Our Ref:

Your Ref:

Date: September 2008

To: All Recipients of the Serviced Grid Code

Regulatory Frameworks
Electricity Codes

National Grid Electricity Transmission plc
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

Tel No: 01926 654971
Fax No: 01926 656601

Dear Sir/Madam

THE SERVICED GRID CODE – ISSUE 3 REVISION 29

Revision 29 of Issue 3 of the Grid Code has been approved by the Authority for implementation on **1st September 2008**.

I have enclosed the replacement pages that incorporate the agreed changes necessary to update the Grid Code Issue 3 to Revision 29 standard.

The enclosed note provides a brief summary of the changes made to the text.

Yours faithfully

Mark Duffield
Electricity Codes

Registered Office:
1-3 Strand
London
WC2N 5EH

Registered in
England and Wales
No 2366977

THE GRID CODE

Issue 3

Revision 29
1st September 2008

THIS DOCUMENT IS ISSUED BY:-

NATIONAL GRID ELECTRICITY TRANSMISSION plc
ELECTRICITY CODES, REGULATORY FRAMEWORKS
NATIONAL GRID HOUSE
WARWICK TECHNOLOGY PARK
GALLOWS HILL
WARWICK
CV34 6DA

REGISTERED OFFICE: **1-3 Strand**
London
WC2N 5EH

THE GRID CODE – ISSUE 3 REVISION 29

INCLUSION OF REVISED PAGES

Title Page

Connection Conditions	CC	-	**Pages 17-20 and 71-74**
Revisions		-	**Pages 25-27**

NOTE: See Page 1 of the Revisions section of the Grid Code for details of how the revisions are indicated on the pages.

NATIONAL GRID ELECTRICITY TRANSMISSION PLC

THE GRID CODE – ISSUE 3 REVISION 29

SUMMARY OF CHANGES

The changes arise from the implementation of modifications proposed in the following Consultation Paper:

- **B/08** – Grid Code requirements for Power Park Modules – Voltage Control and Reactive Power

  Summary of Proposals
  - Changes to the Grid Code to ensure that the Grid Code consistently reflects the proposals put forward by the Power park Modules and Synchronous Generating Units Working Group and the previous Authority decision to approve the amendments put forward in Grid Code consultation G/06.
  - The categories of Users affected by this revision to the Grid Code are:
    - *Generators*.

  A brief description of the proposals is as follows:

  - Minor changes to the diagram in CC.6.3.4 to clarify that for Generating units or Power park Modules in Scotland the reactive power capability requirement may be specified at the HV side of the transformer rather than at the Grid Entry Point and thus at the Grid Entry Point an equivalent reactive range needs to be derived.
  - Amendments to CC.A.7.2.2.4 to clarify that the relaxations specified in CC.6.3.4 apply GB-wide and not just in England and Wales.
  - Amendments to CC.A.7.2.2.7 to clarify that non-synchronous generating units, , DC Converters or Power Park Modules must meet obligations with regard to reactive current rather than reactive power for voltage rises at the Grid Entry Point above 105%.

(c) For the avoidance of doubt in the case of a **Generating Unit** or **Power Park Module** using an **Intermittent Power Source** where the mechanical power input will not be constant over time, the requirement is that the **Active Power** output shall be independent of **System Frequency** under (a) above and should not drop with **System Frequency** by greater than the amount specified in (b) above.

(d) A **DC Converter Station** must be capable of maintaining its **Active Power** input (i.e. when operating in a mode analogous to **Demand**) from the **GB Transmission System** (or **User System** in the case of an **Embedded DC Converter Station**) at a level not greater than the figure determined by the linear relationship shown in Figure 3 for **System Frequency** changes within the range 49.5 to 47 Hz, such that if the **System Frequency** drops to 47.8 Hz the **Active Power** input decreases by more than 60%.

