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17 January 2005

Dear Colleague,

GRID CODE CONSULTATION H/04

On 27 August 2004 NGC[1] submitted a report to the Gas and Electricity Markets Authority (the "Authority")[2] arising from consultation H/04 ("Grid Code Changes to Incorporate New Generation Technologies and DC Inter-connectors (Generic Provisions)")[3] seeking approval for changes to the England & Wales Grid Code. On 1 September, as part of the process to introduce BETTA, amendments were made to the England and Wales Grid Code so that it became a Grid Code for Great Britain (the "GB Grid Code"). NGC has produced a revised version of the GB Grid Code for the Authority with the intention of:

- Incorporating the changes proposed as a result of the H/04 consultation; and
- Incorporating the changes proposed as a result of the parallel process carried out by the Scottish transmission licensees[4] under consultation SA/2004.

Following a review of this GB Grid Code drafting by Ofgem and its consultants a number of points of detail were raised by Ofgem with NGC. NGC gave careful consideration to the comments made and offered its support to them in specific areas. Ofgem requested NGC to produce drafting for the GB Grid Code to show how the comments supported by NGC might be taken account of. This additional drafting, referred to here as the Supplementary Changes, provided here as Attachment 1, did not form part of the H/04 proposals that were consulted on by NGC. However, Ofgem is of the view that these additional proposals, in most respects, offer an improvement over the original drafting. NGC supports the revised drafting. This consultation

[1] National Grid Company plc.
[2] The terms "Ofgem" and "the Authority" are used interchangeably in this letter. Ofgem is the office of the Authority.
[3] This is available on NGC's website at http://www.nationalgridinfo.co.uk/grid_code/mn_consultation_papers.html
[4] Ofgem has today published its proposed 'minded to' decision relating to the SA/2004 consultation relating to the Scottish Grid Code.

offers all parties the opportunity to comment on the Supplementary Changes and these comments will be taken fully into account when the Authority makes its final decision.

The Authority has carefully considered the changes that NGC proposed arising from consultation H/04. The Authority has also given consideration to the Supplementary Changes to the GB Grid Code submitted by NGC at Ofgem's request as referred to above. This letter sets out the decision that the Authority is minded to make regarding the H/04 changes and the Supplementary Changes as now proposed to be incorporated in the GB Grid Code.

Ofgem is aware of the considerable work that has been carried out to develop these important changes to the GB Grid Code. Ofgem considers that the views of all affected parties have been given proper consideration in developing these proposals. Ofgem is aware that a small number of objections to the proposals remain. However, Ofgem is now minded to take the view that the grid code changes proposed in the H/04 report to the Authority together with the Supplementary Changes (subject to specific caveats) now proposed to be incorporated in the GB Grid Code should be approved.

This letter explains the background to the proposals and sets out the Authority's reasons for its proposed 'minded to' decision to approve these changes to the GB Grid Code. It should be noted that arriving at this 'minded to' position in no way fetters the Authority's discretion in making its final decision and it will take all factors into account when making this decision including the responses to this consultation.

A parallel consultation process has been carried out to address almost identical technical issues in Scotland (Report to the Authority SA/2004). Ofgem has published a 'minded to' decision letter today relating to this consultation process and it is recommended that these two letters should be read together to understand the full position for Great Britain.

Background to the proposed changes to NGC's Grid Code

On 31 October 2003 NGC submitted a 'Report to the Authority' relating to consultation D/03; Grid Code Changes to Incorporate New Generation Technologies and DC Inter-connectors (Generic Provisions). Ofgem was aware at this stage that NGC's proposals were not supported by all parties; in particular the wind generation community had raised objections to the change proposals. In recognition of this situation, Ofgem responded to NGC on 6 November 2003. In this letter Ofgem requested NGC to carry out further work to achieve two objectives. Firstly, Ofgem thought it would be beneficial for parties applying for connection, in particular because of the development of BETTA, for there to be a fully consistent approach adopted by NGC and the Scottish transmission licensees who had made similar proposals at an earlier date[5]. Secondly, Ofgem encouraged NGC to carry out further work with the affected stakeholders to address their concerns and wherever possible reach agreement about the change proposals.

Following Ofgem's letter a number of activities were initiated. Firstly, all three GB transmission licensees worked together to align the proposals for Scotland and England and Wales. This work was completed early in 2004. Secondly, a series of meetings with the major manufacturers of wind generators was arranged. At these meetings the licensees explained the aligned proposals and the manufacturers fed back their views on their ability to comply with them and the cost of

[5] Report to the Authority SB/2002

doing so. Finally, Ofgem convened a Forum to discuss the aligned proposals in detail. Representatives of all affected parties were given a voice at the Forum and the notes of the two meetings held were published in full[6].

