Power Purchase Agreement/Arrangement for which the Generator can export up to its agreed connection Capacity unless instructed to do otherwise by the TD&R Licensee in a Dispatch Instruction.

c) Utility-owned Bulk Generation will be subject to Dispatch by the TD&R Licensee for a Dispatch Period of one half hour or such other period of time as required by the TD&R Licensee and in accordance with the Dispatch Instruction.

OC11.1.3 Generation Units subject to Dispatch shall be dispatched in order of merit. The merit-order shall be determined by the TD&R Licensee taking into account the requirements of Section 20(3) of the Act and the principles and criteria relevant to Dispatch of generation in the Integrated Resource Plan. The merit-order shall be compatible with delivering an economical, secure and sustainable supply of electricity.

OC11.1.4 The TD&R Licensee will Dispatch Generation Units to ensure that the load demand of the Grid System is continuously met. The TD&R Licensee may also use Energy Storage Installations and Demand Side Management resources, where these are available and economic to balance generation and demand in the Grid System, whilst maximising utility to the Grid System and Customers.

OC11.2 Principles for Dispatch of Generation

OC11.2.1 The following principles and rules for Dispatch and scheduling generation will be applied by the TD&R Licensee.

OC11.2.2 The TD&R Licensee will schedule Generation Units for exporting of Available Capacity, using a Dispatch model that accurately models plant operation and costs, generally on the basis of the least cost option to meet each MW of additional load. Other criteria such as greenhouse gas emissions, reliability

and ancillary functions will also be considered, consistent with meeting the objectives of the Grid Code.

OC11.2.3 The merit order shall take into account the TD&R Licensee's obligations under Power Purchase Agreement/Arrangement. Generators with a valid Power Purchase Agreement/Arrangement shall have their Available Capacity dispatched according to the economics and nature of the energy resource/technology. This is to ensure the TD&R Licensee meets its obligation to purchase the energy output available under the Power Purchase Agreement/Arrangement.

OC11.2.4 Bulk Generation with renewable energy sources (subject to valid Power Purchase Agreement/Arrangement, Dispatch Period, Availability Declaration, any other Dispatch Instruction in place) will be scheduled ahead of Bulk Generation with non-renewable energy sources.

OC11.2.5 Bulk Generation with non-renewable energy sources with valid Power Purchase Agreements/Arrangements will be scheduled according to the least cost energy output price for the Dispatch Period concerned.

OC11.2.6 Bulk Generation with Power Purchase Arrangements shall be scheduled in order of the least cost option to meet each MW of additional load taking into account the following factors.

a) Availability of units for Dispatch.

b) Differences in load-efficiency curves (that can result in complex shifting of load across units).

c) Fuel type and fuel price (preference for low greenhouse gas emissions).

d) Requirement to provide sufficient spinning reserve.

e) Type of operation required to meet load changes and to keep the frequency of the Grid System within limits.

f) Operational constraints placed on the units such as the need to run at a reduced power rating, thermal constraints, vibration/noise considerations, running hours etc.

OC11.2.7 Units with the lowest production costs will generally be dispatched first in order of unit production cost to meet base load, where the load is shared according to the outputs of the Dispatch model.

OC11.2.8 Remaining Generation Units will be scheduled and loading of dispatched units will be adjusted according to the results of the Dispatch model, to provide the least cost for meeting each MW of additional load.

OC11.2.9 Centrally dispatched gas turbines will be generally dispatched last on the basis of fuel price taking into account the need to ensure there is at least one smaller rated unit kept in reserve as standby emergency generation to respond to an unplanned loss of generation.

OC11.2.10 Sufficient spinning reserves shall be maintained at all times to ensure reliability of electricity supplies for a single event where the largest generation

output power could be lost suddenly. This shall include consideration of whether additional reserves are also required to ensure stability of the Grid System in this event.

NOTE: The largest generation output power could be the output power from the single largest Generation Unit supplying the Grid System or, where greater, the aggregate generation from similar renewable energy sources such as solar PV.

The TD&R Licensee may use Bulk Energy Storage Installations or devices to provide part or all of the spinning reserve requirement.

OC11.2.11 Each Generation Unit subject to Daily or Short-Term Dispatch shall be capable of operation within the power factor range specified by the TD&R Licensee under full load.

OC11.2.12 The TD&R Licensee shall instruct the Generator to control, at all times under Normal Operating Conditions, the following parameters for all its Generation Units subject to short-term Dispatch Instructions.

a) frequency.

b) terminal voltage.

c) apparent and Reactive Power.

OC11.2.13 The TD&R Licensee will optimize the overall system efficiency by instructing the Generator to constantly adjust the load set points of individual Generation Units while preserving Grid System frequency and voltage.

OC11.3 Sale of Electricity to TD&R Licensee

OC11.3.1 Where a Bulk Generation Licence Holder wishes to sell electricity to the TD&R Licensee, the sale of electricity will be done via a Power Purchase Agreement or Power Purchase Arrangement as set out in the relevant Bulk Generation Licence.

OC11.3.2 The TD&R Licensee will agree to purchase the power generated as set out in the Power Purchase Agreement/Arrangement.

OC11.4 Criteria for Dispatch

OC11.4.1 In addition to the principles and rules stated in Grid Code Condition OC11.2, aspects of the Integrated Resource Plan relevant to Dispatch will be considered in the development of the merit-order.

OC11.4.2 The merit-order will ensure the following criteria are met:

a) Contribution to network stability.

b) Contribution to security of supply.

c) Facilitate the connection of renewable energy sources to reduce emissions of greenhouse gases.

d) Affordability of electrical supplies.

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OC11.5 Selecting Dispatch

OC11.5.1 The TD&R Licensee will centrally Dispatch generation based according to the principles and rules stated in Grid Code Condition OC11.2.

REQUIREMENTS FOR GENERATORS

RFG1 Introduction

RFG1.1 Prospective Generators shall initiate discussions at a sufficiently early stage in design to allow the TD&R Licensee to examine the impact of connecting the Generation Unit(s) to the Grid System.

RFG1.2 The TD&R Licensee may refuse permission for the connection of a Generation Unit at a point on the Grid System or may require revision to design or technical parameters of the Generation Unit or may impose certain restrictions in order to ensure that security of supply and quality of supply standards are met.

RFG1.3 Applications for a Standard Contract shall be required to follow the connection process in the Grid Code and the Grid Connection Policy. The Interconnection of Distributed Generation under a Standard Contract shall be subject to the relevant requirements of the Grid Code being met.

RFG2 Objective

RFG2.1 The objectives of the Requirements for Generators Code are to:

a) specify standard methods of Interconnection to the Grid System.

b) specify minimum technical, design and operational criteria which shall be complied with by any prospective Generator or any generation connected to the Grid System.

RFG2.2 Specific requirements for each Generator connection may also be set out in a separate Connection Agreement or, in some cases, Power Purchase Agreement/Arrangement.

RFG3 Scope

RFG3.1 This Requirements for Generators (RFG) applies to all Generation Units, including Bulk Generation and Distributed Generation, that are intended to be or are connected to the Grid System. Where requirements only apply to a specific type or Capacity of generation then this will be explicitly stated.

RFG3.2 In addition to meeting the requirements of the RFG, Generators shall also comply with the requirements of other relevant sections of the Grid Code, where applicable.

RFG4 Specific Rules for Generators

RFG4.1 The integrity, security and quality of supply shall not fall below the required standards for the Grid System as a result of connecting/synchronising Generation Units to the Grid System.

RFG4.2 Conditions for operation of generation shall ensure the safety of the public, personnel and equipment connected to the Grid System.

RFG4.3 Conditions for operating Generation Units in parallel with the Grid System shall comply with the technical and operational requirements of this Grid Code including requirements for compatibility with Grid System protection.

RFG4.4 The Generator shall be responsible for the safety of its personnel and equipment and for the efficient operation of its Generation Units.

RFG4.5 The TD&R Licensee shall be consulted about any generation to be connected to the Grid System and shall have the right to inspect and witness the correct operation of it prior to connection.

RFG4.6 Should a Generation Unit have a detrimental impact on the stability of the Grid System then the TD&R Licensee may require it to be disconnected.

RFG5 Requirements for Generator Connections

RFG5.1 Information Requirements

RFG5.1.1 Information Required from Generators

RFG5.1.1.1 In addition to any relevant information requirements stated elsewhere in the Grid Code, the User shall provide the following minimum information concerning the Generator connection:

a) Export Capacity (AC MW).

b) Contribution to the fault level of the Grid System.

c) Frequency response capability.

d) Synchronising facilities.

e) Whether the device/Installation has any Black Start capability.

RFG5.1.1.2 The level of detail required at the planning stage will vary depending on the type and size of the Generation Unit and the Connection Point with the Grid System. Prior to entering into any Connection Agreement, Generators shall provide the Generator details required in Schedule 4 of Grid Code Annex 1.

