



**GRID CODE  
CONSULTATION DOCUMENT**

**Low Frequency Demand  
Disconnection Relay Settings**

**The purpose of this document is to consult on the above Grid Code Modification Proposal with authorised electricity operators liable to be materially affected by the proposed changes and forms the basis of the subsequent Report to the Authority**

Consultation Ref	E/06
Issue	1
Date of Issue	6 <sup>th</sup> October 2006
<b>Responses required by</b>	<b>3<sup>rd</sup> November 2006</b>
Prepared by	National Grid

## DOCUMENT LOCATION

National Grid website:

<http://www.nationalgrid.com/uk/Electricity/Codes/gridcode/consultationpapers/>

## DISTRIBUTION

Name	Organisation
AEO's	Various
GCRP Members/Alternates	Various
Interested Parties	Various
National Grid Website	

## **A. INTRODUCTION**

1. Paragraph 2 of Condition C14 of the Transmission Licence granted to the National Grid Electricity Transmission plc ("National Grid") provides that National Grid shall, in consultation with authorised electricity operators liable to be materially affected thereby, periodically review the Grid Code and its implementation. That paragraph also requires National Grid, following such review, to send to the Authority:-
  - (a) a report on the outcome of such review;
  - (b) any proposed revisions to the Grid Code as National Grid (having regard to the outcome of such review) reasonably thinks fit for the achievement of the objectives set out in sub-paragraph (b) of Condition C14 of the Transmission Licence; and
  - (c) any written representations or objections from authorised electricity operators (including any proposals by such operators for revisions to the Grid Code not accepted by National Grid in the course of the review) arising during the consultation process and subsequently maintained.
2. This review examines changes to amend the Grid Code Connection Conditions and Operating Code 6 such that it includes the specification of low frequency demand disconnection scheme settings. The change is being proposed following requests by Users to improve the visibility of settings required by National Grid which are currently included in Bilateral Agreements.
3. The proposed changes to the Grid Code were discussed with the Grid Code Review Panel (GCRP) on 21<sup>st</sup> September 2006. Panel Members agreed that National Grid should issue a Consultation Paper regarding the proposed changes.
4. Comments upon the proposed changes within this consultation should be sent to National Grid by 3<sup>rd</sup> November 2006 as detailed in section C. The comments will be reviewed and responded to.
5. Following this consultation, National Grid will prepare a Report to the Authority detailing National Grid's recommended changes to the Grid Code and all comments/responses received from authorised electricity operators through this consultation. Once sent to the Authority this report will be made available on National Grid's website.
6. Where authorised electricity operators' responses have been marked as confidential they will not be published within the version of the Report to the Authority placed on the National Grid website.
7. The revisions to the Grid Code proposed by National Grid and sent to the Authority, require approval by that body and will, if approved, come into force on such date (or dates) of which you will be notified by National Grid, in accordance with the Authority's approval.

## **B. DESCRIPTION OF THE PROPOSED AMENDMENTS AND THEIR EFFECTS**

### **8. Background**

- 8.1 The electricity system in Great Britain is protected against system collapse due to a severe fall in system frequency by the national automatic low frequency demand disconnection scheme specified under Grid Code OC6.6. This was originally conceived by the Central Electricity Generating Board (CEGB) and the Scottish companies in the late 1960s and further developed in the 1970s and 1980s.
- 8.2 In the event of a large fall in system frequency caused by severe generation deficits beyond those normally considered in planning and operational security standards, the relays are specified to operate to disconnect customer demand in stages. In total, up to 60% of system demand in England and Wales and 40% in Scotland can be disconnected by the Low Frequency Relays.
- 8.3 The Grid Code requirements on National Grid and Distribution Network Operators (DNOs) relating to the settings and operation of the automatic low frequency demand disconnection scheme are included in CC.6.4.3 and OC6.6. A specification of the technical requirements of the relays is included in CC.A.5. The frequency settings applied to the relays and the percentage of total demand that should be disconnected at a particular frequency, are currently specified in Bilateral Agreements.
- 8.4 The Low Frequency Relay settings and demand disconnection values are applied consistently to all DNOs connected to a particular Transmission Licensee's Transmission System.
- 8.5 OC6.6 specifies that the demand disconnection will be spread across the total demand of a DNO. It requires that National Grid and the DNO discuss the demand distribution annually and that the Low Frequency Relay settings are reviewed annually. Experience indicates that less frequent reviews of the total levels of demand to be disconnected at a particular frequency are more appropriate as system conditions do not change sufficient quickly to require annual changes. Annual discussions on the distribution of the demand to be disconnected are still useful, even though changes are likely to be infrequent.
- 8.6 For these reasons and to aid visibility to Users, it is appropriate to include the Low Frequency Relay settings and demand disconnection percentage values in the Grid Code rather than the Bilateral Agreement of each Network Operator. Any consequential changes to other codes and agreements will need to be made through the appropriate forum.

### **9. Proposed Grid Code Changes**

- 9.1 It is proposed to include the required frequency settings for Low Frequency Relays together with the percentage demand reduction at each specified level in the Grid Code, removing the requirement to specify them in Bilateral Agreements.
- 9.2 It is also proposed to remove the requirement to review the Low Frequency Relay settings annually, allowing review to be undertaken when it is appropriate.