Following the Forum meetings, the licensees revised their grid code change proposals having given consideration to the views expressed. On 23 June 2004, NGC published Consultation Document H/04. The H/04 proposals built on those set out in D/03 by incorporating the information and views presented to NGC during this additional period of consultation. The H/04 consultation closed on 21 July 2004. NGC received comments on the proposals from fourteen parties including seven from manufacturers of wind turbines and related equipment. Having considered and responded to these comments NGC produced its Report to the Authority dated 27 August 2004.

NGC's recommendation

NGC recommends that the Authority approves the changes to its GB Grid Code set out in the report to the Authority arising from consultation H/04 ("Grid Code Changes to Incorporate New Generation Technologies and DC Inter-connectors (Generic Provisions)"). NGC also supports the Supplementary Changes that are now being consulted on.

Ofgem's Consideration of NGC's Report to the Authority – H/04

Ofgem is aware of the importance of the issues raised by NGC's H/04 proposals. In order to provide technical support to Ofgem in making its decision, Ofgem appointed Sinclair Knight Merz (SKM consultants) in March last year to review NGC's proposals and those of the Scottish licensees. SKM took part in the Forum meetings described above and has now produced a report on the H/04 change proposals and the equivalent Scottish proposals. It should be noted that SKM was not required to report on the final GB Grid Code drafting that is included in this consultation. Ofgem has published the SKM report[7] today.

Under section 5A of the Utilities Act 2000, the Authority is under a duty to carry out an impact assessment where:

- it proposes to do anything for the purposes of or in connection with the carrying out of any function exercisable by it by virtue of Part 1 of the Electricity Act 1989; and
- the Authority considers the proposal to be "important", such as when the proposed changes will have a significant impact on persons engaged in commercial activities connected with electricity generation, transmission, distribution and supply.

Ofgem, in its review of the issues raised by the H/04 proposals, has taken the view that the H/04 proposals are important and has therefore produced an Impact Assessment. This is provided as Attachment 1 to this letter and supports both H/04 and SA/2004 'minded to' decisions.

The H/04 proposals relate to the England and Wales Grid Code. This has, from 1 September 2004, been superseded by the GB Grid Code. It follows therefore that the H/04 proposals

[6] http://www.ofgem.gov.uk/temp/ofgem/cache/cmsattach/6794_ForumMinutesFinal.pdf
http://www.ofgem.gov.uk/temp/ofgem/cache/cmsattach/7237_ForumII_FinalNotes.pdf
[7] "New Generating Technologies and GB Grid Codes", SKM, December 2004.

cannot be implemented in the England and Wales Grid Code as originally drafted. As already described, NGC has now produced a new version of the GB Grid Code that is intended to incorporate the H/04 change proposals (and the equivalent SA/2004 change proposals submitted by the Scottish licensees). This text is available at the NGC website[8]. NGC's incorporation of the H/04 proposals into the GB Grid Code is intended to have the same effect as they would have done had they been included in the England &Wales Grid Code. This consultation provides an opportunity for parties to comment on the incorporation of the H/04 proposals into the GB Grid Code. This consultation also gives an opportunity for parties to comment on the Supplementary Changes which have not been consulted on previously.

Based on its own analysis and the advice of its consultants, SKM, Ofgem has reached a 'minded to' decision regarding the H/04 change proposals and the Supplementary Changes which is set out and explained below. Ofgem in its decision-making also assessed the possible impact of this 'minded to' decision and its Impact Assessment (IA) of the proposals is provided here as Attachment 2. This letter therefore initiates a consultation on the 'minded to' decision, the IA, the GB Grid Code text and the Supplementary Changes. The further steps proposed to reach a final decision are explained at the end of this letter. The Authority will take account of all the responses received in response to this consultation in reaching its final decision.

Ofgem's view

Ofgem considers that, having had regard to the licensee's objectives set out in condition C14.1(b)[9] of the Transmission Licence ("the objectives") and Ofgem's principal objective and wider[10] statutory duties, that the changes proposed in the Report to the Authority, H/04, as modified by the Supplementary Changes (subject to specific caveats) and incorporated into the GB Grid Code should be approved. Ofgem's reasons for reaching this decision are outlined below.

