

Our Ref:

Your Ref:

Date: April 2007

Regulatory Frameworks
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Dear Sir/Madam

THE SERVICED GRID CODE – ISSUE 3 REVISION 20

Revision 20 of Issue 3 of the Grid Code has been approved by the Authority for implementation on **1st April 2007**.

I have enclosed the replacement pages that incorporate the agreed changes necessary to update the Grid Code Issue 3 to Revision 20 standard.

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

Yours faithfully

L Macleod
Electricity Codes



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THE GRID CODE – ISSUE 3 REVISION 20

INCLUSION OF REVISED PAGES

Title Page

Connection Conditions **CC** - **Pages 25 to 26 and Pages 59 to 62**

Operation Code 6 **OC6** - **Content Page and Pages 7 to 11**

Revisions - **Page 21**

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 20

SUMMARY OF CHANGES

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

- **E/06** – Low Frequency Demand Disconnection Relay Settings

THE GRID CODE

Issue 3

**Revision 20
1st April 2007**

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(iv) To avoid unwanted island operation, **Non-Synchronous Generating Units** in Scotland or **Power Park Modules** in Scotland shall be tripped for the following conditions:-

- (1) Frequency above 52Hz for more than 2 seconds
- (2) Frequency below 47Hz for more than 2 seconds
- (3) Voltage as measured at the **Connection Point** or **User System Entry Point** below 80% for more than 2 seconds
- (4) Voltage as measured at the **Connection Point** or **User System Entry Point** above 120% (115% for 275kV) for more than 1 second.

The times in sections (1) and (2) are maximum trip times. Shorter times may be used to protect the **Non-Synchronous Generating Units** or **Power Park Modules**.

Additional Damping Control Facilities for DC Converters

- CC.6.3.16 (a) **DC Converter** owners or **Network Operators** in the case of an **Embedded DC Converter Station** not subject to a **Bilateral Agreement** must ensure that any of their **DC Converters** will not cause a sub-synchronous resonance problem on the **Total System**. Each **DC Converter** is required to be provided with sub-synchronous resonance damping control facilities.
- (b) Where specified in the **Bilateral Agreement**, each **DC Converter** is required to be provided with power oscillation damping or any other identified additional control facilities.

System to Generator Operational Intertripping Scheme

- CC.6.3.17 **NGET** may require that a **System to Generator Operational Intertripping Scheme** be installed as part of a condition of the connection of the **Generator**. Scheme specific details shall be included in the relevant **Bilateral Agreement**.

CC.6.4 GENERAL NETWORK OPERATOR AND NON-EMBEDDED CUSTOMER REQUIREMENTS

- CC.6.4.1 This part of the **Grid Code** describes the technical and design criteria and performance requirements for **Network Operators** and **Non-Embedded Customers**.

Neutral Earthing

- CC.6.4.2 At nominal **System** voltages of 132kV and above the higher voltage windings of three phase transformers and transformer banks connected to the **GB Transmission System** must be star connected with the star point suitable for connection to earth. The earthing and lower voltage winding arrangement shall be such as to ensure that the **Earth Fault Factor** requirement of paragraph CC.6.2.1.1 (b) will be met on the **GB Transmission System** at nominal **System** voltages of 132kV and above.

Frequency Sensitive Relays

- CC.6.4.3 As explained under **OC6**, each **Network Operator**, will make arrangements that will facilitate automatic low **Frequency Disconnection of Demand** (based on **Annual ACS Conditions**). CC.A.5.5. of Appendix 5 includes specifications of the local percentage **Demand** that shall be disconnected at specific frequencies. The manner in which **Demand** subject to low **Frequency** disconnection will be split into discrete MW blocks is specified in OC6.6. Technical requirements relating to **Low Frequency Relays** are also listed in Appendix 5.

Operational Metering

- CC.6.4.4 Where **NGET** can reasonably demonstrate that an **Embedded Medium Power Station** or **Embedded DC Converter Station** has a significant effect on the **GB Transmission System**, it may require the **Network Operator** within whose **System** the **Embedded Medium Power Station** or **Embedded DC Converter Station** is situated to ensure that the operational metering equipment described in CC.6.5.6 is installed such that **NGET** can receive the data referred to in CC.6.5.6. **NGET** shall notify such **Network Operator** of the details of such installation in writing within 3 months of being notified of the application to connect under **CUSC** and the **Network Operator** shall ensure that the data referred to in CC.6.5.6 is provided to **NGET**.