RFG5.1.1.3 The TD&R Licensee will use the information provided to model the Generation Unit(s) to determine a technically acceptable method of connection. For Generation Units with an export Capacity greater than 100 kW, or where the export Capacity exceeds the service limit for the associated voltage level, or where the nature of the proposed connection requires more detailed assessment, the TD&R Licensee may request more detailed information from the Generator.

RFG5.1.1.4 The Generator, as applicable, shall provide operational forecast data as stipulated in:

a) Grid Code Condition OC4.3.

b) Schedule 5 of Grid Code Annex 1.

RFG5.1.2 Information Provided by the TD&R Licensee

RFG5.1.2.1 On request, the TD&R Licensee shall provide sufficient information concerning the characteristics of the Grid System to enable a Generator or prospective Generator to undertake preliminary design for connection of a Generation Unit. Such information shall not be unreasonably withheld and shall be supplied in a timely manner.

RFG5.1.2.2 The TD&R Licensee shall provide relevant information stipulated in Grid Code Condition CC4.2.6 to Generators applying for connection to the Grid System.

RFG5.1.2.3 For generation intended to operate in parallel with the Grid System, the following additional information shall be provided by the TD&R Licensee including:

a) Interface protection requirements.

b) Details of equipment, cabling, switchgear, metering requirements for the Interconnection.

c) Details of any substation site at the interface and associated building requirements.

RFG5.2 Generation Interconnection Studies

RFG5.2.1 In addition to the requirement for any relevant Interconnection studies stated elsewhere in the Grid Code, the User shall conduct additional studies necessary to determine the acceptability of a Generator connection. Where the export Capacity is greater than or equal to 500 kW the TD&R Licensee will provide its network model for the User to carry out the additional studies necessary, subject to agreement with the User regarding the use of data and confidentiality of the data and network model.

RFG5.2.2 The TD&R Licensee may require appropriate power system studies to be undertaken to confirm the operation of the generation is compatible with the Grid Code. These studies may be conducted by the TD&R Licensee directly or at the discretion of the TD&R Licensee by a third party. The results of power system studies and any associated requirements shall be provided to the relevant parties. The cost of these studies shall be borne by the relevant applicant.

RFG5.2.3 The following additional power system studies specific to a Generator connection shall be carried out using suitable power system analysis software programs.

a) Transient stability analysis.

b) Steady-state stability analysis.

c) Voltage stability analysis.

In addition, the TD&R Licensee may request stability or quasi-dynamic analysis for medium and long-term Grid System conditions.

RFG5.3 Determination of Connection Point & Method of Connection

RFG5.3.1 In addition to the requirements for determination of the Connection Point and method of connection stated elsewhere in the Grid Code, particular consideration shall be given to assessing the impact of the Generator connection on the quality of supply to other Users when determining the Connection Point.

RFG5.3.2 Equipment provided by the TD&R Licensee at the Connection Point shall not be used for synchronising between the Grid System and the generation unless expressly agreed in writing by the TD&R Licensee. The Generator shall be responsible for providing equipment to synchronise its Generation Unit(s) with the Grid System.

RFG5.3.3 The Generator shall provide suitable means of disconnecting and isolating each Generation Unit from the Grid System that is clearly identifiable and readily accessible to operators.

RFG5.3.4 The method of Interconnection shall be determined by the TD&R Licensee in accordance with Grid Code Condition CC4.3. The following additional factors for the connection of Generators apply.

a) Capacity of the Grid System to import the generation Capacity.

b) Impact on voltage control employed on the Grid System and supply voltage.

c) Reliability considerations.

d) Provision of auxiliary power supplies from the Grid System.

RFG5.4 Supply Voltage

RFG5.4.1 The voltage level at which Generators are interconnected to the Grid System will be dependent upon, but not limited to, their Capacity, short-circuit current contribution and the other factors that determine the Connection Point.

RFG5.5 Generator Configuration

RFG5.5.1 The TD&R Licensee shall define any specific arrangements for the configuration of the Generation Unit(s) at the Connection Point as part of the connection offer. Distributed Generation connected under the Standard Contract will have a standard configuration.

RFG5.5.2 The Generator shall advise details of any interlocking arrangements that are necessary to ensure the arrangement/operation of the Generation Unit(s) complies with the requirements of this Grid Code. This includes preventing Standby Generation from operating in parallel with the Grid System, where the TD&R Licensee has prohibited this.

RFG5.6 Generator Plant Commissioning

RFG5.6.1 Prior to connection of any generation to the Grid System, the Generator or its agent shall produce a detailed and comprehensive Commissioning programme. The TD&R Licensee shall advise any additional or amended checks/tests to be carried out, which it deems necessary to demonstrate conformance to the Grid Code.

RFG5.6.2 The TD&R Licensee or its designated agent shall be given the opportunity to witness any or all of the on-site Commissioning. Sufficient notice shall be given to the TD&R Licensee to allow it to schedule suitable staff to attend. The TD&R Licensee shall advise the Generator, in advance, of which, if any, tests it intends to witness. Costs incurred by the TD&R Licensee in witnessing any tests will be charged to the Generator by the TD&R Licensee in accordance with the Grid Connection Policy.

RFG5.6.3 The TD&R Licensee shall have the right to specify reasonable tests to confirm satisfactory performance of the Generator connection with the Grid System. This may include:

a) tests to demonstrate the Generation Unit(s) will remain stable and connected to the Grid System under certain conditions.

b) tests to confirm the level of d.c. injection into the Grid System does not exceed levels specified by the TD&R Licensee.

c) over-voltage/under-voltage protection tests.

d) over-frequency/under-frequency protection tests.

e) loss of mains protection tests.

f) other protection tests associated with disconnection of the Generation Unit(s).

g) synchronisation tests.

The costs of carrying out these tests shall be borne by the Generator in accordance with the Grid Connection Policy.

RFG5.6.4 Following installation but prior to final connection and putting any Generator connection into service, the Generator shall demonstrate to the TD&R Licensee that the connection fully conforms with the requirements of the Grid Code and Connection Agreement. The TD&R Licensee shall provide acceptance of this in writing.

RFG6 Technical Requirements for Generators

RFG6.1 Generator Performance Requirements

RFG6.1.1 General

RFG6.1.1.1 In addition to the technical requirements stated elsewhere in the Grid Code, Generators shall comply with the additional technical requirements specified in this part of the Grid Code.

RFG6.1.1.2 The TD&R Licensee shall agree the performance requirements with the Generator during the connection application process. The agreed performance requirements for Bulk Generation shall be included in the Connection Agreement. The minimum performance requirements for Distributed Generation will be as stated in the Standard Contract.

RFG6.1.1.3 Performance requirements may include:

a) export Capacity.

b) voltage control capability (RFG6.1.8).

c) coordination of Generation Unit protection with Grid System protection (RFG6.2).

d) short-circuit current contribution to the fault level of the Grid System at the Connection Point (see RFG6.1.3).

e) frequency response capability (see RFG6.1.5).

f) synchronising capability (see RFG6.1.6).

g) Black Start capability (see RFG6.1.7).

RFG6.1.2 Fault Ride Through and Phase Unbalance

RFG6.1.2.1 Generation Units connected to the Grid System, when stipulated by the TD&R Licensee, shall be required to withstand, without tripping, the effects of a three-phase Grid System fault and the phase Voltage Unbalance imposed during the clearance of this fault by the Grid System main protection. The TD&R Licensee will advise the Generator of the likely tripping time of the Grid System protection, and for phase-phase faults, the likely value of phase Voltage Unbalance during the fault clearance time.

RFG6.1.3 Short-Circuit Levels

RFG6.1.3.1 Generation Units and associated equipment connected to the Grid System shall be designed to withstand both symmetrical and asymmetrical short-circuit conditions at the Connection Point for the maximum declared fault level. This shall include both the short-circuit contribution from the Generation Unit and the Grid System, where applicable.

RFG6.1.4 Frequency Requirements

RFG6.1.4.1 Generation Units connected to the Grid System shall be capable of sustained operation at any load, within their frequency/voltage and power output limits, for the range of system frequencies defined in the Connection Agreement or, where not, in PC4.2.2.

RFG6.1.4.2 Unless otherwise stated in the Connection Agreement, Generators shall disconnect from the Grid System within 0.5 seconds of the system frequency exceeding the absolute limits stated in Grid Code Condition PC4.2.2. Automatic disconnection shall be achieved in this event by the setting of under-frequency and over-frequency protection.

RFG6.1.5 Frequency Response

RFG6.1.5.1 Bulk Generation, where required by the TD&R Licensee, shall have continuously fast acting response automatic governor and excitation control systems to control the Generator power output and voltage levels without instability of operation within the required operating range of the unit.

RFG6.1.5.2 The droop characteristics, where applicable, from no load to full load for Generation Units shall be adjustable. The governor droop shall be agreed

with the TD&R Licensee and shall be in the range of 0% to 5%. The TD&R Licensee shall determine the mode of governor operation required being either droop control or isochronous control.

