MODIFICATION PROPOSAL FORM

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FORM GC1, PROPOSAL OF MODIFICATION TO GRID CODE.

MODIFICATION PROPOSAL ORGINATOR:	EirGrid (Operations)		
MODIFICATION PROPOSAL ORIGINATOR (CONTACT NAME)	Alan Rogers	**MODIFICATION PROPOSAL ORIGINATOR FAX NUMBER:**	
MODIFICATION PROPOSAL ORIGINATOR TELEPHONE NUMBER:	01-2370113	**DATE:**	8th Feb 2012
MODIFICATION PROPOSAL ORIGINATOR E-MAIL ADDRESS:	alan.rogers@eirgrid.com	**MODIFICATION PROPOSAL NUMBER (EIRGRID USE ONLY)**	**MPID 216**
GRID CODE SECTION(S) AFFECTED BY PROPOSAL:	**OC4 - System Services and the Definitions section.**		
GRID CODE VERSION :	**V 4**		

MODIFICATION PROPOSAL DESCRIPTION **(MUST CLEARLY STATE THE DESIRED AMENDMENT, ALL TEXT/FORMULA CHANGES TO THE GRID CODE. THE REQUIRED REASON FOR THE MODIFICATION MUST STATED. ATTACH ANY FURTHER INFORMATION IF NECESSARY.)**	MPID 216 (Systems Services for Interconnectors) was discussed at the GCRP meeting held in Dublin, 13 October 2011. The panel members supported all of the amendments included in the proposal apart from the definition for Governor Droop for Interconnectors. EirGrid have come up with a new term entitled Interconnector Frequency Droop that takes into account the bi-directional nature of the power flow on a HVDC Interconnector. EirGrid propose to provide a definition for **Interconnector Frequency Droop** and to correctly refer to it within the Grid Code (see section OC4.3.4.2.2**)**. **Interconnector Frequency Droop**: In relation to an **Interconnector** transferring power into the **Transmission System,** it is the percentage drop in the **Frequency** that would, under the action of the **Interconnector Frequency Control** system, cause a change in the **Interconnector's** output from zero to its full **Interconnector Registered Import Capacity**. In relation to an **Interconnector** transferring power to an **External System,** it is the percentage drop in the **Frequency** that would, under the action of the **Interconnector Frequency Control** system, cause a change in the **Interconnector's** output from its full **Interconnector Registered Export Capacity** to zero. In both cases, it is assumed that the **Frequency Control** system is regulating the **Frequency** in the **Transmission System**.
IMPLICATION OF NOT IMPLEMENTING THE MODIFICATION	If the proposed modification (MPID 216) is not implemented, then there will be no standard to which new HVDC Interconnectors will be expected to abide by. This modification provides clear information on what system services HVDC Interconnectors are expected to provide.
Please submit the Modification Proposal by fax, post or electronically, using the information supplied above	
EIRGRID REVIEWER	
EIRGRID ASSESSMENT	

THE PROPOSAL MPID 216 – PREVIOUSLY DISCUSSED AT GCRP #29.

OC4 SYSTEM SERVICES

OC4 SYSTEM SERVICES

OC4.1 INTRODUCTION

System Services refers to the services essential to the proper functioning of the **Power System** which electricity utilities collectively provide for their customers in addition to the provision of electrical power, the supply of electric energy, and the transmission and distribution of this energy, and which thus determine **Power Quality**:

(a) **Frequency Control**;

(b) **Voltage Control**;

(c) **Network Control**;

(d) **Operating Margin; and**

(e) **Black Start.**

In order to ensure secure operation, the **TSO** shall have control over all **System Services**; i.e. the **TSO** shall specify what **System Services** are to be provided when and by whom.

OC4.2 SCOPE

OC4.2.1 OC4 applies to the **TSO** and to the following, each of which is a **User** under this OC4:

(a) **Grid Connected Generators** with **Registered Capacity** greater than 2MW;

(b) **Demand Customers**;

(c) The **Distribution System Operator (DSO)**; and

(d) **Interconnector Operators**

OC4.3 FREQUENCY CONTROL

OC4.3.1 INTRODUCTION

OC4.3.1.1 In order to maintain the security and integrity of the **Transmission System** it is necessary that the **TSO** operates the **Transmission System** and **Dispatches** in such a manner as to provide adequate **Frequency Control** so as to achieve operation within applicable **Frequency** limits at all times.

OC4.3.2 OBJECTIVE

OC4.3.2.1 The objectives of OC4.3 are:

(a) to set out the procedures required to ensure that adequate **Frequency Control** capability is provided on the **Transmission System** to enable operational **Frequency Control** by the **TSO** so as to achieve the applicable limits; and

(b) to set out the procedures required to enable the **TSO** to control the **Transmission System Frequency** and (insofar as possible) to maintain **Frequency** within the limits set out in CC8.2.1.

OC4.3.3 DESCRIPTION OF FREQUENCY CONTROL

OC4.3.3.1 **Frequency Control** occurs in two time scales, namely:

(a) **Primary Frequency Control**; and

(b) **Secondary Frequency Control**.

OC4.3.3.2 **Primary Frequency Control**

OC4.3.3.2.1 **Primary Frequency Control** takes place in the period of up to 30 seconds after a change in **Frequency** and is achieved by automatic corrective responses to **Frequency** deviations occurring on the **Transmission System**. This automatic correction arises from:

(a) natural frequency demand relief of motor load;

(b) automatic MW output adjustment of **Generation Units** initiated by **Governor Droop** or other responses including peaking of Combustion Turbine units, condensate stop or frequency triggered response of pumped storage units;

(c) automatic load shedding (see OC5: **Demand Control**).