CC.6.5 COMMUNICATIONS PLANT

- CC.6.5.1 In order to ensure control of the **GB Transmission System**, telecommunications between **Users** and **NGET** must, if required by **NGET**, be established in accordance with the requirements set down below.

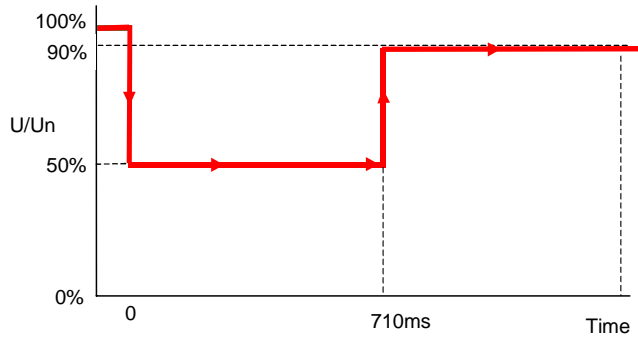
Control Telephony

- CC.6.5.2 **Control Telephony** is the method by which a **User's Responsible Engineer/Operator** and **NGET Control Engineers** speak to one another for the purposes of control of the **Total System** in both normal and emergency operating conditions. **Control Telephony** provides secure point to point telephony for routine **Control Calls**, priority **Control Calls** and emergency **Control Calls**.
- CC.6.5.3 Supervisory tones indicate to the calling and receiving parties dial, engaged, ringing, secondary engaged (signifying that priority may be exercised) and priority disconnect tones.
- CC.6.5.4 Where **NGET** requires **Control Telephony**, **Users** are required to use the **Control Telephony** with **NGET** in respect of all **Connection Points** with the **GB Transmission System** and in respect of all **Embedded Large Power Stations** and **Embedded DC Converter Stations**. **NGET** will install **Control Telephony** at the **User's** location where the **User's** telephony equipment is not capable of providing the required facilities or is otherwise incompatible with the **Transmission Control Telephony**. Details of and relating to the **Control Telephony** required are contained in the **Bilateral Agreement**.
- CC.6.5.5 Detailed information on **Control Telephony** facilities and suitable equipment required for individual **User** applications will be provided by **NGET** upon request.

Operational Metering

- CC.6.5.6 (a) **NGET** shall provide system control and data acquisition (SCADA) outstation interface equipment. The **User** shall provide such voltage, current,

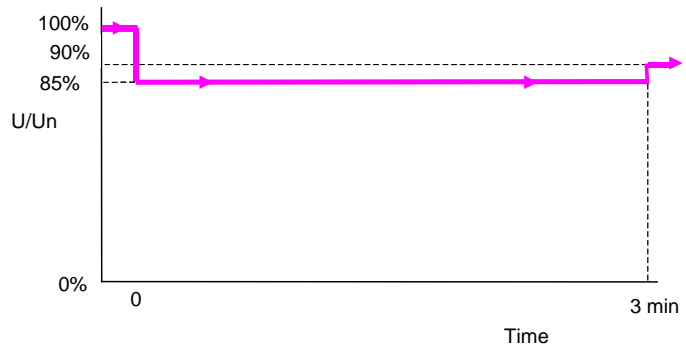
**Supergrid
Voltage
400/275kV**



50% retained voltage, 710ms duration

Figure CC.A.4.3(b)

**Supergrid
Voltage
400/275kV**



85% retained voltage, 3 minutes duration

Figure CC.A.4.3(c)

APPENDIX 5

TECHNICAL REQUIREMENTS LOW FREQUENCY RELAYS FOR THE AUTOMATIC DISCONNECTION OF SUPPLIES AT LOW FREQUENCY

CC.A.5.1

LOW FREQUENCY RELAYS

CC.A.5.1.1

The **Low Frequency Relays** to be used shall have a setting range of 47.0 to 50Hz and be suitable for operation from a nominal AC input of 63.5, 110 or 240V. The following general parameters specify the requirements of approved **Low Frequency Relays** for automatic installations installed and commissioned after 1st April 2007 and provide an indication, without prejudice to the provisions that may be included in a **Bilateral Agreement**, for those installed and commissioned before 1st April 2007:

- (a) **Frequency** settings: 47-50Hz in steps of 0.05Hz or better, preferably 0.01Hz;
- (b) Operating time: Between 100 and 150ms dependent on measurement period setting;
- (c) Voltage lock-out: Selectable within a range of 55 to 90% of nominal voltage;
- (d) Facility stages: One or two stages of **Frequency** operation;
- (e) Output contacts: Two output contacts per stage to be capable of repetitively making and breaking for 1000 operations;
- (f) Accuracy 0.01 Hz maximum error under reference environmental and system voltage conditions.
0.05 Hz maximum error at 8% of total harmonic distortion **Electromagnetic Compatibility Level**.