RFG6.1.5.3 Bulk Generation that has Capacity available to either increase output or decrease output in real-time shall provide frequency response, which may make use of that available Capacity to respond to Grid System frequency deviations.

RFG6.1.6 Synchronising Facilities

RFG6.1.6.1 Each Generator connection shall be equipped with facilities to synchronise it with minimal disturbance to the Grid System.

RFG6.1.6.2 Where required by the TD&R Licensee, two independent synchronising facilities, preferably one automatic and one manual shall be provided, where the primary facility shall be automatic.

RFG6.1.6.3 Synchronisation facilities shall include a synch check function, where applicable (see Grid Code Annex 2). Where required by the TD&R Licensee, the synch check function shall have dual redundancy.

RFG6.1.7 Black Start

RFG6.1.7.1 Where a Generation Unit is designated as a Black Start Unit, it shall be capable of:

a) starting/restarting without any incoming supply or auxiliary supply from the Grid System;

b) connecting to a dead bus; and

c) supplying load, as necessary.

RFG6.1.7.2 In the event of a Black Start situation, the Generator shall act, temporarily upon the provision of Instructions from the TD&R Licensee, as defined in Grid Code Condition OC10.2.

RFG6.1.7.3 The technical specification for any new Black Start Unit, where required, will be detailed and agreed in the Connection Agreement.

NOTE: Distributed Generation will not generally be required to have Black Start capability.

RFG6.1.8 Voltage Fluctuation and Flicker

RFG6.1.8.1 Bulk Generation shall be capable of operating in a voltage control mode to maintain the system voltage at a set-point provided by the TD&R Licensee. The voltage set-point requirement shall be within the normal system voltage operating range, where relevant for the particular control mode.

RFG6.1.8.2 Generation shall not cause significant voltage Flicker when measured at the Point of Common Coupling. Flicker shall not exceed the planning levels stipulated in Grid Code Condition PC4.2.3.3.

RFG6.1.8.3 The maximum voltage fluctuation at the Connection Point should not exceed 5% for planned connection of the largest Generation Unit in the Facility and should remain within 10% of the nominal system voltage in the case the entire Facility trips.

RFG6.1.9 Total Harmonic Distortion

RFG6.1.9.1 The output of a Generation Unit shall not contain harmonic content that could cause disturbance, including unacceptable voltage distortion, or damage to other Users and equipment connected to the Grid System.

RFG6.1.9.2 Generators shall meet the requirements of internationally accepted standards for harmonics, including IEEE 519 and IEC 61000-4-7.

RFG6.1.9.3 Total Harmonic Distortion when measured at the Point of Common Coupling shall not exceed the limits in Table 1 and Table 2 of IEEE 519.

RFG6.1.10 Power Factor

RFG6.1.10.1 Each Generation Unit shall be capable of normal operation at rated output within the power factor range of 0.95 lagging and 0.95 leading when measured at its Connection Point.

RFG6.1.10.2 Bulk Generation shall be designed to supply and absorb Reactive Power within the technical limits specified for the full range of operating conditions at the Capacity and power factor range stated in the Connection Agreement. Distributed Generation shall conform to the technical limits and operating conditions stated in the Standard Contract.

RFG6.2 Protection Requirements

RFG6.2.1 The TD&R Licensee shall, as part of the connection offer, specify the minimum protection requirements to be provided by the Generator at the interface with the Grid System. This may include type test requirements for inverters and their associated protection/control functions at the interface with the Grid System.

Generators will be required to conform with the applicable requirements of the following particular standards:

a) IEEE Standard 1547 for Interconnecting Distributed Resources with Electric Power Systems for Generating Facilities.

b) IEEE Standard 1547.1 for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.

c) UL 1741 Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.

d) IEEE 929 for interfacing solar photovoltaic (PV) systems to the Grid System.

The Generator shall determine what other protection requirements are needed to protect the Generation Unit from events on the Grid System as well as those originating within the Generation Unit and associated connections. The minimum requirements for Distributed Generation shall conform with the protection requirements in Grid Code Annex 2 and the Standard Contract.

NOTE: Events on the Grid System may include voltage fluctuations, voltage Flicker, harmonic distortion and phase unbalance.

RFG6.2.2 All protection equipment provided by the Generator shall be compatible with the standards and practices used on the Grid System. This includes achieving the necessary operating times, sensitivity, discrimination and coordination. The TD&R Licensee shall provide details of specific requirements for Generators during the connection application process.

NOTE: The Generator should be aware that sequential switching may be used on the Grid System. Protection arrangements may also cause disconnection of one or two phases only of a multi-phase connection.

RFG6.2.3 Unless expressly agreed by the TD&R Licensee, Generators shall install protection equipment that conforms to the requirements in Grid Code Annex 2, including:

a) over-voltage and under-voltage protection to disconnect the Generation Unit in the event of a severe variation of voltage. The TD&R Licensee shall specify the acceptable voltage range.

b) over-frequency and under-frequency protection to disconnect the Generation Unit in the event of a severe variation of frequency. The TD&R Licensee shall specify the acceptable frequency range.

c) loss of mains protection to disconnect the Generation Unit in the event of the loss of one or more phases of the Grid System.

d) overcurrent protection as specified elsewhere in the Grid Code.

e) neutral voltage displacement protection.

f) trip lockout.

RFG6.2.4 The TD&R Licensee may specify additional protection requirements depending upon the type of Generation Unit, the method of connection and the system voltage level, which may include but is not limited to:

a) differential protection.

b) directional overcurrent protection.

c) reverse power protection.

d) Circuit-Breaker fail protection.

RFG6.2.5 Where protection at the interface with the Grid System is physically integrated within the overall Generation Unit control system, the functionality of the interface protection unit should not be compromised by any failure of other elements of the control system.

RFG6.3 Neutral Earthing

RFG6.3.1 The TD&R Licensee shall, as part of the connection offer, agree the neutral earthing arrangements to be provided by the Generator.

RFG6.3.2 Where applicable, neutral earthing arrangements shall be compatible for parallel operation with the Grid System.

RFG6.3.3 Neutral earthing arrangements shall avoid circulating currents that could cause mal-operation of protection.

RFG6.3.4 The Generator shall take adequate precautions to ensure the star point is connected to earth by independent safe conditions if any earthed neutral point of the Generation Unit becomes disconnected from earth.

RFG6.3.5 Where a Generation Unit is intended to operate either in parallel with the Grid System or independently of the Grid System, there shall be means:

a) during independent operation to disconnect the phase and neutral conductors of the Grid System and for the system to be independently earthed via the Generation Unit star point.

b) during parallel operation to disconnect the Generation Unit star point from local earth, where the neutrals of the Grid System and generation unit are connected.

Any changeover arrangement to separate the two systems should be of a break-before-make arrangement and should prevent phase or neutral current produced by the generation from flowing into the Grid System when it is operating independently of the Grid System.

RFG6.3.6 Where a Generation Unit is not intended to operate in parallel with the Grid System, the Generator shall take adequate precautions to ensure the star point of the Generation Unit is connected to earth independently of the Grid System. The requirements of RFG7.2 also apply to Standby Generation.

RFG6.4 Provision of Remote Monitoring and Control

RFG6.4.1 Facilities for the remote monitoring and control of a Generator's Facility shall meet the requirements of Grid Code Condition CC5.8 for User connections.

RFG6.4.2 The TD&R Licensee shall, in any event, specify what additional requirements shall be provided for remote monitoring and remote control of the Generator Facility for integration into the TD&R Licensee's SCADA system.

RFG6.4.3 Where the export Capacity is less than 500 kW the Distributed Generator shall provide the TD&R Licensee with the following SCADA inputs when required, as a minimum.

a) Instantaneous Active Power output (MW).

b) Instantaneous Reactive Power output (Mvar).

c) Instantaneous voltage at the Connection Point (kV).

NOTE 1: The Generator Capacity relates to an individual Generation Unit or aggregation of Generation Units in the same Installation.
NOTE 2: Power output is typically derived from metering.

RFG6.4.4 Where the Generator export Capacity is greater than or equal to 500 kW the Bulk Generation Licence Holder shall provide the TD&R Licensee with the following SCADA inputs, as a minimum.

a) Instantaneous real power output (MW).

b) Instantaneous Reactive Power output (Mvar).

c) Instantaneous voltage at the Connection Point (kV).

d) Hourly integrated energy for billing (MWh and Mvarh).

e) Status of Generator interface Circuit-Breaker.

f) Status of Generation Unit transformer(s) High-Voltage Circuit-Breaker(s) and/or isolator(s).

g) High-Voltage bus voltage.

h) Power system stabiliser (PSS) status, if applicable.

i) Automatic voltage regulator (AVR) status, if applicable.

j) Total plant MW, if requested.

k) Instantaneous ambient temperature, if requested.

l) Generator step-up transformer tap setting, if requested.