OC4.3.3.2.2 Automatic **Primary Frequency Control** actions in response to normal **Frequency**

fluctuations, within the levels specified in CC.8.2.1 (a), on the **Transmission System** can be termed as "**Frequency Regulation**". Inadequate **Frequency Regulation** can result in:

(a) unscheduled operation because **Generation Units** are moving away from their **Dispatched MW** levels due to **Frequency** drift;
(b) poor **External Interconnection** tie-line control; and
(c) failure to meet the applicable **Frequency** limits.

OC4.3.3.2.3 **Frequency** deviations, outside the levels specified in CC8.2.1(a), such as those that may occur on the loss of **Generation Unit(s)**, **Interconnectors**, or other MW input into the **Transmission System** or the **Distribution System,** are corrected through the use of **Operating Reserve**.

OC4.3.3.3 **Secondary Frequency Control**

OC4.3.3.3.1 **Secondary Frequency Control** takes place in the time scale from 5 seconds up to 10 minutes after the change in **Frequency**. It is provided by a combination of automatic and manual actions.

OC4.3.3.3.2 Improved **Secondary Frequency Control** can be achieved by use of a **Secondary Frequency Regulation System** which acts directly on the **MW Outputs** of participating **Generation Units** and on the **Active Power** transfer to or from **External Systems** by **Interconnectors**. This automatic action facilitates more frequent MW output adjustments than is practicable by means of **Dispatch Instructions** and manual setpoint adjustment, thus allowing more frequent and rapid **Frequency** correction.

OC4.3.4 FREQUENCY RESPONSE SYSTEMS

OC4.3.4.1 REQUIREMENTS OF GENERATION UNIT GOVERNOR SYSTEMS

OC4.3.4.1.1 In order that adequate **Frequency Regulation** is maintained on the **Transmission System** at all times, **Generators** are required to comply with the provisions of OC4.3.4.1.

OC4.3.4.1.2 Other than as permitted in accordance with OC4.3.4.1.3:

(a) **Generation Units** when **Synchronised** to the **Transmission System** shall operate at all times under the control of a **Governor Control System,** unless otherwise specified by the **TSO**, with characteristics within the appropriate ranges as specified in **Connection Conditions**;
(b) no time delays other than those necessarily inherent in the design of the **Governor Control System** shall be introduced;
(c) A **Frequency Deadband** of no greater than +/- 15mHz may be applied to the operation of the **Governor Control System**. The design, implementation and

operation of the **Frequency Deadband** shall be agreed with the **TSO** prior to the **Commissioning**.

OC4.3.4.1.3 The **Generator** may only restrict governor action in such a manner as to contravene the terms of OC4.3.4.1.2 where:

(a) the action is essential for the safety of personnel and/or to avoid damage to **Plant**, in which case the **Generator** shall inform the **TSO** of the restriction without delay; or
(b) in order to (acting in accordance with **Good Industry Practice**) secure the reliability of the **Generation Unit**; or
(c) the restriction is agreed between the **TSO** and the **Generator** in advance; or
(d) the restriction is in accordance with a **Dispatch Instruction** given by the **TSO**.

OC4.3.4.1.4 In the event that the **TSO** in accordance with OC4.3.4.1.3 either agrees to a restriction on governor action or instructs such a restriction, the **TSO** shall record the nature of the restriction, the reasons, and the time of occurrence and duration of the restriction.

OC4.3.4.1.5 Action required by **Generators** in response to low **Frequency**:

(a) If **System Frequency** falls to below 49.80 Hz each **Generator** will be required to check that each of its **CDGUs** is achieving the required level of response including that required from the **Governor Control System**, where applicable in order to contribute to containing and correcting the low **System Frequency**.
(b) Where the required level of response is not being achieved appropriate action should be taken by the **Generator** without delay and without receipt of instruction from the **TSO** to achieve the required levels of response, provided the **Generator's** local security and safety conditions permit,

OC4.3.4.1.6 Action required by **Generators** in response to high **Frequency**:

If **System Frequency** rises to or above 50.2 Hz each **Generator** will be required to ensure that its **CDGUs** has responded in order to contribute to containing and correction the high **System Frequency** by automatic or manually reducing **MW Output** without delay and without receipt of instruction from the **TSO** to achieve the required levels of response, provided the **Generator's** local security and safety conditions permit.

OC4.3.4.2 REQUIREMENTS OF INTERCONNECTOR FREQUENCY RESPONSE SYSTEMS

OC4.3.4.2.1 In order that adequate **Frequency Control** is maintained on the **Transmission System** at all times, **Interconnectors** are required to comply with the provisions of OC4.3.4.2

OC4.3.4.2.2 Other than as permitted in accordance with OC4.3.4.2.3:

(a) **Interconnectors** when **Energised** shall operate at all times in **Frequency Control** mode**,** unless otherwise specified by the **TSO**, with characteristics within the appropriate ranges as specified in **Connection Conditions**;

(b) The **Interconnector Frequency Droop** shall normally be 4% and shall be settable between 2% and 7%.

(c) No intentional time delays other than those agreed with the **TSO** shall be introduced into the frequency response system;

(d) The **Frequency Deadband** shall normally be zero. Any non-zero deadband must be agreed in advance with the **TSO** and shall not exceed +/-15mHz.

(e) **Interconnectors** shall not act to control the frequency in an **External System** unless agreed in advance with the **TSO** and the **External System Operator.**

OC4.3.4.2.3 The **Interconnector Operator** may only restrict the action of the **Frequency Control** mode in such as a manner as to contravene the terms of OC4.3.4.2.2 where:

(a) The action is essential for the safety of personnel and/or to avoid damage to **Plant**, in which case the **Interconnector Operator** shall inform the **TSO** of the restriction without undue delay; or

(b) in order to (acting in accordance with **Good Industry Practice**) secure the reliability of the **Interconnector,** in which case the **Interconnector Operator** shall inform the **TSO** of the restriction without undue delay; or

(c) the restriction is agreed between the **TSO** and the **Interconnector Operator** in advance; or

(d) the restriction is in accordance with a **Dispatch Instruction** given by the **TSO**.