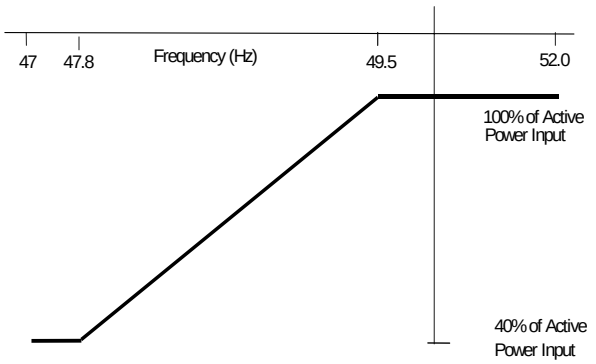

Figure 3

CC.6.3.4 At the **Grid Entry Point** the **Active Power** output under steady state conditions of any **Generating Unit, DC Converter** or **Power Park Module** directly connected to the **GB Transmission System** should not be affected by voltage changes in the normal operating range specified in paragraph CC.6.1.4 by more than the change in **Active Power** losses at reduced or increased voltage. The **Reactive Power** output under steady state conditions should be fully available within the voltage range ±5% at 400kV, 275kV and 132kV and lower voltages, except for a **Power Park Module** or **Non-synchronous Generating Unit** if **Embedded** at 33kV and below (or directly connected to the **GB Transmission System** at 33kV and below) where the requirement shown in Figure 4 applies.

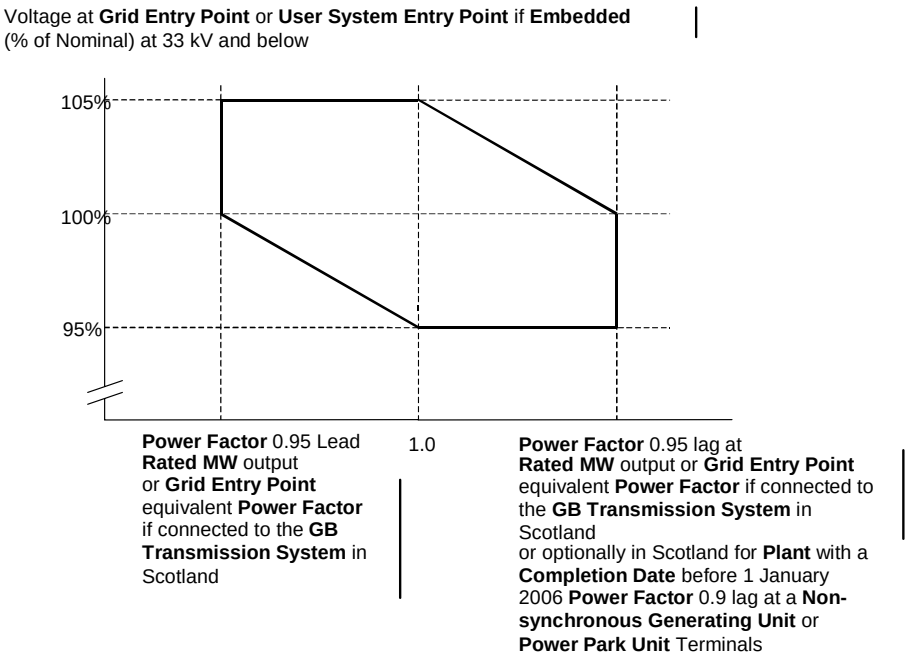

Figure 4

CC.6.3.5 It is an essential requirement that the **GB Transmission System** must incorporate a **Black Start Capability**. This will be achieved by agreeing a **Black Start Capability** at a number of strategically located **Power Stations**. For each **Power Station NGET** will state in the **Bilateral Agreement** whether or not a **Black Start Capability** is required.

Control Arrangements

CC.6.3.6 (a) Each:

(i) **Generating Unit**; or,

(ii) **DC Converter** with a **Completion Date** on or after 1 April 2005; or,

(iii) **Power Park Module** in England and Wales with a **Completion Date** on or after 1 January 2006; or,

(iv) **Power Park Module** in operation in Scotland on or after 1 January 2006 (with a **Completion Date** after 1 July 2004 and in a **Power Station** with a **Registered Capacity** of 50MW or more),

must be capable of contributing to **Frequency** control by continuous modulation of **Active Power** supplied to the **GB Transmission System** or the **User System** in which it is **Embedded**.