RFG6.4.5 Where the generation export Capacity is greater than or equal to 500 kW a remote terminal unit and/or Data Link shall be provided by the Generator at the generation Installation capable of exchanging SCADA information between the Generator and the Operations Control Centre. The Generator shall be responsible for the ongoing maintenance of the remote terminal unit and/or Data Link to ensure it remains serviceable. The protocol for data exchange via the remote terminal unit shall be compatible with that used for communications by the Operations Control Centre. The TD&R Licensee will specify the protocol for data exchange in the Connection Agreement.

NOTE: The User can source a compatible remote terminal unit through the TD&R Licensee, if required.

RFG6.4.6 Where the Bulk Generation voltage regulator controls the voltage of the Grid System, the Generator shall provide the Operations Control Centre with 24-hour telephone access to a continuously staffed or remotely controlled Generator Facility control function via a dedicated phone line, where this is required by the TD&R Licensee. Within an agreed time (typically 10 minutes), the Generator Facility shall be able to adjust the voltage set-point as directed by TD&R Licensee.

RFG7 Operational Requirements for Generators

RFG7.1 Islanding

RFG7.1.1 In the event of a Grid System failure, generation shall, unless explicitly agreed in writing by the TD&R Licensee, automatically disconnect from the Grid System. The generation shall remain disconnected unless:

a) the TD&R Licensee has approved its automatic restoration under specified Grid System conditions.

b) the TD&R Licensee has specifically instructed its reconnection to the Grid System.

c) Distributed Generation is fitted with automatic reconnection facilities, where it will only automatically reconnect if the Grid System voltage and frequency parameters are within specified limits (see Grid Code Condition PC4.2).

RFG7.1.2 Exceptionally, the TD&R Licensee may require the Generator to remain connected in the event of a Grid System failure and to operate as an intentional Islanded Condition. Where Islanded operation is required, the TD&R Licensee shall provide written operational conditions as part of the Connection Agreement.

RFG7.2 Standby Generation

RFG7.2.1 Standby Generation, intended solely for providing an alternative supply to Users when the Grid System is unavailable, will not be permitted to operate in parallel with the Grid System without the express agreement of the TD&R Licensee. This is to avoid the possibility of an unintentional Islanded Condition.

With the express agreement of the TD&R Licensee, in writing, Standby Generation not intended for parallel operation may be permitted to operate in parallel with the Grid System for no more than five minutes in any one month and no more frequently than once per week. This will only be permitted where loss of supply during changeover causes significant disruption to the User. If the duration of parallel operations exceeds these limits then it shall be considered to be operating in long-term parallel mode and shall be required to meet the requirements for operating in parallel with the Grid System.

RFG7.2.2 Where there is a parallel path in both the neutral and earthing systems, the Generator shall provide a changeover device which switches both the phase(s) and neutral to avoid circulating currents.

RFG7.2.3 The Generator shall ensure that any part of the Facility being supplied by the Standby Generation remains disconnected from the Grid System whilst it is in operation.

RFG7.2.4 Unless agreed otherwise with the TD&R Licensee, any system which can be supplied by Standby Generation shall have a break-before-make changeover device/system to prevent parallel operation with the Grid System. The changeover device/system shall be of a fail-safe design and shall be acceptable to the TD&R Licensee.

RFG7.3 Inspection, Testing and Monitoring

RFG7.3.1 Facilities for the inspection, testing and monitoring of a Generator's Facility and associated connections to the Grid System shall meet the requirements of Grid Code Condition OC8 for User connections.

RFG7.3.2 The TD&R Licensee shall be given all reasonable facilities to inspect and monitor a Generator Facility and the associated connections to the Grid System, whenever requested. The TD&R Licensee shall provide advance notice, where reasonably practicable, of any inspection, testing and monitoring visit.

RFG7.3.3 The Generator shall agree to any reasonable request to undertake testing of the Generator/Facility, when requested by the TD&R Licensee.

NOTE: The requirement for inspection, testing and monitoring under Grid Code Condition RFG7.3 applies to the period after the Facility has been commissioned. The intention is that the TD&R Licensee will bear its own costs associated with its activities under this requirement.

RFG8 Communication and Control Requirements for Generators

RFG8.1 Notice Required for Synchronisation

RFG8.1.1 Generators shall obtain permission from the TD&R Licensee prior to synchronising Bulk Generation with the Grid System, unless:

a) stated otherwise in the Connection Agreement.

b) synchronisation is necessary to comply with a Dispatch Instruction.

c) as a result of an automatic reclose scheme, which has been Approved.

RFG8.1.2 Generators may disconnect and be de-synchronised from the Grid System without prior agreement from the TD&R Licensee in the event of:

a) the need to ensure the safety of persons and/or equipment.

b) Emergency situations.

c) automatic tripping.

RFG8.2 Designated Contact Persons

RFG8.2.1 The Generator shall nominate contact persons, provide contact details and agree the communication channel(s) for coordinating the operation of its generation Facility.

RFG8.3 Control Arrangements

RFG8.3.1 The Generator shall establish and maintain adequate arrangements for controlling Generation Units to ensure the required quality of supply, reliability of supply and operational safety are met at the interface with the Grid System. As a minimum, communication and control requirements shall comply with Grid Code Conditions CC5.8 and OC7, where applicable. Control arrangements for Distributed Generation shall comply with the Standard Contract.

RFG8.3.2 The TD&R Licensee shall define any specific communication and control requirements for Bulk Generation in the Connection Agreement. This may include:

a) the protocol for communication between control facilities of the TD&R Licensee and the Generator including Dispatch Instructions.

b) system protection communication requirements.

c) SCADA communication requirements.

d) Tele-metering.

e) Operational communication channels, such as telephone, facsimile, email.

f) revenue metering.

RFG8.3.3 Bulk Generation that is subject to central Dispatch shall be issued Dispatch Instructions by the TD&R Licensee, usually by telephone followed up by a written Instruction. The written Instruction may be by email or other agreed

communication medium. The Generator shall formally acknowledge receipt and understanding of the Dispatch Instruction as soon as possible usually by telephone followed up in writing or email.

RFG9 Maintenance Requirements for Generators

RFG9.1 Maintenance requirements for generation and associated connections to the Grid System shall meet the requirements of Grid Code Condition OC9.6 for User connections. Provisions for meter reading, settlement and dispute resolution shall meet the requirements in CC7.

RFG9.2 Specific requirements for maintenance of a Generation Unit connected to the Grid System shall be agreed between the Generator and the TD&R Licensee and included in the Connection Agreement. This may include specific time periods when Outages can be scheduled.

RFG9.3 Equipment shall be suitably designed and labelled so as not to pose a hazard to any personnel that may be required to access and maintain it.

NOTE: Typically, a maintenance plan will be produced, in advance, for a minimum period of three years with a detailed plan for the first year. The maintenance plan will be reviewed and, where necessary, updated annually.

RFG9.4 Where Bulk Generation is subject to central Dispatch, Bulk Generation Licence Holders shall notify the TD&R Licensee of any Scheduled Outages required for maintenance at least 120 days before the beginning of the calendar year in which the Scheduled Outages are to take place.

The duration and timing of maintenance shall be consistent with Prudent Utility Practice and shall not be scheduled longer than is necessary.

The TD&R Licensee will approve the Scheduled Outages required by the maintenance plan or will advise adjustments and reasons for the adjustment within 30 days after receiving notification from the Generator.

In case of amendments being advised the Generator shall resubmit the maintenance plan with the amendments for approval by the TD&R Licensee.

Either the TD&R Licensee or the Generator may request amendments to the Approved maintenance plan. Joint agreement by the TD&R Licensee and the Generator is required to amend the previously agreed maintenance plan. The status of updates to the maintenance plan shall be checked at least on a quarterly basis.

RFG10 Metering Requirements for Generators

RFG10.1 Metering of a Generator Facility and associated connections to the Grid System shall meet the requirements of Grid Code Condition CC7 for User connections together with any specific requirement for metering in this Code.

RFG10.2 All measuring devices and metering equipment required for revenue metering shall be owned, supplied, installed and maintained by the TD&R Licensee, unless agreed otherwise with the Generator. Metering specifications and standards shall conform to Prudent Utility Practice and the TD&R Licensee

shall provide its specifications and requirements for metering equipment upon request. The Generator shall make provision for metering equipment, including measurement transformers, to be installed in their switchgear, where deemed necessary by the TD&R Licensee.

RFG10.3 The specific types of metering equipment, timing devices, locations of meters, the details of the metering arrangement and the records to be kept shall be compatible with normal TD&R Licensee practice and shall be determined by the TD&R Licensee in consultation with the Generator. The Generator may provide its own revenue assurance metering equipment.

RFG10.4 Also all technical matters related to meter accuracy, metering configuration, energy losses measurement, meter reading process, backup metering check requirement and meter security audit will be determined by the TD&R Licensee in consultation with the Generator.

RFG10.5 The revenue metering will either be installed at the boundary between the Grid System and the Generator Facility, or as close to it as practicable.