The first issue considered by Ofgem was the fundamental need for the H/04 change proposals. Ofgem is minded to accept the view taken by NGC that the original drafting of the England & Wales Grid Code made the implicit assumption that all generators connecting to the transmission system would be synchronous plant. Ofgem is minded to accept therefore that the GB Grid Code does need to be updated to explicitly recognise the particular characteristics of non-synchronous generating plant that parties are now seeking to connect to the transmission

[8] http://www.nationalgridinfo.co.uk/grid_code/mn_consultation_papers.html

[9] The licensee's transmission licence defines the Grid Code objectives as follows:

(i) to permit the development, maintenance and operation of an efficient, co-ordinated and economical system for the transmission of electricity;
(ii) to facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the GB transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity); and
(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in Great Britain taken as a whole.

[10] Ofgem's statutory duties are wider than the matters that NGC must take into consideration and include amongst other things social and environmental guidance provided to Ofgem by the government.

system at an increasing rate. The Forum discussions confirmed that all affected parties support this view.

The proposed changes to the Connection Conditions have been the focus of the consultation process and Ofgem's views on these proposals are set out here. Ofgem's views on the main technical issues are discussed below and this is followed by a commentary on the capacity and timing thresholds relating to these proposals for the NGC system.

i) Fault Ride Through (FRT)

NGC is required under its licence to promote the security of its transmission system[11]. One of the generator performance characteristics necessary to achieve this is the ability to remain connected to the grid and continue to generate when faults occur on the transmission system. This is referred to as Fault Ride Through capability. The synchronous generators that have dominated the plant mix to date have a natural ability to remain connected to the system when transmission faults occur. There has therefore never been a need to formally require an FRT capability to be provided via the grid codes.

Non-synchronous generators do not have the same inherent ability to withstand the disturbances resulting from system faults. If a significant tranche of such plant is connected to the system that is susceptible to tripping as a result of credible transmission faults the fundamental security of the system will be diminished. Ofgem recognises that this could be addressed by providing an increasing capacity of reserve plant but this approach would result in a number of adverse economic and environmental impacts. These impacts are discussed in the IA. Ofgem has concluded that the introduction of an FRT requirement has merits which would ultimately benefit consumers. Ofgem is therefore minded to approve the proposed modifications to the GB Grid Code to introduce an FRT requirement for all plant.

There has been much discussion about the details of an FRT requirement and the ability of manufacturers to provide plant that can comply with the requirement. NGC has taken account of the comments made by respondents to its consultation and has developed the proposed FRT requirement accordingly. Manufacturers have indicated that their machines can already or will soon be able to meet the proposed FRT requirement without material cost increases. Ofgem's independent consultants, are supportive of the proposed requirement[12] and have reported that it is broadly consistent with equivalent requirements being introduced by other transmission operators. However, the consultants have commented that the H/04 drafting of the FRT provision lacks clarity and recommended that the provisions should be redrafted to address this. NGC has responded to this and the Supplementary Changes document proposes revised drafting of the FRT provisions.

Ofgem has noted that the proposed FRT requirement is specified in a different way to that adopted by grid operators in Ireland (ESB) and Germany (E.oN). This difference relates to the specification of the transmission system voltage depressions that plant must be resilient to. There is no fundamental reason why the same approach should be used by all grid operators but if comparisons showed significant differences they should be examined and understood.

[11] Licence condition C14.1 (b) (iii) refers.
[12] "New Generating Technologies and GB Grid Codes", SKM, December 2004.

Without fettering its discretion, Ofgem considers that the differences are not material and that NGC's proposal is acceptable.

ii) Frequency Range

The GB Grid Code already requires generators to be able to operate at frequencies above and below the nominal 50 Hz. This is to ensure that generation is able to continue to contribute towards meeting demand in exceptional operating circumstances. Like FRT, this requirement is founded in the need to ensure supply security.

The application of this requirement to non-synchronous generators has not been a contentious issue and the manufacturers have confirmed that their equipment can meet this requirement. Ofgem is therefore minded to approve this element of the overall proposals.

iii) Frequency Control

Ofgem is minded to recognise that non-synchronous generators should be able to provide a frequency control capability to the grid. While this is not essential at current penetration levels, Ofgem considers that it will become so as wind farm projects increase in size and the overall penetration increases. The argument has been made that the current ROC payments will make it commercially unattractive for wind generators to provide this service and that the capability should not be made a requirement. However, there is a possibility that at times of low system demand the ability of wind farms to provide frequency control may reduce the occasions when such plant will need to be constrained off the system. It is also possible that the wind farms now being planned will be operating after the ROC scheme ends so that the ability to provide frequency control may be both technically and commercially desirable.

Ofgem understands that it is now possible for wind turbines to provide frequency control and that the additional costs are small, being related primarily to software and control facilities. Ofgem is therefore minded to approve the GB Grid Code change proposals with respect to frequency control.

iv) Reactive Range & Voltage Control

The control of system voltage within the statutory limits requires that sources of reactive power are available across the system at various voltage levels. Generating plant has traditionally been the preferred source of reactive power.

