GRID CODE

CONSULTATION DOCUMENT

Frequency Response Requirements

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	D/07
Issue	1.0
Date of Issue	2nd August 2007
Responses required by	**31st August 2007**
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 such that they clarify the response required by Generating Units and Power Park Modules to changes in transmission system frequency.

3. The proposed changes to the Grid Code were discussed with the Grid Code Review Panel (GCRP) on 17th May 2007. 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 31st August 2007 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 Generating plant response characteristics for the period of 0 to 10 seconds following a disturbance are critical in limiting maximum frequency excursions. A maximum frequency dip following a large generation loss could occur within 10 seconds and any unnecessary delay of response from frequency sensitive generation within this period could result in unnecessary customer demand disconnections and possible blackouts.

8.2 The earlier that the response is delivered by generators within the 0 to 10 seconds time scale, the lower is the risk of the system frequency being driven outside its acceptable limits leading to possible demand disconnections. For this reason, the existing wordings '… *Active Power output to be released increasingly with time over the period of 0 to 10 seconds* …' have been adopted in the Primary and High Frequency Responses in the Glossary and Definitions section of the Grid Code. This message is also enhanced diagrammatically in Figures CC.A.3.2 and CC.A.3.3 in the Appendix 3 of the Grid Code.

8.3 During recent discussions with Generators on the frequency response performance of wind farms, suggestions were made by Generators that the minimum frequency response performance requirement of a Generating Unit, in particular during the initial response period, should be further clarified in the Grid Code.

8.4 This issue was discussed at the Power Park Modules and Synchronous Generating Units Working Group (PPMSGUWG). Whilst National Grid believed that the initial response requirement has been clearly stated in the Grid Code, National Grid agreed to include a statement in the CC.A.3.4, where the response profile is specified, similar to the words used in the Glossary and Definitions to aid visibility. A proposal was made in the Working Group Report and G/06 Consultation Document dated 14 December 2006.

8.5 For the initial response following the start of the frequency change, an inherent delay with any type of generating plant has always been recognized but appropriate control measures help to minimize any avoidable delay. This has been successfully adopted by the industry in the past and National Grid believed that no further clarification of maximum allowable delay was necessary.

8.6 With the current Grid Code wordings, the industry has successfully designed generating plant to minimize the initial time delay following a 10 second ramp frequency injection to generally less than two seconds. This has also been achieved by recently tested Power Park Modules.

8.7 However at one PPM site, an initial delay of over 5 seconds was observed which NGET believes is not the result of any inherent delays in wind turbine dynamic behaviour but due to the choice of control design and settings adopted.

8.8 Following a recent tripartite meeting between National Grid, OFGEM and a developer, there appeared to be a need to consider if a further clarification in

the Grid Code, in addition to that proposed in G/06, is required in relation to the inclusion of a minimum time delay for plant response.

8.9 National Grid presented a paper at the May GCRP discussing three possible options. These options are described below. National Grid proposes that option 3 is adopted and the legal text associated with this option is included in Appendix A. This option does not introduce any additional requirements on generators; it aims to clarify the requirements and in practice represents a relaxation of the existing requirements.

9. Options

Option 1- Adopt the Proposals of G/06

9.1 This option recognises that the Grid Code wording together with that proposed in the G06 Consultation Document is adequate to communicate with developers and their plant suppliers that the initial response is of significant importance to system security. On this basis, they will ensure appropriate control measures to minimize any avoidable time delays in the plant response. This has been successfully adopted by the industry in the past including wind farms.

9.2 This approach gives some flexibility to plant designers should there be any genuine inherent plant delay which is absolutely unavoidable. From past experience and some wind farm test records, National Grid believes PPMs are capable of reducing any initial avoidable delays to those achieved by other plant types.

9.3 This option might not be considered to provide the additional clarity and might still result in a future debate on this issue as indicated in the recent OFGEM/Developer/National Grid meeting.

Option 2- Include a Maximum Time Delay Requirement in the Grid Code

9.4 An alternative is to include a maximum time delay requirement in the Grid Code to provide further clarity. Based on National Grid's experience and the need to contain the adverse impact on system frequency stability, the maximum delay requirement may be up to two seconds. The effect of such a delay in terms of the increase in the risk of system frequency being driven outside secure limits, possibly leading to unnecessary demand disconnections and blackouts, needs to be evaluated.

9.5 A requirement that permits two seconds initial response time delay on a generic basis for all future plant may be unnecessary for many plant that inherently responds with insignificant initial delay.