CC.A.5.2

LOW FREQUENCY RELAY VOLTAGE SUPPLIES

CC.A.5.2.1

It is essential that the voltage supply to the **Low Frequency Relays** shall be derived from the primary **System** at the supply point concerned so that the **Frequency** of the **Low Frequency Relays** input voltage is the same as that of the primary **System**. This requires either:

- (a) the use of a secure supply obtained from voltage transformers directly associated with the grid transformer(s) concerned, the supply being obtained where necessary via a suitable automatic voltage selection scheme; or
- (b) the use of the substation 240V phase-to-neutral selected auxiliary supply, provided that this supply is always derived at the supply point concerned and is never derived from a standby

supply **Generating Unit** or from another part of the **User System**.

CC.A.5.3 SCHEME REQUIREMENTS

CC.A.5.3.1 The tripping facility should be engineered in accordance with the following reliability considerations:

(a) Dependability

Failure to trip at any one particular **Demand** shedding point would not harm the overall operation of the scheme. However, many failures would have the effect of reducing the amount of **Demand** under low **Frequency** control. An overall reasonable minimum requirement for the dependability of the **Demand** shedding scheme is 96%, ie. the average probability of failure of each **Demand** shedding point should be less than 4%. Thus the **Demand** under low **Frequency** control will not be reduced by more than 4% due to relay failure.

(b) Outages

Low **Frequency Demand** shedding schemes will be engineered such that the amount of **Demand** under control is as specified in Table CC.A.5.5.1a and is not reduced unacceptably during equipment outage or maintenance conditions.

CC.A.5.4 LOW FREQUENCY RELAY TESTING

CC.A.5.4.1 **Low Frequency Relays** installed and commissioned after 1st January 2007 shall be type tested in accordance with and comply with the functional test requirements for **Frequency Protection** contained in Energy Networks Association Technical Specification 48-6-5 Issue 1 dated 2005 "ENA Protection Assessment Functional Test Requirements – Voltage and Frequency Protection".

For the avoidance of doubt, **Low Frequency Relays** installed and commissioned before 1st January 2007 shall comply with the version of CC.A.5.1.1 applicable at the time such **Low Frequency Relays** were commissioned.

CC.A.5.5 SCHEME SETTINGS

CC.A.5.5.1 Table CC.A.5.5.1a shows, for each **Transmission Area**, the percentage of peak **Demand** (based on **Annual ACS Conditions**) that each **Network Operator** whose **System** is connected to the **GB Transmission System** within such **Transmission Area** shall disconnect by **Low Frequency Relays** at a range of frequencies. Where a **Network Operator's System** is connected to the **GB Transmission System** in more than one **Transmission Area**, the settings for the **Transmission Area** in which the majority of the **Demand** is connected shall apply.

Table CC.A.5.5.1a

Frequency Hz	%Demand disconnection for each Network Operator in Transmission Area		
	NGET	SPT	SHETL
48.8	5		
48.75	5		
48.7	10		
48.6	7.5		10
48.5	7.5	10	
48.4	7.5	10	10
48.3			
48.2	7.5	10	10
48.0	5	10	10
47.8	5		
Total % Demand	60	40	40

Note – the percentages in table CC.A.5.5.1a are cumulative such that, for example, should the frequency fall to 48.6 Hz in the **NGET Transmission Area**, 27.5% of the total **Demand** connected to the **GB Transmission System** in the **NGET Transmission Area** shall be disconnected by the action of **Low Frequency Relays**.

< End of CC >

OPERATING CODE NO.6

DEMAND CONTROL

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(This contents page does not form part of the Grid Code)

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OC6.6 AUTOMATIC LOW FREQUENCY DEMAND DISCONNECTION

OC6.6.1 Each **Network Operator** will make arrangements that will enable automatic low **Frequency Disconnection** of at least:

- (i) 60 per cent of its total peak **Demand** (based on **Annual ACS Conditions**) where such **Network Operator's System** is connected to the **GB Transmission System** in **NGET's Transmission Area**
- (ii) 40 per cent of its total peak **Demand** (based on **Annual ACS Conditions**) where such **Network Operator's System** is connected to the **GB Transmission System** in either **SPT's** or **SHETL's Transmission Area**

in order to seek to limit the consequences of a major loss of generation or an **Event** on the **Total System** which leaves part of the **Total System** with a generation deficit. Where a **Network Operator's System** is connected to the **GB Transmission System** in more than one **Transmission Area**, the figure above for the **Transmission Area** in which the majority of the **Network Operator's Demand** is connected shall apply.