(b) Each:

(i) **Generating Unit**; or,

(ii) **DC Converter** (with a **Completion Date** on or after 1 April 2005 excluding current source technologies); or

(iii) **Power Park Module** in England and Wales with a **Completion Date** on or after 1 January 2006; or,

(iv) **Power Park Module** in Scotland irrespective of **Completion Date,**

must be capable of contributing to voltage control by continuous changes to the **Reactive Power** supplied to the **GB Transmission System** or the **User System** in which it is **Embedded**.

CC.6.3.7 (a) Each **Generating Unit, DC Converter** or **Power Park Module** (excluding **Power Park Modules** in Scotland with a **Completion Date** before 1 July 2004 or **Power Park Modules** in a **Power Station** in Scotland with a **Registered Capacity** less than 50MW) must be fitted with a fast acting proportional **Frequency** control device (or turbine speed governor) and unit load controller or equivalent control device to provide **Frequency** response under normal operational conditions in accordance with **Balancing Code 3** (**BC3**). In the case of a **Power Park Module** the frequency or speed control device(s) may be on the **Power Park Module** or on each individual **Power Park Unit** or be a combination of both. The Frequency control device(s) (or speed governor(s)) must be designed and operated to the appropriate:

(i) **European Specification**; or

(ii) in the absence of a relevant **European Specification**, such other standard which is in common use within the European Community (which may include a manufacturer specification);

as at the time when the installation of which it forms part was designed or (in the case of modification or alteration to the **Frequency** control device (or turbine speed governor)) when the modification or alteration was designed.

The **European Specification** or other standard utilised in accordance with sub-paragraph CC.6.3.7 (a) (ii) will be notified to **NGET** by the **Generator** or **DC Converter Station** owner or, in the case of an **Embedded Medium Power Station** not subject to a **Bilateral Agreement** or **Embedded DC Converter Station** not subject to a **Bilateral Agreement**, the relevant **Network Operator**:

(i) as part of the application for a **Bilateral Agreement;** or

(ii) as part of the application for a varied **Bilateral Agreement;** or

(iii) in the case of an **Embedded Development**, within 28 days of entry into the **Embedded Development Agreement** (or such later time as agreed with **NGET**); or

(iv) as soon as possible prior to any modification or alteration to the **Frequency** control device (or governor); and

(b) The **Frequency** control device (or speed governor) in co-ordination with other control devices must control the **Generating Unit, DC Converter** or **Power Park Module Active Power Output** with stability over the entire operating range of the **Generating Unit, DC Converter** or **Power Park Module**; and

(c) The **Frequency** control device (or speed governor) must meet the following minimum requirements:

(i) Where a **Generating Unit, DC Converter** or **Power Park Module** becomes isolated from the rest of the **Total System** but is still supplying **Customers**, the **Frequency** control device (or speed governor) must also be able to control **System Frequency** below 52Hz unless this

causes the **Generating Unit, DC Converter** or **Power Park Module** to operate below its **Designed Minimum Operating Level** when it is possible that it may, as detailed in BC 3.7.3, trip after a time. For the avoidance of doubt the **Generating Unit, DC Converter** or **Power Park Module** is only required to operate within the **System Frequency** range 47 - 52 Hz as defined in CC.6.1.3.;

(ii) the **Frequency** control device (or speed governor) must be capable of being set so that it operates with an overall speed **Droop** of between 3% and 5%. For the avoidance of doubt, in the case of a **Power Park Module** the speed **Droop** should be equivalent of a fixed setting between 3% and 5% applied to each **Power Park Unit** in service;

(iii) in the case of all **Generating Units, DC Converter** or **Power Park Module** other than the **Steam Unit** within a **CCGT Module** the **Frequency** control device (or speed governor) deadband should be no greater than 0.03Hz (for the avoidance of doubt, ±0.015Hz). In the case of the **Steam Unit** within a **CCGT Module**, the speed governor deadband should be set to an appropriate value consistent with the requirements of CC.6.3.7(c)(i) and the requirements of BC3.7.2 for the provision of **Limited High Frequency Response**;

For the avoidance of doubt, the minimum requirements in (ii) and (iii) for the provision of **System Ancillary Services** do not restrict the negotiation of **Commercial Ancillary Services** between **NGET** and the **User** using other parameters; and

(d) A facility to modify, so as to fulfil the requirements of the **Balancing Codes**, the **Target Frequency** setting either continuously or in a maximum of 0.05 Hz steps over at least the range 50 ±0.1 Hz should be provided in the unit load controller or equivalent device.