REQUIREMENTS FOR ENERGY STORAGE CONNECTIONS

RFES1 Introduction

RFES1.1 Energy storage systems for use with the Grid System are still in their infancy. It is expected that the use of such systems will accelerate as suitable technology becomes more practical, affordable and with the Capacity required for operation with the Grid System.

RFES1.2 Prospective Energy Storage Operators are required to comply with relevant parts of this Requirements for Energy Storage (RFES) Code when proposing, designing, planning and connecting Energy Storage Installations to the Grid System. These requirements also apply to Users of the Grid System, where they connect such devices to their own Installations insofar as they affect the operation of the Grid System.

RFES2 Objective

RFES2.1 The objectives of the Requirements for Energy Storage Code are to:

a) define any specific requirements to be satisfied before energy storage devices/Installations can be connected to the Grid System.

b) facilitate the use of Energy Storage Installations, where appropriate, to help reduce emissions of greenhouse gases and to improve the security of supply and standards of supply.

c) specify additional technical, design and operational criteria which shall be complied with by any Energy Storage Installations connected to the Grid System.

RFES2.2 Specific requirements for each Energy Storage Installations may also be set out in a separate Connection Agreement or, in some cases, Power Purchase Agreement/Arrangement.

RFES3 Scope

RFES3.1 This Requirements for Energy Storage Code applies to all Energy Storage Installations that are intended and are able to import/export electricity to the Grid System.

NOTE: Energy Storage Installations that are not able to export electricity to the Grid System are not within the scope of this Requirement for Energy Storage (RFES) Code.

RFES3.2 Although these requirements apply specifically to Energy Storage Installations, compliance with other sections of the Grid Code, where applicable, is required.

RFES4 Specific Rules for Energy Storage

RFES4.1 The connection of Energy Storage Installations shall not cause the integrity, security or quality of supply provided to other Users of the Grid System to fall below relevant standards set out in the Grid Code.

RFES4.2 Conditions for operation of Energy Storage Installations, which may be set out in the Connection Agreement, shall guarantee the safety of the public, operational persons and equipment connected to the Grid System.

RFES4.3 Energy Storage Installations intended for operation in parallel with the Grid System shall comply with all specific conditions imposed by the TD&R Licensee at all times. This shall include all requirements for electrical protection systems.

RFES4.4 The Energy Storage Operator shall be responsible for the efficient operation of its Installation.

RFES4.5 The TD&R Licensee shall:

a) be informed whenever an Energy Storage Installation is proposed for connection to the Grid System.

b) shall have the right to inspect the Energy Storage Installation, by agreement with the Energy Storage Operator.

Where appropriate, the right to inspect shall include a demonstration of the operation of the Energy Storage Installation to confirm satisfactory performance with Grid Code requirements. The requirements for satisfactory operation of the Installation apply to both export and import of power from and to the Energy Storage Installation.

RFES4.6 Where any Energy Storage Installation is found to have a detrimental impact on the stability of the Grid System, the TD&R Licensee shall have the right to disconnect the device/Installation from the Grid System.

RFES5 Requirements for Energy Storage Connections

RFES5.1 Information Requirements

RFES5.1.1 Information Required from Energy Storage Installations

RFES5.1.1.1 In addition to any relevant information requirements stated elsewhere in the Grid Code, the Energy Storage Operator shall provide the following information concerning the Energy Storage Installation:

a) Export and import Capacity (AC MW).

b) Contribution to the fault level of the Grid System.

c) Frequency response capability.

d) Synchronising facilities.

e) Whether the device/Installation has any Black Start capability.

RFES5.1.1.2 The Energy Storage Operator shall provide operational forecast data, as stipulated in Schedule 5 of Grid Code Annex 1, where this is appropriate to their Installation.

RFES5.1.2 Information Provided by the TD&R Licensee

RFES5.1.2.1 On request, the TD&R Licensee shall provide sufficient information concerning the characteristics of the Grid System to enable a prospective Energy Storage Operator to undertake preliminary design for connection of an Energy Storage Installation. Such information shall not be unreasonably withheld and shall be supplied in a timely manner.

RFES5.2 Interconnection Studies

RFES5.2.1 In addition to the requirement for any relevant Interconnection studies stated elsewhere in the Grid Code, the prospective Energy Storage Operator shall conduct additional studies necessary to determine the acceptability of an Energy Storage Installation.

RFES5.2.2 The TD&R Licensee may require appropriate power system studies to be undertaken to confirm the operation of the Energy Storage Installation is compatible with the Grid Code. These studies may be conducted by the TD&R Licensee directly or at the discretion of the TD&R Licensee by a third party. The TD&R Licensee may charge for these studies in accordance with the Grid Connection Policy.

RFES5.3 Determination of Connection Point & Method of Connection

RFES5.3.1 In addition, to the requirements for determination of the Connection Point and method of connection stated elsewhere in the Grid Code, particular consideration shall be given to assessing the impact of the Energy Storage Installation on the quality of supply to other Users when determining the Connection Point.

RFES5.3.2 Equipment provided by the TD&R Licensee at the Connection Point shall not be used for synchronising between the Grid System and the Energy Storage Installation unless expressly agreed in writing by the TD&R Licensee.

RFES5.3.3 The Energy Storage Operator shall provide suitable means of isolating the Energy Storage Installation from the Grid System that is clearly identifiable and readily accessible to operators.

RFES5.4 Supply Voltage

RFES5.4.1 The voltage level at which Energy Storage Installations are interconnected to the Grid System will be dependent upon, but not limited to, their Capacity, short-circuit current contribution and the other factors that determine the Connection Point.

RFES5.5 Configuration

RFES5.5.1 The TD&R Licensee shall define any specific arrangements for the Energy Storage Installation at the Connection Point as part of the connection offer.

RFES5.6 Commissioning

RFES5.6.1 Prior to connection of any Energy Storage Installation to the Grid System, the Energy Storage Operator or its agent shall produce a detailed and comprehensive Commissioning programme. The TD&R Licensee shall advise any additional or amended checks/tests to be carried out, which it deems necessary to demonstrate conformance to the Grid Code.

RFES5.6.2 The TD&R Licensee shall be given the opportunity to witness any or all of the on-site Commissioning. Sufficient notice shall be given to the TD&R Licensee to allow it to schedule suitable staff to attend. The TD&R Licensee shall advise the Energy Storage Operator, in advance, of which, if any, tests they intend to witness. Costs incurred by the TD&R Licensee in witnessing any tests shall be borne by the Energy Storage Operator.

RFES5.6.3 The TD&R Licensee shall have the right to specify reasonable additional tests to confirm satisfactory performance of the Energy Storage Installation with the Grid System. This may include tests to demonstrate that it will remain stable and connected to the Grid System under certain circumstances.

Unless proven by appropriate type testing, the TD&R Licensee shall require the following issues during Commissioning to be addressed. The costs of carrying out any additional tests shall be borne by the Energy Storage Operator.

- Disconnection if the protection settings are exceeded.
- Disconnection within the required time for protection co-ordination.
- Over / under voltage settings.
- Over / under frequency settings.
- Loss of mains disconnection (where appropriate).
- Frequency drift and frequency step change stability.
- Automatic reconnection with the appropriate delay.
- Harmonics.
- Power factor.
- Voltage Flicker.
- Overcurrent protection.
- Short circuit current contribution.
- Self-monitoring of any solid-state switch.
- Associated transformer tests.
- Communication tests.

RFES5.6.4 Prior to final connection and putting any Energy Storage Installation into service, the Energy Storage Operator shall demonstrate to the TD&R Licensee that the connection fully conforms with the requirements of the Grid

Code and Connection Agreement. The TD&R Licensee shall provide acceptance of this in writing.

RFES6 Technical Requirements for Energy Storage

RFES6.1 Energy Storage Performance Requirements

RFES6.1.1 The TD&R Licensee shall agree the performance requirements with the prospective Energy Storage Operator during the connection application process. The agreed performance requirements shall be included in the Connection Agreement.

RFES6.1.2 Performance requirements may include:

a) export and import power and energy including duration of discharge/charge cycles at rated Capacity.

b) short-circuit current contribution to the fault level of the Grid System.

c) frequency response capability.

d) synchronising capability.

e) Black Start capability.

f) Efficiency test.

g) Loss of mains operation.

RFES6.2 Protection Requirements

RFES6.2.1 The TD&R Licensee shall, as part of the connection offer, specify the minimum protection requirements to be provided by the Energy Storage Operator for the Energy Storage Installation. This may include type test requirements for inverters and their associated protection/control functions at the interface with the Grid System.

Energy Storage Installations will be required to conform with the applicable requirements of the following particular standards:

a) IEEE Standard 1547 for Interconnecting Distributed Resources with Electric Power Systems for Generating Facilities.

b) IEEE Standard 1547.1 for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.

c) UL 1741 Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.

The Energy Storage Operator shall determine what other protection requirements are needed to protect the Energy Storage Installations from events on the Grid System.