OC6.6.2 (a) The **Demand** of each **Network Operator** which is subject to automatic low **Frequency Disconnection** will be split into discrete MW blocks.

(b) The number, size (% **Demand**) and the associated low **Frequency** settings of these blocks, will be as specified in Table CC.A.5.5.1a. **NGET** will keep the settings under review.

(c) The distribution of the blocks will be such as to give a reasonably uniform **Disconnection** within the **Network Operator's System**, as the case may be, across all **Grid Supply Points**.

(d) Each **Network Operator** will notify **NGET** in writing by calendar week 24 each year of the details of the automatic low **Frequency Disconnection** on its **User System**. The information provided should identify, for each **Grid Supply Point** at the date and time of the annual peak of the **GB Transmission System Demand at Annual ACS Conditions** (as notified pursuant to OC1.4.2), the frequency settings at which **Demand Disconnection** will be initiated and amount of **Demand** disconnected at each such setting.

OC6.6.3 Where conditions are such that, following automatic low **Frequency Demand Disconnection**, and the subsequent **Frequency** recovery, it is not possible to restore a large proportion of the total **Demand** so disconnected within a reasonable period of time, **NGET** may instruct a **Network Operator** to implement additional **Demand Disconnection** manually, and restore an equivalent amount of the **Demand** that had been disconnected automatically. The purpose of such action is to ensure that a subsequent fall in **Frequency** will again be contained by the operation of automatic low **Frequency Demand Disconnection**.

OC6.6.4 Once an automatic low **Frequency Demand Disconnection** has taken place, the **Network Operator** on whose **User System** it has occurred, will not reconnect until **NGET** instructs that **Network Operator** to do so in accordance with **OC6**.

- OC6.6.5 Once the **Frequency** has recovered, each **Network Operator** will abide by the instructions of **NGET** with regard to reconnection under OC6.6 without delay. Reconnection must be achieved as soon as possible and the process of reconnection must begin within 2 minutes of the instruction being given by **NGET**.
- OC6.6.6 (a) **Non-Embedded Customers** (including a **Pumped Storage Generator**) must provide automatic low **Frequency** disconnection, which will be split into discrete blocks.
- (b) The number and size of blocks and the associated low **Frequency** settings will be as specified by **NGET** by week 24 each calendar year following discussion with the **Non-Embedded Customers** (including a **Pumped Storage Generator**) in accordance with the relevant **Bilateral Agreement**.
- OC6.6.7 (a) In addition, **Generators** may wish to disconnect **Generating Units** from the **System**, either manually or automatically, should they be subject to **Frequency** levels which could result in **Generating Unit** damage.
- (b) This **Disconnection** facility on such **Generating Unit** directly connected to the **GB Transmission System**, will be agreed with **NGET** in accordance with the **Bilateral Agreement**.
- (c) Any **Embedded Power Stations** will need to agree this **Disconnection** facility with the relevant **User** to whose **System** that **Power Station** is connected, which will then need to notify **NGET** of this.
- OC6.6.8 The **Network Operator** or **Non-Embedded Customer**, as the case may be, will notify **NGET** with an estimation of the **Demand** reduction which has occurred under automatic low **Frequency Demand Disconnection** and similarly notify the restoration, as the case may be, in each case within five minutes of the **Disconnection** or restoration.
- OC6.6.9 Pursuant to the provisions of OC1.5.6 the **Network Operator** and **Non-Embedded Customer** will supply to **NGET** details of the amount of **Demand** reduction or restoration actually achieved.
- OC6.6.10 (a) In the case of a **User**, it is not necessary for it to provide automatic low **Frequency** disconnection under OC6.6 only to the extent that it is providing, at the time it would be so needed, low **Frequency** disconnection at a higher level of **Frequency** as an **Ancillary Service**, namely if the amount provided as an **Ancillary Service** is less than that required under OC6.6 then the **User** must provide the balance required under OC6.6 at the time it is so needed.
- (b) The provisions of OC7.4.8 relating to the use of **Demand Control** should be borne in mind by **Users**.