Option 3- Include an Indicative Allowable Time Delay in the Grid Code

9.6 This option builds on the issues discussed in options 1 and 2 above. It proposes introducing additional clarity to the existing Grid Code wording and that proposed in G06 consultation document. It codifies existing practice that ensures that plant control systems are designed to reduce any avoidable initial delay to a minimum as far as is reasonably practicable and in any event to less than two seconds. It also recognizes that there might be a longer unavoidable time delay.

9.7 Given the system security considerations, National Grid believes, from past experience, that most generating plant can be designed to have insignificant initial delay.

10. Other Aspects of Frequency Response Profile

10.1 Based on discussions at the GCRP and subsequent comments, the profile of the frequency response over the period 0 to 10 seconds also needs clarification in wording in addition to the profile shown in Figure CC.A.3.2. Also, comments have been received that confusion arises from the final statement in CC.A.3.1 that the response requirements are defined diagrammatically in CC.A.3.2 and CC.A.3.3 when it has not been made clear that these diagrams are based on test signals.

10.2 National Grid proposes that these issues are clarified by

- specifying that, as a minimum, the response should be linear when referring to the response required in both CC.A.3.4 and the Glossary and Definitions
- changing the reference in CC.A.3.1 to CC.A.3.4., in which the diagrams of CC.A.3.2 and CC.A.3.3 are explained, rather than directly to the figures of CC.A.3.2. and CC.A.3.3.

as shown in the attached legal text

11. Consultation

11.1 National Grid proposes that the changes shown in the legal text included in Appendix A are adopted in the Grid Code. These changes are based on the previous proposals of G/06 and the additions described above. National Grid believes that the proposed changes will improve the clarity of the frequency response requirements without imposing any additional requirements on generators.

C. RESPONSES

12. This section will contain a summary of responses received during the Consultation and will be completed as part of the Report to the Authority.

13. Your formal responses may be:-

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

Emailed to: richard.dunn@uk.ngrid.com

Appendix A : Proposed Grid Code Changes

Key to the changes:

Black – existing Grid Code text
Red – proposed in G06 Consultation Document
Blue – proposed additional wordings for Option 3 and other changes recommended in this paper

MINIMUM FREQUENCY RESPONSE REQUIREMENT PROFILE AND OPERATING RANGE
for new Power Stations and DC Converter Stations.

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CC.A.3.1 SCOPE

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The minimum **Frequency** response requirement profile is shown diagrammatically in Figure CC.A.3.1. The capability profile specifies the minimum required levels of **Primary Response**, **Secondary Response** and **High Frequency Response** throughout the normal plant operating range. The definitions of these **Frequency** response capabilities are ~~illustrated diagrammatically in Figures CC.A.3.2 & CC.A.3.3.~~ discussed in CC.A.3.4.

CC.A.3.4 TESTING OF FREQUENCY RESPONSE CAPABILITY

The response capabilities shown diagrammatically in Figure CC.A.3.1 are measured by taking the responses as obtained from some of the dynamic response tests specified by **NGET** and carried out by **Generators** and **DC Converter Station** owners for compliance purposes and to validate the content of **Ancillary Services Agreements** using an injection of a **Frequency** change to the plant control system (i.e. governor and load controller). The injected signal is a linear ramp from zero to 0.5 Hz **Frequency** change over a 10-second period, and is sustained at 0.5 Hz **Frequency** change thereafter, as illustrated diagrammatically in figures CC.A.3.2 and CC.A.3.3. 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**, **NGET** may require the **Network Operator** within whose **System** the **Embedded Medium Power Station** or **Embedded DC Converter Station** is situated, to ensure that the **Embedded Person** performs the dynamic response tests reasonably required by NGET in order to demonstrate compliance within the relevant requirements in the **CC**s.

The **Primary Response** capability (P) of a **Generating Unit** or a **CCGT Module** or **Power Park Module** or **DC Converter** is the minimum increase in **Active Power** output between 10 and 30 seconds after the start of the ramp injection as illustrated diagrammatically in Figure CC.A.3.2. As a minimum, this increase in **Active Power** output should be

released linearly with time over the period 0 to 10 seconds from the time of the start of the **Frequency** fall as illustrated by the Plant Response in Figure CC.A.3.2. If there is an initial inherent delay in the increase of **Active Power** output following a **Frequency** fall, this must be minimised as far as is reasonably practicable and in any event such a delay should be no longer than two seconds unless in NGET's reasonable opinion a longer delay is unavoidable.

The **Secondary Response** capability (S) of a **Generating Unit** or a **CCGT Module** or **Power Park Module** or **DC Converter** is the minimum increase in **Active Power** output between 30 seconds and 30 minutes after the start of the ramp injection as illustrated diagrammatically in Figure CC.A.3.2.