NOTE: Events on the Grid System may include voltage fluctuations, voltage Flicker, harmonic distortion and phase unbalance.

RFES6.2.2 All protection equipment provided by the Energy Storage Operator shall be compatible with the standards and practices used on the Grid System. This includes achieving the necessary operating times, sensitivity, discrimination and coordination. The TD&R Licensee shall provide details of specific requirements for Energy Storage Installations during the connection application process.

NOTE: The Energy Storage Operator should be aware that automatic switching may be used on the Grid System. Protection arrangements may also cause disconnection of one or two phases only of a multi-phase connection.

RFES6.2.3 Unless expressly agreed by the TD&R Licensee, the Energy Storage Operator shall install:

a) over-voltage and under-voltage protection to disconnect the energy storage device/Installation in the event of a severe variation of voltage. The TD&R Licensee shall specify the acceptable voltage range.

b) over-frequency and under-frequency protection to disconnect the Energy Storage Installation in the event of a severe variation of frequency. The TD&R Licensee shall specify the acceptable frequency range.

c) loss of mains protection to disconnect the Energy Storage Installation in the event of the loss of one or more phases of the Grid System.

d) overcurrent protection as specified elsewhere in the Grid Code.

RFES6.2.4 Where protection at the interface with the Grid System is physically integrated within the overall Energy Storage Installation control system, the functionality of the interface protection unit should not be compromised by any failure of other elements of the control system.

RFES6.3 Neutral Earthing

RFES6.3.1 The TD&R Licensee shall, as part of the connection offer, agree the neutral earthing arrangements to be provided by the Energy Storage Operator for the Energy Storage Installation.

RFES6.3.2 Where applicable, neutral earthing arrangements shall be compatible for parallel operation with the Grid System.

RFES6.4 Provision of Remote Monitoring and Control

RFES6.4.1 Facilities for the remote monitoring and control of an Energy Storage Installation shall normally be the same as an equivalent generation connection.

RFES6.4.2 The TD&R Licensee shall, in any event, specify what additional requirements shall be provided for remote monitoring and remote control of the Energy Storage Installation.

RFES7 Operational Requirements for Energy Storage

RFES7.1 Islanding

RFES7.1.1 In the event of a Grid System failure, Energy Storage Installations shall, unless explicitly agreed in writing by the TD&R Licensee, automatically disconnect from the Grid System. The device/Installation shall remain disconnected unless the TD&R Licensee has:

a) Approved its automatic restoration under specified Grid System conditions.

b) specifically instructed its reconnection to the Grid System.

RFES7.1.2 Exceptionally, the TD&R Licensee may require the Energy Storage Installation to remain connected in the event of a Grid System failure and to operate as an intentional Islanded Condition. Where Islanded operation is required, the TD&R Licensee shall provide written operational conditions as part of the Connection Agreement.

RFES7.1.3 In order to avoid the possibility of an unintentional Islanded Condition, Energy Storage Installations intended solely for standby supply to a User will not be permitted to operate in parallel with the Grid System without the express agreement of the TD&R Licensee.

With the express agreement of the TD&R Licensee, in writing, Energy Storage Installations intended for standby supply but not intended for parallel operation may be permitted to operate in parallel with the Grid System for no more than five minutes in any one month and no more frequently than once per week. This will only be permitted where loss of supply during changeover causes significant disruption to the User. If the duration of parallel operations exceeds these limits then it shall be considered to be operating in long-term parallel mode and shall be required to meet the requirements for operating in parallel with the Grid System.

RFES7.2 Standby Generation

RFES7.2.1 Not used.

RFES7.3 Inspection, Testing and Monitoring

RFES7.3.1 Facilities for the inspection, testing and monitoring of an Energy Storage Installation shall be the same as an equivalent generation connection unless stated otherwise in writing by the TD&R Licensee (refer to RFG7.3).

RFES7.3.2 The TD&R Licensee shall be given all reasonable facilities to inspect and monitor an Energy Storage Installation. The Energy Storage Operator shall agree to any reasonable request to undertake testing of the device/Installation, when requested by the TD&R Licensee.

RFES8 Communication and Control Requirements for Energy Storage

RFES8.1 Designated Contact Persons

RFES8.1.1 The Energy Storage Operator shall nominate contact persons, provide contact details and agree the communication channel(s) for coordinating the operation of its Energy Storage Installation, in the same manner as for an equivalent generation connection (refer to RFG8.3).

RFES8.2 Control Arrangements

RFES8.2.1 The Energy Storage Operator shall establish and maintain adequate arrangements for controlling Energy Storage Installations to ensure the required standards of supply, reliability of supply and operational safety are met at the interface with the Grid System. These arrangements shall generally be the same as for an equivalent generation connection.

RFES9 Maintenance Requirements for Energy Storage

RFES9.1 Specific requirements for maintenance of an Energy Storage Installation connected to the Grid System shall be agreed between the Energy Storage Operator and the TD&R Licensee and included in the Connection Agreement.

RFES9.2 Equipment shall be suitably designed and labelled so as not to pose a hazard to any personnel that may be required to access and maintain it.

NOTE: Typically, a maintenance plan will be produced, in advance, for a minimum period of three years with a detailed plan for the first year. The maintenance plan will be reviewed and, where necessary, updated annually.

RFES10 Metering Requirements for Energy Storage

RFES10.1 The requirements for metering of an Energy Storage Installation shall be the same as for an equivalent generation connection (refer to RFG10).

DEFINITIONS & GLOSSARY

Terms used in this Grid Code shall be interpreted as provided in this Definitions & Glossary, including when pluralised, unless the subject matter or context clearly requires otherwise.

Any term not specifically mentioned in this Definitions & Glossary shall be interpreted, in the order of precedence stated in Grid Code Condition GC4.2.4 and failing that as generally understood in the energy industry.

Alternative terms used in Grid Code related documents that have the same meaning as the term are shown against the term in parenthesis.

AC	alternating current
Active Power	product of voltage and the in-phase component of alternating current that equates to the true power in watts or multiples of
Apparatus	all equipment in which electrical conductors are used, supported or of which they may form a part
Approved	approved by the TD&R Licensee
ASAI	average service availability index as defined in IEEE Standard 1366-1998
Authority	Regulatory Authority established under the RAA
Availability Declaration	declaration by the Generator of Available Capacity for a Generation Unit for Dispatch in the Dispatch Period NOTE: Available Capacity means, for any Dispatch Period, the Active Power, expressed in MW at the reference conditions, of each Generation Unit forming part of the Facility available for delivery to the applicable Connection Point.
Available Capacity	for any Dispatch Period, the Active Power, at the reference conditions, of each Generation Unit forming part of the Facility available for delivery to the applicable Connection Point
BELCO	Bermuda Electric Light Company Limited
Black Start	restarting the Grid System following a total disconnection of all generation
Black Start Unit	Generation Unit with Black Start capability

Bulk Energy Storage Installation	Energy Storage Installation operating in parallel with the Grid System with an installed Capacity at or above the licence threshold as defined in the Act
Bulk Generation	generation operating in parallel with the Grid System with an installed Capacity at or above the licence threshold as defined in the Act
Bulk Generation Licence	Bulk Generation licence issued by the Authority under the Act
Bulk Generation Licence Holder	holder of a Bulk Generation Licence
CAIDI	customer average interruption duration index
Capacity	maximum power that is agreed by the TD&R Licensee to be imported to or exported from (as the context requires) the Grid System at a Connection Point
Circuit-Breaker	mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also of making, carrying for specified time and breaking currents under specified abnormal circuit conditions, such as those of short-circuit
Civil Emergency	any natural disaster or other Emergency declared by the Government
Commissioning	tests conducted on equipment for the first time or after modification or major maintenance that are designed to establish that an Installation/equipment can be safely operated and connected to the Grid System
Condition	specific provision within the Grid Code
Connection Agreement	agreement between the TD&R Licensee and a User setting out terms and conditions relating to their Interconnection NOTE: Connection Agreement includes the Standard Contract.
Connection Point (or Point of Connection or Point of Interconnection)	physical point at which a User's Apparatus, equipment or Installation is connected to the Grid System