(e) (i) Each **Generating Unit** and/or **CCGT Module** which has a **Completion Date** after 1 January 2001 in England and Wales, and after 1 April 2005 in Scotland, must be capable of meeting the minimum **Frequency** response requirement profile subject to and in accordance with the provisions of Appendix 3.

(ii) Each **DC Converter** at a **DC Converter Station** which has a **Completion Date** on or after 1 April 2005 must be capable of meeting the minimum **Frequency** response requirement profile subject to and in accordance with the provisions of Appendix 3**.**

(iii) Each **Power Park Module** in operation in England and Wales with a **Completion Date** on or after 1 January 2006 must be capable of meeting the minimum **Frequency** response requirement profile subject to and in accordance with the provisions of Appendix 3.

(iv) Each **Power Park Module** in operation on or after 1 January 2006 in Scotland (with a **Completion Date** on or after 1 April 2005 and a **Registered Capacity** of 50MW or more) must be capable of meeting the minimum **Frequency** response requirement profile subject to and in accordance with the provisions of Appendix 3.

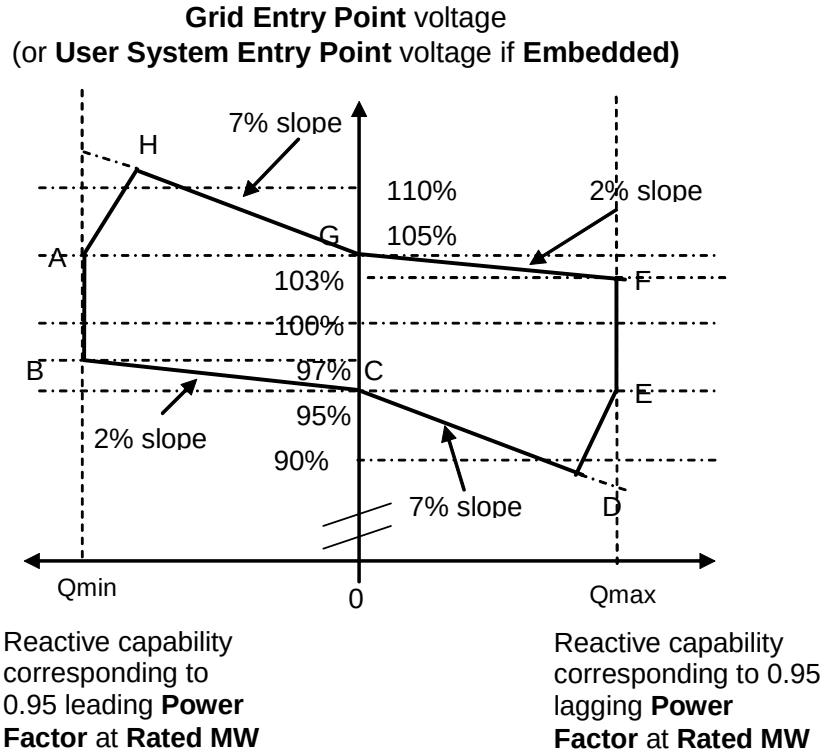

Figure CC.A.7.2.2b

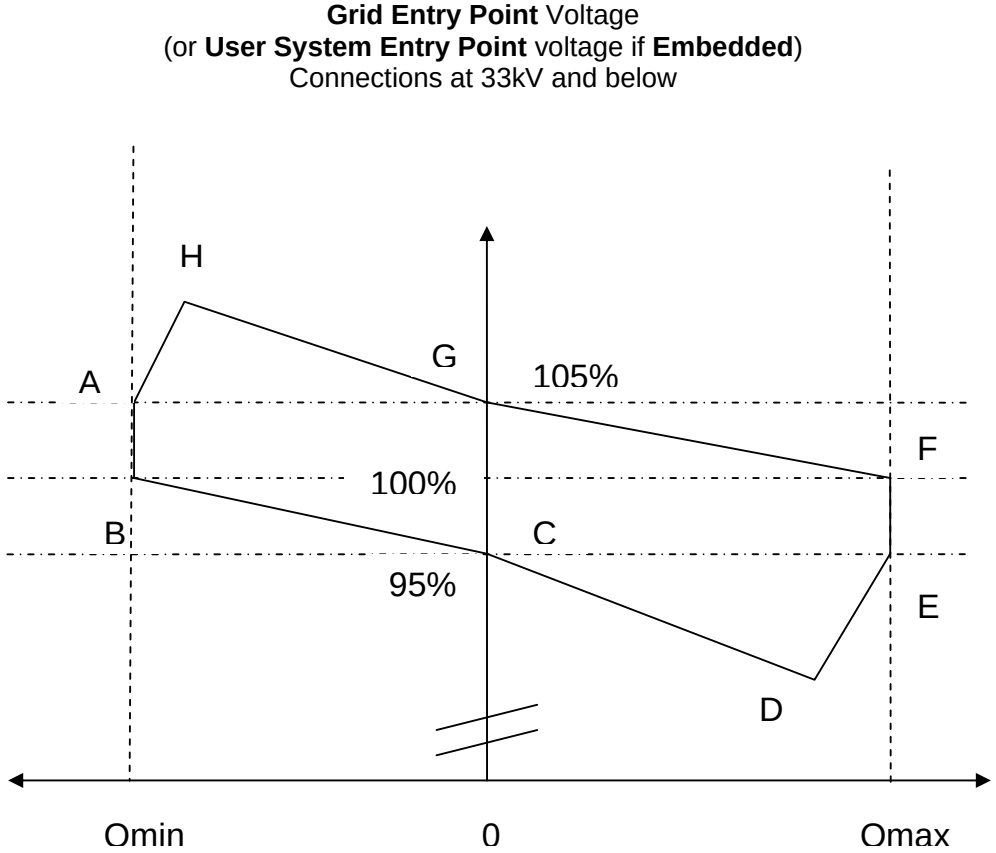

Figure CC.A.7.2.2c

CC.A.7.2.2.4 Figure CC.A.7.2.2b shows the required envelope of operation for **Non-Synchronous Generating Units**, **DC Converters** and **Power Park Modules** except for those **Embedded** at 33kV and below or directly connected to the **GB Transmission System** at 33kV and below. Figure CC.A.7.2.2c shows the required envelope of operation for **Non-Synchronous Generating Units**, **DC Converters** and **Power Park Modules Embedded** at 33kV and below or directly connected to the **GB Transmission System** at 33kV and below. Where the **Reactive Power** capability requirement of a directly connected **Non-Synchronous Generating** Unit, **DC Converter** or **Power Park Module** in Scotland, as specified in CC6.3.2 (c), is not at the **Grid Entry** Point, the values of Qmin and Qmax shown in this figure will be as modified by the 33/132kV or 33/275kV or 33/400kV transformer. The enclosed area within points ABCDEFGH is the required capability range within which the **Slope** and **Setpoint Voltage** can be changed.

CC.A.7.2.2.5 Should the operating point of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** deviate so that it is no longer a point on the operating characteristic (figure CC.A.7.2.2a) defined by the target **Setpoint Voltage** and **Slope**, the continuously acting automatic voltage control system shall act progressively to return the value to a point on the required characteristic within 5 seconds.

CC.A.7.2.2.6 Should the **Reactive Power** output of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** reach its maximum lagging limit at a **Grid Entry Point** voltage (or **User System Entry Point** voltage if **Embedded**) above 95%, the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** shall maintain maximum lagging **Reactive Power** output for voltage reductions down to 95%. This requirement is indicated by the line EF in figures CC.A.7.2.2b and CC.A.7.2.2c. Should the **Reactive Power** output of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** reach its maximum leading limit at a **Grid Entry Point** voltage (or **User System Entry Point** voltage if **Embedded**) below 105%, the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** shall maintain maximum leading **Reactive Power** output for voltage increases up to 105%. This requirement is indicated by the line AB in figures CC.A.7.2.2b and CC.A.7.2.2c.