OC4.3.4.2.4 In the event that the **TSO** in accordance with OC4.3.4.2.3 either agrees to a restriction on the control action or instructs such a restriction, the **TSO** shall record the nature of the restriction, the reasons, and the time of occurrence and duration of the restriction.

OC4.3.4.2.5 Action required by **Interconnector Operators** in response to low **Frequency**:

(a) If **System Frequency** falls to below 49.80 Hz each **Interconnector Operator** will be required to ensure that it has responded in order to contribute to containing and correcting the low **System Frequency** by automatic or manually increasing the **Active Power** transfer from an **External System** or decreasing the **Active Power** transfer to the **Transmission System** without delay and without receipt of instruction from the **TSO** to achieve the required levels of response, provided the **Interconnector's** local security and safety conditions permit.

(b) Any such action shall be in accordance with the **Interconnector Operating Protocol** agreed between the **Interconnector Operator**, the **TSO** and the **External System Operator**.

OC4.3.4.2.6 Action required by **Interconnector Operators** in response to high **Frequency**:

a) If **System Frequency** rises above 50.2 Hz each **Interconnector Operator** will be required to ensure that it has responded in order to contribute to containing and correction of the high **System Frequency** by automatic or manually decreasing the **Active Power** transfer from an **External System** or increasing the **Active Power** transfer to the **Transmission System** without delay and without receipt of instruction from the **TSO** to achieve the required levels of response, provided the **Interconnector's** local security and safety conditions permit.

b) Any such action shall be in accordance with the **Interconnector Operating Protocol** agreed between the **Interconnector Operator**, the **TSO** and the **External System Operator**.

OC4.3.4.2.7 Action required by **Interconnector Operators** in response to **External System Frequency Events:**
Automatic MW setpoint changes of **Interconnectors** triggered by **Frequency Events** on the **External System** shall be agreed between the **Interconnector Operator,** the **TSO**, and the **External System Operator** in accordance with the **Interconnector Operating Protocol.**

OC4.3.4.2.8 The **TSO** having due regard to system security may instruct the **Interconnector Operator** to disable the **Frequency Control** mode of an **Interconnector** at any time, and this instruction must be carried out without delay.

OC4.3.5 DISPATCH INSTRUCTIONS

When the **TSO** determines it is necessary, by having monitored the **System Frequency**, it may, as part of the procedure set out in SDC2, issue a **Dispatch Instruction** (including **Target Frequency** where applicable) in order to seek to regulate **Frequency** to meet the requirements for **Frequency Control**. The **TSO** will give, where applicable, 15 minutes notice to each relevant **User** of variation in **Target Frequency**.

OC4.3.6 AUTOMATIC GENERATOR CONTROL (AGC)

OC4.3.6.1 The secondary **Frequency** regulation system operational on the **Transmission System** is known as the "**Automatic Generator Control**" (**AGC**).

OC4.3.6.2 **Generation Units** and **Interconnectors** with a **Registered Capacity** of 60MW or greater are, under **Connection Conditions**, required to be connected to **AGC**, the **AGC Control Range** being a **Registered Operating Characteristic**.

OC4.3.6.3 Other than as provided for in OC4.3.6.4 and OC4.3.6.5 all **Generation Units** and **Interconnectors** fitted with **AGC** shall operate under the control of **AGC** when within their **AGC Control Range**.

OC4.3.6.4 In the event that the **Generator** or **Interconnector Operator** (acting in accordance with **Good Industry Practice**) considers that it is necessary to secure the reliability of a **Generation Unit** or **Interconnector**, or for the safety of personnel and/or **Plant**, to prevent a **Generation Unit** or **Interconnector** from operating under **AGC** and commences to control the MW output manually, then the **Generator** or **Interconnector Operator** shall inform the **TSO** of this without delay. **Generators** and **Interconnector Operators** shall also inform the **TSO** of the reasons for not operating the **Generating Unit** or **Interconnector** under **AGC**, and the course of action being taken to rectify the problem forthwith. When the problem has been rectified, the **Generator** or **Interconnector Operator** shall contact the **TSO** to arrange for the **Generation Unit** or **Interconnector** to return to operation under the control of **AGC**.

OC4.3.6.5 The **TSO** may issue a **Dispatch Instruction** to a **Generator** or **Interconnector Operator** to prevent a **Generation Unit** or **Interconnector** (fitted with **AGC**) from operating under **AGC**, in accordance with **SDC2**.

OC4.3.6.6 **Generation Units** or **Interconnectors** not operating under **AGC** for reasons set out in OC4.3.6.4 and OC4.3.6.5 shall nevertheless continue to follow **MW Dispatch Instructions** as required by SDC2.

OC4.4 VOLTAGE CONTROL

OC4.4.1 INTRODUCTION

OC4.4.1.1 In order to maintain security and integrity of the **Transmission System**, to avoid damage to the **Transmission System** and to **User Plant**, and to maintain **Voltages** at **User Connection Points** within the limits specified in the **Connection Conditions**, it is necessary for the **TSO** to control **Transmission System Voltages**.

OC4.4.1.2 **Voltage** control of power systems requires that a Mvar demand is met and that sufficient dynamic **Voltage** control capability is available on the **Transmission System** to cover changes in the Mvar demand such as result from **Demand** variations, to facilitate controlled **Voltage** adjustment and to limit the duration and extent of **Voltage** fluctuations under fault conditions. In order to do this, static and dynamic reactive reserve capability is required. To control **Transmission System Voltages**, the **TSO** will utilise a variety of methods of dynamic and static control.