OC6.7 EMERGENCY MANUAL DISCONNECTION

- OC6.7.1 Each **Network Operator** will make arrangements that will enable it, following an instruction from **NGET**, to disconnect **Customers** on its **User System** under emergency conditions irrespective of **Frequency** within 30 minutes. It must be

possible to apply the **Demand Disconnections** to individual or specific groups of **Grid Supply Points**, as determined by **NGET**.

- OC6.7.2 (a) Each **Network Operator** shall provide **NGET** in writing by week 24 in each calendar year, in respect of the next following year beginning week 24, on a **Grid Supply Point** basis, with the following information (which is set out in a tabular format in the Appendix):
- (i) its total peak **Demand** (based on **Annual ACS Conditions**); and
 - (ii) the percentage value of the total peak **Demand** that can be disconnected (and in the case of that in the first 5 minutes it must include that which can also be reduced by voltage reduction) within timescales of 5/10/15/20/25/30 minutes.
- (b) The information should include, in relation to the first 5 minutes, as a minimum, the 20% of **Demand** that must be reduced on instruction under OC6.5.
- OC6.7.3 Each **Network Operator** will abide by the instructions of **NGET** with regard to **Disconnection** under OC6.7 without delay, and the **Disconnection** must be achieved as soon as possible after the instruction being given by **NGET**, and in any case, within the timescale registered in OC6.7. The instruction may relate to an individual **Grid Supply Point** and/or groups of **Grid Supply Points**.
- OC6.7.4 **NGET** will notify a **Network Operator** who has been instructed under OC6.7, of what has happened on the **GB Transmission System** to necessitate the instruction, in accordance with the provisions of **OC7** and, if relevant, **OC10**.
- OC6.7.5 Once a **Disconnection** has been applied by a **Network Operator** at the instruction of **NGET**, that **Network Operator** will not reconnect until **NGET** instructs it to do so in accordance with **OC6**.
- OC6.7.6 Each **Network Operator** will abide by the instructions of **NGET** with regard to reconnection under OC6.7 without delay, and shall not reconnect until it has received such instruction and reconnection must be achieved as soon as possible and the process of reconnection must begin within 2 minutes of the instruction being given by **NGET**.
- OC6.7.7 **NGET** may itself disconnect manually and reconnect **Non-Embedded Customers** as part of a **Demand Control** requirement under emergency conditions.
- OC6.7.8 If **NGET** determines that emergency manual **Disconnection** referred to in OC6.7 is inadequate, **NGET** may disconnect **Network Operators** and/or **Non-Embedded Customers** at **Grid Supply Points**, to preserve the security of the **GB Transmission System**.
- OC6.7.9 Pursuant to the provisions of OC1.5.6 the **Network Operator** will supply to **NGET** details of the amount of **Demand** reduction or restoration actually achieved.

OC6.8 OPERATION OF THE **BALANCING MECHANISM** DURING **DEMAND CONTROL**

Demand Control will constitute an **Emergency Instruction** in accordance with BC2.9 and it may be necessary to depart from normal **Balancing Mechanism** operation in accordance with BC2 in issuing **Bid-Offer Acceptances**. **NGET** will inform affected **BM Participants** in accordance with the provisions of **OC7**.

APPENDIX

EMERGENCY MANUAL DEMAND REDUCTION/DISCONNECTION SUMMARY SHEET
(As set out in OC6.7)

NETWORK OPERATOR _____ [YEAR] PEAK: _____

GRID SUPPLY POINT (Name)	PEAK MW	% OF GROUP DEMAND DISCONNECTION (AND/OR REDUCTION IN THE CASE OF THE FIRST 5 MINUTES) (CUMULATIVE)						REMARKS
		TIME (MINS)						
		5	10	15	20	25	30	

Notes: 1. Data to be provided annually by week 24 to cover the following year.

< End of OC6 >

CC	2	CC.3.4 amended
	26	CC.6.4.4 amended
OC1	5	OC1.6.1 (a) amended

Revision 19

Effective Date: 1 January 2007

CODE	PAGE	CLAUSE
CC	60	CC.A.5.1.1 amended
	61	CC.A.5.4 inserted

Revision 20

Effective Date: 1 April 2007

CODE	PAGE	CLAUSE
CC	26	CC.6.4.3 amended
	60	CC.A.5.1.1 amended
	61	CC.A.5.3.1(b) amended
	61 and 62	CC.A.5.5 inserted
OC6	7	OC6.6.1 amended
	7	OC6.6.2(b) amended