CC.A.7.2.2.7 For **Grid Entry Point** voltages (or **User System Entry Point** voltages if **Embedded**) below 95%, the lagging **Reactive Power** capability of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** should be that which results from the supply of maximum lagging reactive current whilst ensuring the current remains within design operating limits. An example of the capability is shown by the line DE in figures CC.A.7.2.2b and CC.A.7.2.2c. For **Grid Entry Point** voltages (or **User System Entry Point** voltages if **Embedded**) above 105%, the leading **Reactive Power** capability of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** should be that which results from the supply of maximum leading reactive current whilst ensuring the current remains within design operating limits. An example of the capability is shown by the line AH in figures CC.A.7.2.2b and CC.A.7.2.2c. Should the **Reactive Power** output of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** reach its maximum lagging limit at a **Grid Entry Point** voltage (or **User System Entry Point** voltage if **Embedded**) below 95%, the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** shall maintain maximum lagging reactive current output for further voltage decreases. Should the **Reactive Power** output of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** reach its maximum leading limit at a **Grid Entry Point** voltage (or **User System Entry Point** voltage if **Embedded**) above 105%, the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** shall maintain maximum leading reactive current output for further voltage increases.

CC.A.7.2.3 Transient Voltage Control

CC.A.7.2.3.1 For an on-load step change in **Grid Entry Point** or **User System Entry Point** voltage, the continuously acting automatic control system shall respond according to the following minimum criteria

i. the **Reactive Power** output response of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** shall commence within 0.2 seconds of the application of the step. It shall progress linearly although variations from a linear characteristic shall be acceptable provided that the MVAr seconds delivered at any time up to 1 second are at least those that would result from the response shown in figure CC.A.7.2.3.1a.

ii. the response shall be such that, for a sufficiently large step, 90% of the full reactive capability of the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module**, as required by **CC.6.3.2** (or, if appropriate, **CC.A.7.2.2.6** or **CC.A.7.2.2.7**), will be produced within 1 second

iii. the magnitude of the **Reactive Power** output response produced within 1 second shall vary linearly in proportion to the magnitude of the step change

iv. the settling time shall be no greater than 2 seconds from the application of the step change in voltage and the peak to peak magnitude of any oscillations shall be less than 5% of the change in steady state **Reactive Power** within this time.

v. following the transient response, the conditions of CC.A.7.2.2 apply.

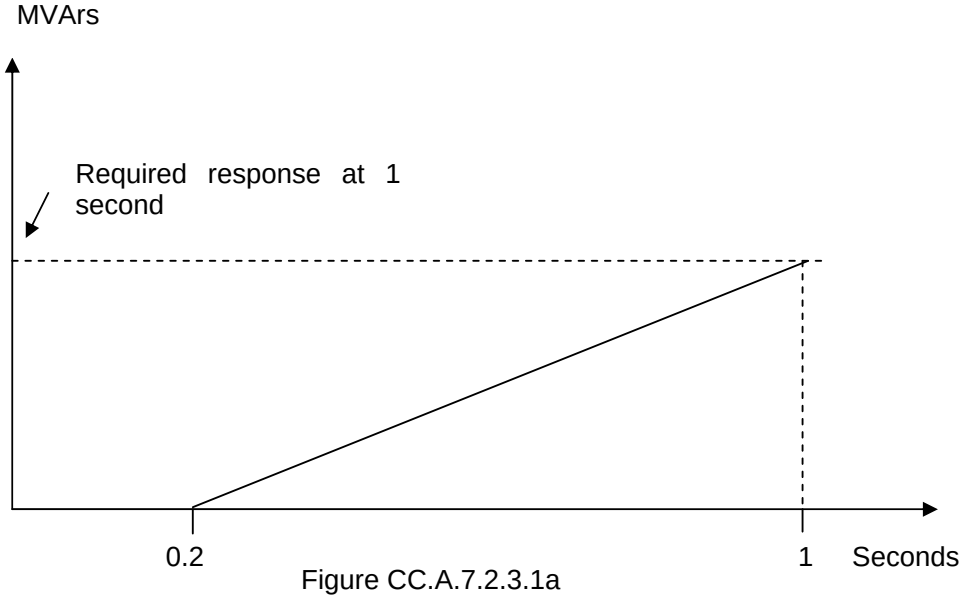

Figure CC.A.7.2.3.1a

CC.A.7.2.4 Power Oscillation Damping

CC.A.7.2.4.1 The requirement for the continuously acting voltage control system to be fitted with a **Power System Stabiliser (PSS)** shall be specified in the **Bilateral Agreement** if, in **NGET's** view, this is required for system reasons. However if a **Power System Stabiliser** is included in the voltage control system its settings and performance shall be agreed with **NGET** and commissioned in accordance with **BC.2.11.2**.