OC4.4.1.3 **Voltage** control strategies used by the **TSO** include:

(a) transformer tap-changing, cable switching, reactor and capacitor switching, and other control methods which involve utilisation of **Transmission System Plant** only;
(b) tap-changing on **Generator Transformers**;
(c) **Demand** power factor correction;
(d) utilisation of **Generation Unit Reactive Power** capability, both by means of **AVR** control and also **Mvar Dispatch Instructions** issued by the **TSO** to **Generators**;
(e) utilisation of **Interconnector Reactive Power** capability by means of suitably acting **AVR** control and/or **Mvar Dispatch Instructions** issued by the **TSO** to **Interconnector Operators.**

OC4.4.2 OBJECTIVES

OC4.4.2.1 The objective of OC4.4 is to set out the control strategies used by the **TSO**, in conjunction with **Users** where appropriate, in controlling **Transmission System Voltages**.

OC4.4.2.2 OC4.4 sets out the procedures required (in conjunction with those in SDC2 to enable the **TSO** to:
(a) maintain voltage stability of the **Transmission System;**
(b) maintain **Transmission System Voltages** at **User Connection Points** within operational limits as specified in the **Connection Conditions**.

OC4.4.2.3 OC4.4 sets out the procedures for the utilisation of **User Plant** or facilities by the **TSO** for the purposes of **Transmission System Voltage** control, where appropriate.

OC4.4.2.4 Some procedures for implementation of **Voltage** control strategies (e.g. **Generation Unit** Mvar **Dispatch, Interconnector Mvar Dispatch**) are addressed under the provisions of SDC2 and therefore this OC4.4 shall be read in conjunction with these provisions.

OC4.4.3 DESCRIPTION OF VOLTAGE CONTROL

OC4.4.3.1 **Voltage Control** is achieved by ensuring sufficient availability of dynamic and static reactive power from contributions listed in OC4.4.3.2. The factors, which are obviously most readily subject to control by the **TSO**, are the Mvar produced/absorbed by **Generation Units, Interconnectors,** and installed dedicated **Voltage Control** facilities.

OC4.4.3.2 The **TSO** shall endeavour to maintain sufficient availability of dynamic and static reactive power in order to operate **Transmission System Voltages** at **Connection Points** within the levels specified in CC.8.3, at all times. Factors, which will influence the required Mvar capacity, include the following:

OC4.4.3.2.1 The charging capacitance of the **Transmission System**.

OC4.4.3.2.2 **Customer** Mvar **Demand**.

OC4.4.3.2.3 **Transmission System** Mvar losses.

OC4.4.3.2.4 **Generation Unit** Mvar production or absorption.

OC4.4.3.2.5 **Interconnector** Mvar production or absorption

OC4.4.3.2.6 **Voltage Control** facilities, such as capacitor banks and reactors.

OC4.4.3.3 The effects of **Transmission System** capacitance can be controlled and to some extent utilised by controlled variation of the **Transmission System Voltage**. Thus at times of high Mvar **Demand** (normally times of high MW **Demand**), the **Transmission System Voltage** may be operated towards the upper portion of the allowable control range, and at times of low Mvar **Demand** (normally times of low MW **Demand**), the **Transmission System Voltage** may be operated towards the lower portion of the allowable control range. This daily variation is typically required for operation of the **Transmission System**.

OC4.4.3.4 Due to the electrical characteristics of a **Transmission System**, the **Voltage** (for **Plant** operated at the same nominal **Voltage**) will not be the same at all points on the **Transmission System**.

OC4.4.4 VOLTAGE CONTROL POLICY

OC4.4.4.1 The **TSO** shall control system voltage in order to minimise system losses and cost of use of **Ancillary Services**. The **TSO** shall determine and modify as appropriate general procedures for its use in controlling **Voltage** on the **Transmission System**. The procedures shall be formulated having due regard to relevant economics of **Transmission System** operation and **Power System** reliability. In particular, the **Voltage Control** shall take cognisance of daily, weekly and seasonal factors and the **TSO** shall determine:

(a) suitable target **Voltages** in order to limit/control the effect of transmission capacitance;
(b) best utilisation of dedicated **Voltage Control** facilities; and
(c) Mvar dynamic reserve requirements.

OC4.4.5 METHODS UTILISED IN EXERCISING VOLTAGE CONTROL

OC4.4.5.1 **Transmission System Voltages** shall be continuously monitored by the **TSO**. Appropriate **Voltage** operating points shall be determined by the **TSO**, taking account of OC4.4.4 and in particular of **System** conditions pertaining at the time of operation.

OC4.4.5.2 The **TSO** shall adjust **System Voltages**, using control facilities that are available so as to achieve the Mvar capacity necessary in order to operate **Transmission System Voltages** at **Connection Points** within the levels specified in CC.8.3 and retain a dynamic Mvar capability to deal with changing **System** conditions which result from changes in **Demand** or changes in transmission or generation configuration, whether as a result of control actions or faults. This may necessitate the modification of **Generator MW** output or **Interconnector(s) Active Power** transfer from an **External System** or **Active Power** transfer to the **Transmission System.**

OC4.4.5.3 The excitation system of each **Generation Unit** shall normally be operated under the control of a continuously acting **AVR**, which shall be set so as to maintain a constant terminal voltage. The **Generator** may not disable or restrict the operation of the **AVR** except in accordance with OC4.4.5.5, in which event the **Generator** shall notify the **TSO** without delay.

OC4.4.5.4 Each **Interconnector** shall control the voltage at the **Grid Connection Point** by means of a suitable continuously acting **AVR.** The voltage control mode shall be as agreed under the **Interconnector Operating Protocol.** The **Interconnector Operator** may not disable or restrict the operating of the **AVR** except in accordance with OC4.4.5.5, in which event the **Interconnector Operator** shall notify the **TSO** without undue delay.

OC4.4.5.5 The **Generator** or **Interconnector Operator** may only disable or restrict **AVR** action where:

(a) the action is essential for the safety of personnel and/or **Plant**; or

(b) in order to (acting in accordance with **Good Industry Practice**), secure the reliability of the **Generation Unit or Interconnector**; or

(c) the restriction is agreed between the **TSO** and the **Generator** or **Interconnector Operator** in advance.