Customer	User whose equipment/Installation is connected to the Grid System for the main purpose of obtaining a supply of electricity
Daily (or Short-Term) Dispatch	Dispatch on a short-term Dispatch Period basis to allow the balancing of energy production and energy consumption NOTE: In this context, short-term means the issue of Dispatch Instructions on a daily or shorter notice period, typically half-hourly.
Data Link	system provided by a User acceptable to the TD&R Licensee capable of providing data exchange between the equipment/Installation and the TD&R Licensee's Operations Control Centre in a manner that is effectively the same as a remote terminal unit
Demand Side Management	means to control the level of demand in place of Dispatch of Bulk Generation, which may be provided on a commercial basis
Dispatch (or Central Dispatch)	means the operating control of an integrated electric system to (a) assign specific Generation Units and other sources of supply to meet the demand as load rises or falls, (b) control operations and maintenance of High-Voltage lines, substations and equipment, including administration of Safety Procedures, (c) operate interconnections, (d) manage energy transactions with other interconnected control areas, and (e) curtail demand to balance generation
Dispatch Instruction	instruction issued by the TD&R Licensee to a Bulk Generation Licence Holder in accordance with Dispatch procedures to change the output or manner of operation of a Generation Unit in its Facility (or Installation)
Dispatch Period	period of one half-hour or such other period of time as agreed with the TD&R Licensee, where the Generation Unit subject to Dispatch is required to comply with Dispatch Instructions NOTE: For units subject to Non-Daily or Long-Term Dispatch, the Dispatch Period will generally be the period stated in the Connection Agreement/Power Purchase Agreement/Arrangement for which the Generator can export up to its agreed connection Capacity unless instructed to do otherwise by the TD&R Licensee in a Dispatch Instruction. Under a Power Purchase Agreement/Arrangement this will

	generally be the expiry period of the Power Purchase Agreement/Arrangement.
Distributed Generation	Generation Unit(s) operating in parallel with the Distribution System with an installed Capacity below the licence threshold as defined in the Act
Distributed Generator	holder of a Standard Contract
Distribution System	that part of the Grid System which operates at a nominal voltage below 22 kilovolts (kV)
Disturbing Load	loads which have the potential to introduce harmonics, Flicker or Voltage Unbalance into the Grid System
Emergency	any abnormal system condition that requires automatic or immediate manual action to prevent or limit physical threat to persons or property or loss of generation supply or transmission facilities
Energy Storage Installation	Installation, Facility or device that can store electrical energy imported from the Grid System and can export stored electrical energy to the Grid System
Energy Storage Operator	type of User that owns/operates Energy Storage Installations
Facility (or Installation)	a specified location with a specified Capacity that is either connected to or is proposed to be connected to the Grid System, comprising of equipment on the User side of the Connection Point
Flicker	impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time NOTE: Flicker is the effect on certain types of electric lamps, in particular incandescent lamps, while the electromagnetic phenomenon causing it is referred to as voltage fluctuation.
Force Majeure Event	act of God, war, strike, lockout, industrial action, fire, flood, drought, tempest or other event beyond reasonable control
Generation Unit	individual item of plant and associated equipment that generates electrical energy

Generator	type of User that owns/operates Generation Units for export to the Grid System
Government	Government of Bermuda
Grid Code	code developed by the TD&R Licensee, with the approval of the Authority, in compliance with its TD&R Licence
Grid Connection Policy	statement of methodology and the basis of charges for provision of a connection to the Grid System prepared by the TD&R Licensee
Grid System	Transmission System and Distribution System in Bermuda including any Apparatus, equipment and Installations that directly connect Users
High-Voltage	voltage exceeding 1,000 volts
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
Installation (or Facility)	a specified location with a specified Capacity that is either connected to or is proposed to be connected to the Grid System, comprising of equipment on the User side of the Connection Point
Instruction	formal instruction issued by the TD&R Licensee, where necessary, that a User shall comply with without undue delay, which is consistent with meeting the requirements of the Grid Code
Integrated Resource Plan (IRP)	energy plan for the supply of electricity in Bermuda approved by the Authority in accordance with, and set out in the matters required by, Part 8 of the Act
Interconnection	electrical connection of an item of equipment or Facility in parallel with the Grid System
Interested Parties	stakeholders, sectoral participants (as defined in the RAA) and sectoral providers (as defined in the RAA) to the Grid Code
Islanded Condition (or Island)	portion of the Grid System intentionally energized solely by one or more local distributed

	sources of energy through their associated Connection Point whilst that portion of the Grid System is electrically separated from the rest of the Grid System
Islanding	condition in which a portion of the Grid System is energized by a Facility, while that portion of the Grid System is electrically separated from the rest of the Grid System
kV	kilo volt
kVA	kilo volt ampere
Load Shedding	reduction of demand or load, where necessary, in a controlled manner by reducing voltage, using Demand Side Management resources and/or by disconnecting Users
Low-Voltage	less than or equal to 1,000 volts
MVA	mega volt ampere
Mvar	mega volt ampere reactive
MW	mega watt
Non-Daily (or Long-Term) Dispatch	Dispatch of Generation Units on a longer-term Dispatch Period basis to allow the balancing of energy production and energy consumption. NOTE: Non-Daily or Long-Term Dispatch will facilitate the use of smaller, energy efficient units with less bureaucracy. In this context, longer term means the issue of Dispatch Instructions covering at least a 24-hour period. Instructions could be issued for up to several months at a time.
Normal Operating Conditions	conditions where the Grid System is intact and operating within normal limits
Operating Procedures	Approved set of policies, practices, procedures or system adjustments that may be automatically or manually implemented within a specified timeframe to maintain the operational integrity of the Grid System and that are subject to reasonable updates and amendments
Operations Control Centre (or Dispatch Centre)	location from which remote monitoring and control of the Grid System and Dispatch is carried out by the TD&R Licensee

Outage	planned or unplanned interruption of supply or taking out of service any Apparatus, equipment or Facility/Installation for maintenance or for operational reasons that could reduce the capability to supply demand or to export generation
Ownership Boundary	boundary between the Grid System and equipment owned by the User
Planned Contingency Conditions	abnormal conditions defined in the Operations Code requiring a pre-planned response by the TD&R Licensee and Users
Point of Common Coupling	point in the Grid System which is electrically closest to the Facility or Installation concerned and to which other Users are or might be connected
Point of Supply (or Point of Delivery)	means the point at which electricity is supplied to/from the Grid System and where that supply is metered.
Power Purchase Agreement	agreement that sets out the terms under which a Generator will sell, and the TD&R Licensee will purchase the energy generated by a Generator
Power Purchase Arrangement	arrangement by which BELCO, as a Bulk Generation Licence Holder, will sell, and the TD&R Licensee will purchase, the energy generated by BELCO
Power Island	part of the Grid System that is operating independently of the fully interconnected Grid System
Professional Engineer	any individual licensed to carry on the practice of engineering, by the Professional Engineers Registration Council of Bermuda
Prudent Utility Practice (or Good Utility Practice)	generally accepted design, practices, methods, and operation of a power system, to achieve safety, dependability, efficiency, and economy, and to meet utility and industry codes, standards, and regulations
RAA	Regulatory Authority Act 2011

Reactive Power	product of voltage and current and the sine of the phase angle between them measured in units of volt-amperes reactive (var) and standard multiples thereof
Return to Service (RTS)	estimate of time from receipt of Instruction by the TD&R Licensee to re-energising Apparatus, equipment or a Facility which is out-of-service
RMS	Root Mean Square
Safety Management System (SMS)	system of Safety Rules, Operating Procedures, Instructions and other arrangements, generally written, to ensure the safety of equipment and persons who are required to operate on and/or work at or in close proximity to the interface with the Grid System
Safety Procedures	any of the TD&R Licensee's standard protection policy, standard work practices and similar policies and practices, which shall be subject to reasonable updates and amendments by the TD&R Licensee at the TD&R Licensee's discretion, from time to time
Safety Rules	Approved set of rules, safety precautions and safety procedures to ensure the safe operation of the Grid System and the safety of persons who operate, work on or work in close proximity to the Grid System NOTE: The Safety Rules are the foundation of the TD&R Licensee's Safety Management System.
SAIDI	system average interruption duration index as defined in IEEE Standard 1366-1998
SAIFI	system average interruption frequency index as defined in IEEE Standard 1366-1998
SCADA	supervisory control and data acquisition
Scheduled Maintenance Programme	means, in respect of a Facility or Installation, the program of Scheduled Outages Approved by the TD&R Licensee
Scheduled Outage (or Planned Outage)	planned interruption or reduction of the Capacity Apparatus, equipment/Facility that has been

	scheduled for a specified period and that is required to be Approved
Shutdown	partial or total shutdown of the Grid System
Significant Event	operational incident or event that is declared by the TD&R Licensee to be significant and requires further investigation and action
Site Responsibility Schedule	schedule of responsibilities for a site shared by a User and the TD&R Licensee
Standard Contract	Standard Contract for Distributed Generation referred to in section 49 of the Act
Standby Generation	Generation Unit which is not permitted to operate in parallel with the Grid System NOTE: Standby Generation includes large scale self-supply Generation Units with an output greater than licence threshold (as defined in the Act).
System Diagram	diagram(s) showing the Interconnection of Apparatus, equipment, operational boundaries, means of achieving electrical safety from the system and any other information necessary to ensure safety, coordination, control and effective operation of the Grid System
TD&R	transmission, distribution & retail
TD&R Licensee	holder of the TD&R Licence for the island of Bermuda NOTE: BELCO is the current TD&R Licensee.
Total Harmonic Distortion (THD)	ratio of the RMS of the harmonic content, considering harmonic components up to the 50th order and specifically excluding interharmonics, expressed as a percent of the fundamental NOTE: Harmonic components of order greater than 50 may be included when necessary.
Transmission System	that part of the Grid System which operates at a nominal voltage of 22 kilovolts (kV) or above
User	User of the Grid System other than the TD&R Licensee but including BELCO in its capacity as a Bulk Generation Licence Holder