CC.A.7.2.5 Overall Voltage Control System Characteristics

CC.A.7.2.5.1 The continuously acting automatic voltage control system is required to respond to minor variations, steps, gradual changes or major variations in **Grid Entry Point** voltage (or **User System Entry Point** voltage if **Embedded**).

CC.A.7.2.5.2 The overall voltage control system shall include elements that limit the bandwidth of the output signal. The bandwidth limiting must be consistent with the speed of response requirements and ensure that the highest frequency of response cannot excite torsional oscillations on other plant connected to the network. A bandwidth of 0-5Hz would be judged to be acceptable for this application. All other control systems employed within the **Non-Synchronous Generating Unit**, **DC Converter** or **Power Park Module** should also meet this requirement

CC.A.7.2.5.3 The response of the voltage control system (including the **Power System Stabiliser** if employed) shall be demonstrated by applying suitable step disturbances into the voltage control system of the **Power Park Module** or **Power Park Unit**, or by changing the actual voltage at a suitable point, with the generator operating at points specified by **NGET** (up to rated MVA output). The damping shall be judged to be adequate if the corresponding **Active Power** response to the disturbances decays within 2 seconds of the application of the step.

< End of CC >

Revision 27 Effective Date: 27 June 2008

CODE	PAGE	CLAUSE
G&D	12	Definition of Emergency Deenergisation Instruction added
BC2	13	BC2.9.1.2(e)(ii) amended
	13	BC2.9.1.2(e)(iii) added
	14	BC2.9.2.2(i) created from existing text
	14	BC2.9.2.2(ii) added
	14	BC2.9.2.5 added

Revision 28 Effective Date: 7 July 2008

CODE	PAGE	CLAUSE
G&D	4	Definition of Block Load Capability added
	24	Definition of Local Joint Restoration Plan amended
	35	Definition of Re-synchronisation amended
	40	Definition of Synchronised amended
PC	38	PC.A.5.1.1 amended
	38	PC.A.5.1.2 amended
	55	PC.A.5.7 added
OC9	1	OC9.1.2 amended
	2	OC9.2.5 amended
	2	OC9.4.1 heading deleted
	2	OC.9.4 new sub-heading added
	2	OC.9.4.2. heading deleted
	3	OC9.4.4 amended
	3	OC9.4.5.2 amended
	3	OC9.4.6 amended

	4	OC9.4.7.2 amended
	4	OC9.4.7.4 (a) amended
	7	New OC9.7.9 added
	7	Previous OC9.4.7.9 renumbered to OC9.4.7.10 and amended
	7	Previous OC9.4.7.10 renumbered to OC9.4.7.11
	7	Previous OC9.4.7.11 renumbered to OC9.4.7.12 and amended
	8	OC9.4.7.12(b)(viii) amended
	9	OC9.4.7.12(b)(xi) amended
	9	OC9.4.7.12(b)(xii) added
	10	OC9.4.7.12(c)(viii) amended
	10	OC9.4.7.12(c)(xi) amended
	10	OC9.4.7.12(c)(xii) added
	11	OC9.5 amended
	11	OC9.5.1(d) amended
	16	OC9.5.6 added
BC2	14	BC2.9.2.2(ii) amended
	14	BC2.9.2.2(iii) added
	14	BC2.9.2.6 added
DRC	5	DRC.6.1.16 added
	5	DRC.6.2 amended
	58	Schedule 16 added

Revision 29 Effective Date: 1 September 2008

CODE	PAGE	CLAUSE
CC	18	CC.6.3.4 amended

CODE	PAGE	CLAUSE
	72	CC.A.7.2.2.4 amended CC.A.7.2.2.7 amended