OC4.4.5.6 In the event of a **Generation Unit** not operating under **AVR**, the **TSO** may impose restrictions on the operation of the **Generation Unit** in accordance with **Prudent Utility Practice**, to the extent necessary to provide for safe and secure operation of the **Transmission System** and operation within prescribed standards, including where necessary instructing the **Generator** to **De-Energise** the **Generation Unit**. Where the **TSO** takes such action, the **TSO** shall consult with the **Generator** as soon as practicable in order to determine a safe operating regime, which causes minimum restriction on the operation of the **Generation Unit**.

OC4.4.5.7 In the event of an **Interconnector** not operating under **AVR**, the **TSO** may impose restrictions on the operation of the **Interconnector** in accordance with **Prudent Utility Practice**, to the extent necessary to provide for safe and secure operation of the **Transmission System** and operation within prescribed standards, including where necessary instructing the **Interconnector Owner** to **De-Energise** the **Interconnector**.

OC4.4.5.8 The **TSO** shall, by means of **Dispatch Instructions** (as provided in SDC2), instruct **Generators** and **Interconnectors** to adjust the **Reactive Power** outputs of **Generation Units** and **Interconnectors**, and the relevant provisions of SDC2 shall apply.

OC4.4.5.9 Other facilities which shall be utilised by the **TSO**, where appropriate, in order to exercise **Voltage Control** shall include:

(a) switching in or out of dedicated **Voltage Control** facilities, such as capacitor banks and reactors;

(b) tap-changing on 400/220kV and 220/110kV **Transmission System** transformers;

(c) switching out of transmission **HV** cables (and occasionally transmission lines) in order to reduce the capacitive contribution of the **Transmission System**.

OC4.4.5.10 The extent to which **Voltage Control** mechanisms can be utilised may be limited by **System** conditions and other limitations of **Plant** and **Apparatus**.

OC4.4.5.11 On some occasions it shall be necessary to reschedule **Generation Units** or **Interconnectors** away from their desired output in order to achieve **Transmission System Voltages** at **Connection Points** within the levels specified in CC.8.2.

OC4.4.6 EMERGENCY or EXCEPTIONAL VOLTAGE CONTROL

OC4.4.6.1 Additional **Voltage Control** mechanisms may be utilised in the event of **System Emergency Conditions**. These shall include the following:

OC4.4.6.1.1 **Generators** may be requested to operate **Generation Units** at Mvar production or absorption levels outside their currently declared **Technical Parameters**. This will be done by agreement between the **Generator** and the **TSO** and **Generators** will not be penalised for non-compliance with this clause.

OC4.4.6.1.2 Changes in **System Voltage** can be achieved by instructing, as a form of **Dispatch Instruction** under OC4.4, **Generators** to carry out a **Simultaneous Tap Change.** In the event that the **TSO** considers it necessary to carry out a **Simultaneous Tap Change**, **Generators** shall comply with the **TSO's** instructions.

OC4.4.6.1.3 **Demand** shedding may be used to prevent **Voltage** from contravening low **Voltage** limits (as further provided in OC5) at **Connection Points.** .

OC4.4.6.1.4 **Interconnector Operators** may be requested to operate **Interconnectors** at Mvar production or absorption levels outside their currently declared **Technical Parameters**. This will be done by agreement between the **Interconnector Operator** and the **TSO** and **Interconnector Operators** will not be penalised for non-compliance with this clause.

OC4.5 NETWORK CONTROL

OC4.5.1 INTRODUCTION

OC4.5.1.1 In implementing the **Transmission Outage Programme**, in routine operation of the **Transmission System** and in responding to emergency and fault situations on the **Transmission System**, the **TSO** needs to carry out network switching and **Control Actions** which may from time to time affect the operations of **Users** or security of supply to **Users**.

OC4.5.1.2 The purpose of this OC4.5 is to set out the actions which may be taken by the **TSO** in controlling the **Transmission System**, to set out the procedures whereby the **TSO** shall inform **Users**, where practicable, as to network **Control Actions** which will or may be likely to significantly affect a **User's** operations and to identify where the **TSO** shall, insofar as reasonably practicable, consult with **Users** and take into consideration **Users'** reasonable requirements.

OC4.5.2 OBJECTIVE

OC4.5.2.1 The first objective of OC4.5 is to identify the **Control Actions** that may be taken by the **TSO**, in order that the **TSO** may carry out maintenance and operation of the **Transmission System** and respond to **Transmission System** faults and emergencies.

OC4.5.2.2 The second objective of OC4.5 is to establish procedures whereby the **TSO** will:

(a) where practicable, inform **Users** who will be or are likely to be significantly affected by network **Control Actions** of relevant details of intended **Control Actions** and the effect of those **Control Actions**;
(b) consult with **Users** as appropriate in order to find out and take into consideration reasonable objections raised by **Users** so affected.

OC4.5.3 NETWORK CONTROL ACTIONS

OC4.5.3.1 The **TSO** needs to carry out operational network switching for a number of purposes, which will include:

(a) **Outages** of transmission **Plant** and **Apparatus** for the purposes of maintenance, new works, **System Tests**, protection testing and work by **Users**;
(b) **Outages** of transmission **Plant** due to suspected or potential faults and emergency repairs;
(c) **Voltage Control**;

(d) limiting power flows on the **Transmission System** to levels consistent with the capabilities of the transmission **Plant** and system security.

e) **Energisation** or **De-energisation** of **Interconnectors**

OC4.5.3.2 Additionally, network switching may occur automatically and without advance warning due to operation of protection equipment in isolating or clearing faults on transmission **Plant** or on **User's Plant** which is connected to the **Transmission System.**

OC4.5.3.3 Automatic switching sequences may also be established to limit power flows or **Voltage** or **Frequency** deviations in the event of faults elsewhere on the **System**.