The **High Frequency Response** capability (H) of a **Generating Unit** or a **CCGT Module** or **Power Park Module** or **DC Converter** is the decrease in **Active Power** output provided 10 seconds after the start of the ramp injection and sustained thereafter as illustrated diagrammatically in Figure CC.A.3.3. As a minimum, this reduction in **Active Power** output should be released linearly with time over the period 0 to 10 seconds from the time of the start of the **Frequency** rise as illustrated by the Plant Response in Figure CC.A.3.2. If there is an initial inherent delay in the reduction of **Active Power** output following a **Frequency** rise, this must be minimised as far as is reasonably practicable and in any event such a delay should be no longer than two seconds unless in NGET's reasonable opinion a longer delay is unavoidable.

Glossary & Definitions *[associated changes]*

High Frequency Response

An automatic reduction in **Active Power** output in response to an increase in **System Frequency** above the **Target Frequency** (or such other level of **Frequency** as may have been agreed in an **Ancillary Services Agreement**). This reduction in **Active Power** output must be in accordance with the provisions of the relevant **Ancillary Services Agreement** which will provide that, as a minimum, it will be released ~~increasingly~~ linearly[w1] with time over the period 0 to 10 seconds from the time of the **Frequency** increase on the basis set out in the **Ancillary Services Agreement** and fully achieved within 10 seconds of the time of the start of the **Frequency** increase and it must be sustained at no lesser reduction thereafter. The interpretation of the **High Frequency Response** to a + 0.5 Hz frequency change is shown diagrammatically in Figure CC.A.3.3. If there is an initial inherent delay in the reduction of **Active Power** output following a **Frequency** rise, this must be minimised as far as is reasonably practicable and in any event such a delay should be no longer than two seconds unless in NGET's reasonable opinion a longer delay is unavoidable.

Primary Response

The automatic increase in **Active Power** output of a **Genset** or, as the case may be, the decrease in **Active Power Demand** in response to a

System Frequency fall. This increase in **Active Power** output or, as the case may be, the decrease in **Active Power Demand** must be in accordance with the provisions of the relevant **Ancillary Services Agreement** which will provide that, as a minimum, it will be released ~~increasingly~~ linearly with time over the period 0 to 10 seconds from the time of the start of the **Frequency** fall on the basis set out in the **Ancillary Services Agreement** and fully available by the latter, and sustainable for at least a further 20 seconds. The interpretation of the **Primary Response** to a – 0.5 Hz frequency change is shown diagrammatically in Figure CC.A.3.2. If there is an initial inherent delay in the increase of **Active Power** output from a **Genset** following a **Frequency** fall, this must be minimised as far as is reasonably practicable and in any event such a delay should be no longer than two seconds unless in NGET's reasonable opinion a longer delay is unavoidable.

Figure CC.A.3.2 - Interpretation of Primary and Secondary Response Values

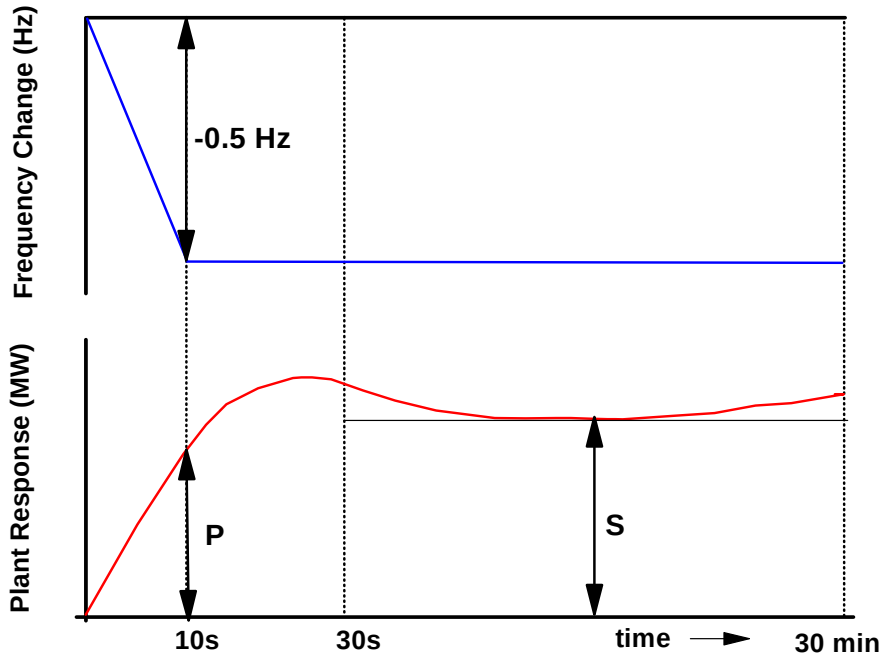

Figure CC.A.3.3 - Interpretation of High Frequency Response Values