Voltage Unbalance	ratio as a percentage between the RMS values of the negative sequence component and the positive sequence component of the voltage

ANNEXES

Annex 1 Data Requirements to be Provided by Users

Schedule 1 – General details NOTE: To be provided by all Users requesting a new connection or material change to an existing connection.	
User name	
User address	
User contact details Including a list of the names, emails, and telephone numbers of authorised representatives	
Name of consultant (where applicable)	
Consultant address	
Consultant contact details	
Site address / location plan	
Type of connection (including nominal voltage) required	
Details of any existing Connection Agreements	
Target date for the provision of the connection / Commissioning of the connection	
Details of existing and / or proposed Facility including single line diagrams where available	
Required level of security for the connection	
Other relevant information	

Annex 1 (continued)

Schedule 2 – Installation details NOTE: To be provided by all Users requesting a new connection or material change to an existing connection.	
Capacity of connection required	
Active Power import requirements	
Reactive Power import requirements	
Active Power export capability	
Reactive Power export capability	
Energy storage export and import capability (Capacity and duration)	
Demand Side Management capability (Capacity and duration)	
Maximum load on each phase at the time of maximum demand	
Maximum phase unbalance	
Maximum harmonic content	
Fluctuating loads State rate of change of active and Reactive Power both increasing and decreasing	
Shortest repetitive time interval between fluctuation in active and Reactive Power	
Largest step change in active and Reactive Power both increasing and decreasing	
Type and details of starter employed for controlled rectifiers and large motor drives	
Requirements for metering	
Other relevant information	

Annex 1 (continued)

Schedule 3 – Installation design parameters NOTE: To be provided by all Users requesting a new connection or material change to an existing connection, as appropriate to their Installation.	
Reactive compensation equipment Reactance of any capacitor banks and any series reactors Rating of individual shunt reactors (not associated with cables) Rating of individual capacitor banks Details of any automatic control logic such that operating characteristics can be determined. Location of the proposed Connection Point on the network	
Capacitor banks Details of the equivalent lumped network susceptance of the User's Facility referred back to the connection with the Distribution System Including shunt reactors which are an integrated part of a cable system and which are not normally in or out of service independent of the cable. Excluding independently switched reactive compensation connected to the User's Facility and any susceptance of any User's Installation inherent in the active and reactive demand.	
Fault infeed Maximum and minimum short-circuit contribution to the system Time constant (or X/R ratio) under maximum and minimum short-circuit conditions (contribution from rotating plant)	

Annex 1 (continued)

Interconnection impedance *(if requested by the TD&R Licensee)* Positive sequence resistance Zero sequence resistance Positive sequence reactance Zero sequence reactance Susceptance	

Details of circuit parameters	
Details of controlling switchgear Including make and break ratings of Circuit-Breakers, current transformer and voltage transformer locations and ratios, synchronising and interlocking systems	
Details of protection equipment including relay details, setting ranges, applied settings and setting calculations	
Power factor correction equipment and control systems	
Details of transient over-voltage effects	
Specification of major equipment (including basic insulation levels)	
Commissioning procedures/results	

Annex 1 (continued)

Schedule 4 – Generation Unit details (for each individual unit) NOTE: This schedule applies for all Generation Units but does not apply to Energy Storage Installations.		
Manufacturer		
Type		
Prime mover		
Excitation system		
Method of voltage control		
Speed governor details		
Rated voltage at Generation Unit terminals		
Rated current at Generation Unit terminals		
Rated Active Power		
Rated Reactive Power		
Rated apparent power		
Fault level contribution		
Inertia constant		
Direct axis reactance	Sub-transient	
	Transient	
	Synchronous	
Direct axis time constant	Sub-transient	
	Transient	
Zero sequence impedance	Resistance	
	Reactance	
Negative sequence impedance	Resistance	
	Reactance	
Associated Generation Unit transformer	Voltage ratio	
	Rating	
	Vector group	
	Tap arrangements	
	Resistance	
	Reactance	

Annex 1 (continued)

	Earthing arrangements	

Annex 1 (continued)

Schedule 5 – Operational forecasts NOTE: This schedule applies to Bulk Generation, Energy Storage Installations with a Capacity ≥ 500 kW, and HV demand Users with a capacity ≥ 500 kW (subject to the specific application detailed below).	
Submission document	**Submission time**
Short-term daily forecast **(only for resources subject to short-term Dispatch Instructions)** Daily forecast for each calendar day Half-hourly forecast of electrical generation / Demand Side Management / energy storage availability with a Capacity ≥ 500 kW for the full calendar day	By 10:00hrs on the day preceding the calendar day in question
Short-term seven-day forecast Weekly forecast for the calendar week specified. A calendar week shall commence at 00:00hrs on Sunday and run to 24:00hrs on the following Saturday Half-hourly forecast of electrical generation / Demand Side Management / energy storage availability with a Capacity ≥ 500 kW for the full calendar week	By 10:00hrs on the Friday prior to the start of the calendar week in question
Medium-term monthly forecast Monthly forecast for each calendar month Half-hourly forecast of electrical generation / Demand Side Management / energy storage availability with a Capacity ≥ 500 kW for the full calendar month	Fourteen days prior to the start of the calendar month in question
Long-term annual forecast Annual forecast for each calendar year Half-hourly forecast of electrical generation / Demand Side Management / energy storage availability with a Capacity ≥ 500 kW for the full calendar year	Ninety days prior to the start of the calendar year in question
Daily generation / Demand Side Management / energy storage exported for each calendar day **(only for resources subject to short-term Dispatch Instructions from the TD&R Licensee)** Half-hourly actual export of electricity generation / reduction of demand / export of energy storage for the full calendar day compared to the short-term daily forecast	By 10:00hrs on the day following the day in question

Annex 1 (continued)

Outage forecast Availability of generation set / Demand Side Management / energy storage export with a Capacity ≥ 500kW Planned, and known unplanned, Outages impacting electrical generation / Demand Side Management / energy storage availability with a Capacity ≥ 500kW for the full calendar year Known risks (such as risk of trip activities) impacting electrical generation / Demand Side Management / energy storage availability with a Capacity ≥ 500kW covering the following 28-day period	By 10:00hrs on each calendar day

Annex 2 Protection Requirements for Interconnection

Rating		Source	Grid System I/F	O/C	U/V & O/V	Neg Seq.	U/F & O/F	Reverse Power	Gen Diff.	Line Diff.	Sync Chk	Lockout	Intertrip	LoM
Power	Voltage			50/ 51/ 51V	27/ 59	47V	81 O/U	32R	87G	87L	25	86	-	78V
<500 kW	≤4,160 V	Renew-ables^	O/H	Standard Type-Certified UL 1741 or IEEE 929 Package										
≥500 kW	4,160 V	Fossil	Sub-station	Yes	Yes	Yes	Yes	Yes	Yes^{+}	Yes^{+}	Yes	Yes	Yes^{+}	Yes^{+}
		Renew-ables^	Sub-station or O/H	Yes*	Yes	Yes	Yes	No	No	>1.5 MW (Note 4)	No	Yes^{+}	Yes	Yes^{+}
	22,000 V / 33,000 V	Fossil	Sub-station	Yes	Yes	Yes	Yes	Yes	Yes	Yes^{+}	Yes	Yes	Yes	Yes^{+}
		Renew-ables^		Yes*	Yes	Yes	Yes	No	No	>1.5 MW (Note 4)	No	Yes	Yes	Yes^{+}

*51V not required $^{+}$Subject to case-by-case review ^Inverter connected

NOTES:

1. This table specifies protection requirements at the Generator Facility except for interconnection relays that may be distributed.
2. 'Fossil' includes oil or gas fired generation. Renewables include inverter connected generation from renewable energy sources.
3. Relays may be in a single multifunction intelligent electronic device (IED) or part of an inverter package, as appropriate.
4. Applies to independent Interconnection protection for inverters over 1.5 MW.
5. LoM protection incorporated in standard type certified UL 1741 or IEEE 929 inverters is required for Distributed Generation ≤ 500 kW. For generation > 500 kW the requirements for LoM protection at the interface with the Grid System will be evaluated on a case-by-case review basis.

KEY:

Protection	Description	ANSI Relay Number IEEE C37.2
I/F	Interface	
O/C	Overcurrent	50/51/51V
U/V	Undervoltage	27P
O/V	Overvoltage	59
Neg Seq	Negative Sequence	47V
U/F	Underfrequency	81U
O/F	Overfrequency	81O
Gen Diff	Generator Differential	87G
Line Diff	Line Differential	87L
Sync Chk	Synchronising Check	25
O/H	Overhead	
LoM	Loss of Mains	78V

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