OC4.5.4 NOTIFICATION TO USERS OF NETWORK CONTROL

OC4.5.4.1 All network **Control Actions** carried out on the **Transmission System** have the potential in a given set of circumstances to affect **Users**. To attempt to inform **Users** of every **Control Action** is not practicable and in most cases the information will not be of value to the **User** as the **User** will not invoke any specific action as a result of receipt of the information.

OC4.5.4.2 Where it is identified and agreed, in accordance with the terms of the **Connection Agreements** and/ or Operating Agreements, between the **TSO** and a **User** that a specific **Control Action** (usually an action affecting the **Transmission System** configuration) has an **Operational Effect** on a **User** and that there is merit in notifying the **User** in advance of the **Control Action**, then the **TSO** will notify the **User** of the **Control Action** (if planned and where time permits), in accordance with any standing agreement that may be agreed with the **User**.

OC4.5.4.3 Typical examples of actions notified in accordance with OC4.5.4.2 may include:

Notification to the **DSO** of a significant reduction in supply security to a **Grid Supply Point**, where the **DSO** may arrange standby feeding arrangements at lower **Voltages**;

Notification to a **Demand Customer** of a significant reduction in supply security to a **Grid Supply Point** (such as the **Outage** of one of two transmission connections) where the **Demand Customer** may arrange standby supply or run in-house **Generation**.

OC4.5.4.4 Where it is necessary to carry out urgent switching or other network **Control Actions** resulting from a **System** condition or fault, then it may not be possible for the **TSO** to inform **Users** in advance of the switching or other **Control Actions**. The **TSO** shall endeavour to inform **Users** where time permits, but this shall not delay timely implementation of **Control Actions** as required. Where the **TSO** is unable to inform **Users** prior to the **Control**

Actions, then the provisions of OC4.5.5 shall apply.

OC4.5.5 CONTROL UNDER FAULT OR EMERGENCY CONDITIONS

OC4.5.5.1 In the event of a **System** fault or protection operation or other automatic operation, it will not be possible to invoke standing procedures in accordance with OC4.5.4 prior to the occurrence of the **Control Action.**

OC4.5.5.2 In the circumstances referred to in OC4.5.5.1 or in the event that the **TSO** needs to implement **Control Actions** urgently and without informing **Users**, then unless the situation is of a temporary nature and has been rectified to normal, the **TSO** shall inform **Users** of the occurrence of the actions

OC4.5.5.3 The **TSO** shall also inform **Users** as to the likely duration of the condition and shall update this prognosis as appropriate. The **TSO** shall additionally inform **Users** when the condition has ended.

OC4.5.5.4 **Emergency** Assistance to and from **External Systems** will be detailed in the **Interconnector Operating Protocol** agreed between the **Interconnector Operator**, the **TSO** and the **External System Operator**, and shall include the following actions:

(a) An **External System Operator** may request that the **TSO** take any available action to increase the **Active Power** transferred into its **External System**, or reduce the **Active Power** transferred into the **Transmission System**. Such request must be met by the **TSO** providing this does not require a reduction of Demand on the **Transmission System**, or lead to a reduction in security on the **Transmission System**.

(b) The **TSO** may request that an **External System Operator** takes any available action to increase the **Active Power** transferred into the **Transmission System**, or reduce the **Active Power** transferred into its **External System** by way of **Emergency** assistance if the alternative is to instruct a Demand reduction on all or part of the **Transmission System**. Such request must be met by the **External System Operator** providing this does not require a reduction of Demand on its **External System**, or lead to a reduction in security on such **External System**.

OC4.5.6 DE-ENERGISATION OF USERS BY THE TSO

OC4.5.6.1 **De-Energisation** of a **User's Plant** and **Apparatus** may be effected at any time and from time to time if and to the extent that the **TSO** reasonably considers it necessary in order to provide for safe and secure operation of the **Transmission System** within prescribed standards, including in circumstances which otherwise cause or in the **TSO's** view are likely to cause one or more of the following:

(a) risk to the safety of personnel;

(b) risk to the stability of the **Transmission System**;

(c) risk to the **Transmission System** or any **User's Plant** or **Apparatus**;

(d) **Transmission System** elements to become loaded beyond their emergency limits;

(e) **Voltage** excursions on the **Transmission System** outside the ranges specified in CC.8.3;

(f) any behaviour causing sustained operation outside the normal **Transmission System** operating **Frequency** range;

(g) any material breach of a **Connection Condition**; and

(h) any action or inaction which places the **TSO** in breach of any legal or statutory or regulatory obligation.

OC4.6 OPERATING MARGIN

OC4.6.1 INTRODUCTION

OC4.6.1.1 In order to cater for **Demand** forecast variations and to cover against a sudden loss of generation from the **Transmission System**, it is necessary that an **Operating Margin** is maintained through the **Operational Control Phase**.

OC4.6.1.2 The **Operating Margin** is the amount of reserve (provided by additional **Generation** or **Demand** reduction measures) available above that required to meet the expected **System Demand**. **Prudent Utility Practice** requires that a continuum of **Operating Margin** is provided to adequately limit, and then correct, the potential **Frequency** deviation which may occur due to a **Generation**/**Demand** imbalance.

OC4.6.1.3 OC4.6 describes different types of reserve, as provided in a number of reserve time scales, which the **TSO** expect to utilise in the provision of the **Operating Margin**.

OC4.6.1.4 Minimum connection and operating requirements for **Generators** and **Interconnectors** are outlined in the **Connection Conditions**.

OC4.6.1.5 Procedures for the **Monitoring** and **Testing** of **Operating Reserve** are outlined under OC10.