- 9.3 The proposed changes will improve visibility by publicising the settings to be applied to Low Frequency Relays. They will also remove the requirement to undertake reviews of the settings more often than is necessary and will make any changes to the settings the subject of a Grid Code modification.
- 9.4 The proposed changes to the Condition Connections and Operating Code 6 (Demand Control) can be found in Appendix A to this consultation.
- 9.5 As these proposals interact with the changes contained within Grid Code consultation A/06 that were approved by the Authority for implementation on 1<sup>st</sup> January 2007 two sets of legal text are provided. The first would apply if these proposals are approved by the Authority for implementation on or before 31<sup>st</sup> December 2006, the second if the proposals were to be approved by the Authority for implementation on or after 1<sup>st</sup> January 2007.

**C. RESPONSES**

11. This section will contain a summary of responses received during the Consultation and will be completed as part of the Report to the Authority.
12. Your formal responses may be:-

Posted to:           Lilian Macleod  
                           Electricity Codes  
                           Regulatory Frameworks  
                           National Grid Electricity Transmission plc  
                           National Grid House  
                           Warwick Technology Park  
                           Gallows Hill  
                           Warwick  
                           CV34 6DA

Emailed to:       [lilian.macleod@uk.ngrid.com](mailto:lilian.macleod@uk.ngrid.com)

## Appendix A (Part 1): Proposed Grid Code Changes

Note – This legal text is based on Issue 3, Revision 17 of the Grid Code.

### Conditions Connections

#### 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.5.4 of Appendix 5 includes specifications of the total percentage Demand that shall be disconnected at specific frequencies. The Bilateral Agreement will specify** The manner in which **Demand** subject to low **Frequency** disconnection will be split into discrete MW blocks with associated **Low Frequency Relay** settings **is specified in OC6.6.** Technical requirements relating to **Low Frequency Relays** are also listed in Appendix 5.

### 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 be in accordance with the requirements of the **Bilateral Agreement**. They should 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 **is given as an indication, without prejudice to the provisions that may be included in a Bilateral Agreement:**

- |     |                              |  |
|-----|------------------------------|--|
| (a) | <b>Frequency</b> settings:   | 47-50Hz in steps of 0.05Hz or better, preferably 0.01Hz;   |
| (b) | Measurement period settings: | Within a minimum selectable settings range of 4 to 6 cycles;   |
| (c) | Operating time:              | Between 100 and 150ms dependent on measurement period setting;                                       |
| (d) | Voltage lock-out:            | Selectable within a range of 55 to 90% of nominal voltage;   |
| (e) | Facility stages:             | One or two stages of <b>Frequency</b> operation;   |
| (f) | Output contacts:             | Two output contacts per stage to be capable of repetitively making and breaking for 1000 operations. |

## 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 by **NGET** in table **CC.A.5.4.1a** and is not reduced unacceptably during equipment outage or maintenance conditions.

CC.A.5.4 SCHEME SETTINGS

CC.A.5.4.1 Table CC.A.5.4.1a 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.5.4.1a

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

Note – the percentages in table CC.A.5.4.1a 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**

Operating Code 6 (Demand Control)

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) ~~in England and Wales, 60 per cent, and in Scotland, 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 **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 **SHELT'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, location, size (**% Demand**) and the associated low **Frequency** settings of these blocks, will be as specified by ~~NGET by week 12 in each calendar year following discussion with the Network Operator in accordance with the Bilateral Agreement and will be reviewed annually by NGET in Table CC.A.5.4.1a. 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.

## Appendix A (Part 2): Proposed Grid Code Changes

Note – This legal text shows the proposed changes to Appendix 5 based on the Grid Code changes that have been approved for implementation from January 1<sup>st</sup> 2007 (Grid Code A/06).

### Conditions Connections

#### 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 Bilateral Agreement will specify** The manner in which **Demand** subject to low **Frequency** disconnection will be split into discrete MW blocks with associated **Low Frequency Relay** settings **is specified in OC6.6.** Technical requirements relating to **Low Frequency Relays** are also listed in Appendix 5.

### 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 be in accordance with the requirements of the **Bilateral Agreement**. They should 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 **en**specify the requirements of approved **Low Frequency Relays** for automatic installations **is given as an indication, without prejudice to the provisions that may be included in a Bilateral Agreement:**

- |     |                            |  |
|-----|----------------------------|--|
| (a) | <b>Frequency settings:</b> | 47-50Hz in steps of 0.01Hz;  |
| (b) | <b>Operating time:</b>     | Between 100 and 150ms dependent on measurement period setting;                                       |
| (c) | <b>Voltage lock-out:</b>   | Selectable within a range of 55 to 90% of nominal voltage;   |
| (d) | <b>Facility stages:</b>    | One or two stages of <b>Frequency</b> operation;   |
| (e) | <b>Output contacts:</b>    | 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% 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
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CC.A.5.3.1 The tripping facility should be engineered in accordance with the following reliability considerations:

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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 by **NGET** 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 1<sup>st</sup> 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 1<sup>st</sup> 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

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OC6.6 **AUTOMATIC LOW FREQUENCY DEMAND DISCONNECTION**

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- (i) ~~in England and Wales, 60 per cent, and in Scotland, 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 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 **SHTL'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, ~~location,~~ size (**% Demand**) and the associated low **Frequency** settings of these blocks, will be as specified ~~by NGET by week 12 in each calendar year following discussion with the Network Operator in accordance with the Bilateral Agreement and will be reviewed annually by NGET 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.