OC4.6.2 OBJECTIVE

OC4.6.2.1 The objective of OC4.6 is to describe the various time scales for which reserves are required, to describe the policy which will govern the dispatch of the reserves, and to describe the procedures for monitoring the performance of **Generation Units,** participating **Interconnectors,** and other reserve providers.

OC4.6.3 CONSTITUENTS OF OPERATING MARGIN

OC4.6.3.1 The **Operating Margin** consists of **Operating Reserve** (which is further broken down into four time-scales), **Replacement Reserve**, **Substitute Reserve** and **Contingency Reserve**.

OC4.6.3.2 **Operating Reserve**.

OC4.6.3.2.1 **Operating Reserve** is additional MW output provided from **Generation** plant, reduction of **Active Power** transfer to an **External System** or increase of **Active Power** transfer to the **Transmission System** by **Interconnectors,** or reduction in **Customer Demand**, which

must be realisable in real time operation to contain and correct any potential **Transmission System Frequency** deviation to an acceptable level.

OC4.6.3.2.2 **Operating Reserve** definitions relate to the time elapsed from the occurrence of an event which has initiated a **Frequency** disturbance. The definition of the time at which the event is deemed to have occurred and other associated definitions are addressed in OC4.6.4.

OC4.6.3.3 **Primary Operating Reserve (POR)**.

OC4.6.3.3.1 **Primary Operating Reserve (POR)** is the additional MW output (and/or reduction in **Demand** or reduction of **Active Power** transfer to an **External System**) required at the **Frequency** nadir (minimum), compared to the pre-incident output (or **Demand**) where the nadir occurs between 5 and 15 seconds after an **Event.**

OC4.6.3.3.2 If the actual **Frequency** nadir is before 5 seconds or after 15 seconds after the event, then for the purpose of **POR** monitoring (in accordance with OC 10.4.4) the nadir is deemed to be the lowest Frequency which did occur between 5 and 15 seconds after the **Event.**

OC4.6.3.4 **Secondary Operating Reserve (SOR)**

OC4.6.3.4.1 **Secondary Operating Reserve (SOR)** is the additional MW output (and/or reduction in **Demand** or reduction of **Active Power** transfer to an **External System**) required compared to the pre-incident output (or **Demand** or **Active Power** transfer to an **External System**), which is fully available and sustainable over the period from 15 to 90 seconds following an **Event.**

OC4.6.3.5 **Tertiary Operating Reserve**

OC4.6.3.5.1 **Tertiary Operating Reserve band 1 (TOR1)** is the additional MW output (and/or reduction in **Demand** or reduction of **Active Power** transfer to an **External System**) required compared to the pre-incident output (or **Demand** or **Active Power** transfer to an **External System**) which is fully available and sustainable over the period from 90 seconds to 5 minutes following an **Event.**

OC4.6.3.5.2 **Tertiary Operating Reserve band 2 (TOR2)** is the additional MW output (and/or reduction in **Demand** or reduction of **Active Power** transfer to an **External System**) required compared to the pre-incident output (or **Demand** or **Active Power** transfer to an **External System**) which is fully available and sustainable over the period from 5 minutes to 20 minutes following an **Event.**

OC4.6.3.6 **Replacement Reserve** is the additional MW output (and/or reduction in **Demand** or reduction of **Active Power** transfer to an **External System**) required compared to the pre-

incident output (or **Demand** or **Active Power** transfer to an **External System**) which is fully available and sustainable over the period from 20 minutes to 4 hours following an **Event.**

OC4.6.3.7 **Substitute Reserve** is the additional MW output (and/or reduction in **Demand** or reduction of **Active Power** transfer to an **External System**) required compared to the pre-incident output (or **Demand** or **Active Power** transfer to an **External System**) which is fully available and sustainable over the period from 4 hours to 24 hours following an **Event**.

OC4.6.3.8 **Contingency Reserve** is the margin of Availability over forecast **Demand**, which is required in the period from 24 hours ahead down to real time, to cover against uncertainties in availability of generation capacity and also against weather forecast and **Demand** forecast errors. **Contingency Reserve** is provided by generation plant which is not required to be **Synchronised**, but which must be held available to **Synchronise** within a limited time scale.

OC4.6.4 DEFINITIONS ASSOCIATED WITH AN OPERATING RESERVE INCIDENT

OC4.6.4.1 Following the occurrence of a significant **Frequency** disturbance, the **TSO** shall monitor, in accordance with OC10.4, and analyse the adequacy of the provision of **Operating Reserve**. For the purposes of this performance analysis, the following criteria have been defined.

OC4.6.4.2 A significant **Frequency** disturbance event is deemed to have occurred if the **Frequency** falls below 49.70 Hz.

OC4.6.4.3 The time of occurrence of the event is defined as the last time at which the **Frequency** fell through the level of 49.80 Hz, prior to the occurrence of the **Frequency** nadir.

OC4.6.4.4 The pre-incident **Frequency** value is the average **Transmission System Frequency** between 60 and 30 seconds prior to the **Event.**

OC4.6.4.5 The pre-incident value of MW output of a **Generation Unit** or **Interconnector**, **Active Power** transfer to an **External System** by **Interconnector or** MW **Demand** of a **Customer**, is the appropriate MW value averaged over the period between 60 and 30 seconds prior to the **Event.**

OC4.6.5 OPERATING MARGIN POLICY

OC4.6.5.1 **Contingency Reserve**

OC4.6.5.1.1 The **TSO** shall determine the amount of **Contingency Reserve** required for each time scale up to 24 hours ahead, taking due consideration of relevant factors, including but not

limited to the following:

(a) historical **Availability Factor** and reliability performance of individual **Generation Units**;

(b) notified risk to the reliability of individual **Generation Units**;

(c) **Demand** forecasting uncertainties; and

(d) Status and availability of **Interconnectors.**

OC4.6.5.2 **Operating Reserve**

OC4.6.5.2.1 The **TSO** shall determine the amount of **Primary Operating Reserve**, **Secondary Operating Reserve, Tertiary Operating Reserve** and **Replacement Reserve** to be carried at any time to ensure system security. This will not be constrained by the **Trading and Settlement Rules.** Due consideration will be taken of relevant factors, including but not limited to the following:

(a) the relevant **TSO** operating policy in existence at that time;
(b) the extent to which **Customer** disconnections allowed under the relevant standard have already occurred within the then relevant period;
(b) the elapsed time since the last **Customer** disconnection incident;
(d) particular events of national or widespread significance, which may justify provision of additional **Operating Reserve**;
(e) the cost of providing **Operating Reserve** at any point in time;
(f) the magnitude and number of the largest generation infeeds to the **Transmission System** at that time, including infeeds over **External Interconnections** and also over single transmission feeders within the **Transmission System** and also the amount of **Generation** that could be lost following a single **Contingency**;
(g) ambient weather conditions, insofar as they may affect (directly or indirectly) **Generation Unit** and/or **Transmission System** reliability;
(h) the predicted **Frequency** drop on loss of the largest infeed as may be determined through simulation using a dynamic model of the **Power System**;
(i) constraints imposed by agreements in place with **Externally Interconnected Parties**;
(j) uncertainty in future **Generation** output.
(k) uncertainty in future Interconnector status and availability,

OC4.6.5.3 The **TSO** shall keep records of significant alterations to the **Operating Reserve** policy so determined under OC4.6.6.2.

OC4.6.6 RESPONSIBILITIES OF THE TSO IN RESPECT OF OPERATING RESERVE

OC4.6.6.1 The **TSO** shall in accordance with **Prudent Utility Practice** make reasonable endeavours to **Dispatch** generation and **Interconnectors** as applicable and otherwise operate the system in compliance with the **TSO's** determinations as to **Operating Margin** policies made from time to time.

OC4.6.6.2 The **TSO's** sole responsibility, having met its obligations under the preceding provisions of OC4.6, shall be to, acting in accordance with **Prudent Utility Practice**, **Dispatch** such **Generation Units** and **Interconnectors** as are required to meet:

(a) **System Demand**; and

(b) the level of **Operating Reserve** required by the **TSO's** then **Operating Reserve** policies.

OC4.7 BLACK START

OC4.7.1 INTRODUCTION

OC4.7.1.1 In order to recover the **Transmission System** from a **Partial Shutdown** or **Total Shutdown**, it is necessary to have certain **Power Stations** ("**Black Start Stations**") available which have the ability for at least one of its **Generation Units** to **Start-Up** from **Shutdown** and to energise a part of the **Total System**, or be **Synchronised** to the **System**, upon instruction from the **TSO**, without an external electrical power supply. **Interconnectors** may also be considered as **Black Start Stations,** as detailed in the **Interconnector Operating Protocol** agreed between the **Interconnector Operator**, the **TSO** and the **External System Operator.**

OC4.7.2 OBJECTIVE

OC4.7.2.1 The objectives of OC4.7 is to set out the requirements of **Black Start Stations** to enable recovery of the **Transmission System** from a **Partial Shutdown** or **Total Shutdown**:

OC4.7.3 REQUIREMENTS OF BLACK START STATIONS

OC4.7.3.1 In order that adequate security is maintained on the **Transmission System** at all times, **Black Start Stations** are required to comply with the provisions of OC4.7.3.

OC4.7.3.2 Other than as permitted in accordance with OC4.7.3.3:

During a **Black Start** situation, instructions in relation to **Black Start Stations** will be in the format required for instructions to **Units** in **SDC1**and **SDC2**, and will recognise any differing **Black Start** operational capabilities (however termed) set out in the relevant **Ancillary Services Agreement** in preference to the declared operational capability as registered pursuant to **SDC1** (or as amended from time to time in accordance with **SDC1** and **SDC2**). For the purposes of these instructions the **Black Start** will be an emergency circumstance. For **Power Stations** or **Interconnectors** which are not **Black Start Stations**, **Dispatch** instructions will recognise each **Unit's** declared operational capability as registered pursuant to **SDC1** (or as amended from time to time in accordance with **SDC1** and **SDC2**).

OC4.7.3.3 If during the **Demand** restoration process any **Generation Unit** or **Interconnector** that is part of a **Black Start Station** cannot, because of the **Demand** being experienced, keep within its safe operating parameters, the **Generator** or **Interconnector Operator** shall

inform the **TSO.** The **TSO** will, where possible, either instruct **Demand** to be altered or will re-configure the **Transmission System** or will instruct a **User** to re-configure its **System** in order to alleviate the problem being experienced by the **Generator** or **Interconnector Operator**. However, the **TSO** accepts that any decision to keep a **Unit** operating, if outside its safe operating parameters, is one for the **Generator** or **Interconnector Operator** concerned alone and accepts that the **Generator** or **Interconnector Operator** may change generation on that **Unit** if it believes it is necessary for safety reasons (whether relating to personnel or **Plant** and/or **Apparatus**). If such a change is made without prior notice, then the **Generator or Interconnector Operator** shall inform the **TSO** as soon as reasonably practical

GLOSSARY:

Interconnector Frequency Droop:

In relation to an **Interconnector** transferring power into the **Transmission System,** it is the percentage drop in the **Frequency** that would, under the action of the **Interconnector Frequency Control** system, cause a change in the **Interconnector's** output from zero to its full **Interconnector Registered Import Capacity**. In relation to an **Interconnector** transferring power to an **External System,** it is the percentage drop in the **Frequency** that would, under the action of the **Interconnector Frequency Control** system, cause a change in the **Interconnector's** output from its full **Interconnector Registered Export Capacity** to zero. In both cases, it is assumed that the **Frequency Control** system is regulating the **Frequency** in the **Transmission System**.