Ofgem is minded to approve amendments requiring that non-synchronous generators should be able to provide reactive as well as real power to the grid. It is understood that the inherent ability of a non-synchronous generator to produce and absorb reactive power is related to each machine's specific design. However, for generators that have a limited capability, auxiliary plant can be provided to compensate allowing a pre-defined overall capability to be achieved. Comments have been made about the relationship of real and reactive output, in particular the suggestion that the reactive capability should be reduced between 50%-20% output. Ofgem notes however that NGC's proposal for non-synchronous generators is somewhat less onerous than for synchronous machines and that a relaxation has been incorporated for outputs below 20%. Ofgem is therefore minded to approve NGC's proposal.

v) Negative Phase Sequence

No material comments were received from respondents to the H/04 consultation relating to these proposals and Ofgem is therefore minded to approve them on the basis that they are necessary in the context of NGC's licence objectives.

vi) Thresholds

For connections in England & Wales, all small Power Stations (i.e. less than 50MW Power Park Modules (PPMs)) are exempted from the proposed requirements and licence exempt embedded generators are also exempted from the GB Grid Code, although generators in this class of greater than 50MW are required to enter into a Licence Exempt Generation Agreement with NGC. NGC is proposing that certain elements of the proposed changes are introduced from 1 January 2006.

The timescale for the introduction of these requirements should be set by the needs of the grid system and the licensee's ability to meet its licence obligations. Setting this timescale is not a precise science as the actual rate of new plant commissioning is not in the licensee's control. Ofgem is minded to accept the case that NGC has put forward on this element of the overall proposals and approve the capacity and timescale thresholds proposed by NGC.

Different thresholds apply in Scotland and these are discussed in Ofgem's 'minded to' decision letter regarding the SA/2004 consultation.

vii) DC Interconnectors

The H/04 consultation process also proposed that explicit requirements should be included in the grid code for DC Interconnectors. These requirements will only apply to DC Interconnectors with a completion date after 1 January 2004 and so will not impact on either of the two existing DC Interconnectors into the GB system. Ofgem is minded to agree that explicit connection requirements should be included in the Grid Code for this class of user and is minded to accept them subject to the comments made by SKM.

SKM raised an issue with respect to the DC Interconnector proposals. NGC considered SKM's comments and was supportive of a modification to the H/04 drafting. This is addressed in the Supplementary Changes document. No material comments were received from any other respondents to the H/04 consultation relating to these proposals.

The further development of ancillary services markets

Since the initial development of the grid codes in Great Britain the principle has been adopted that all plant connected to the transmission system (and certain distribution connected generating plant) should meet the minimum performance requirements set out in the grid codes. These requirements relate in particular to the provision of ancillary services. As part of the development of the H/04 (and SA/2004) proposals some parties have suggested the development of the ancillary services markets to allow generators to meet their obligations (for example, mandatory frequency response obligations) by purchasing services (either directly or via NGC) from other participants. This approach could reduce the need to impose wide ranging technical requirements through the grid codes.

Ofgem is committed to the development of efficient markets, wherever possible and considers that there may be further scope for development of ancillary services markets. For example, on the 28 September 2004, Ofgem directed a modification to the Connection and Use of System Code (CUSC) to introduce further competition in the provision of mandatory frequency response.[13] The issue of the development of ancillary services markets to allow generators to buy out their obligations has been discussed previously in industry workgroups. However, at this stage no formal proposals have been raised. Ofgem would consider any proposal on the issue of buy out that is raised on its individual merits.

Ofgem recognises that there is an immediate need to provide clarity to parties developing generation projects that incorporate non-synchronous technologies regarding connection requirements. Ofgem therefore has taken the view that the further development of markets could not be guaranteed to deliver an acceptable outcome in the time available. However, this does not in any way preclude further market developments and Ofgem would encourage parties with such proposals to pursue them through existing industry forums.

The Authority's decision

Ofgem is aware of the considerable work that has been carried out to develop these important changes to the GB Grid Code. Ofgem considers that the views of all affected parties have been given proper consideration in developing these proposals. Ofgem is aware that a small number of objections to the proposals remain. However, Ofgem is now minded to take the view that the H/04 proposals as amended by the Supplementary Changes (subject to specific caveats) now proposed to be incorporated in the GB Grid Code should be approved.

In the event that the Authority decides to confirm this 'minded to' decision following this consultation it is the intention to direct the changes to the GB Grid Code from 1 April 2005.

This timescale should not be affected by the BETTA process but Ofgem may chose to review the implementation date should the BETTA process make this necessary and/or beneficial.

Responding to this letter

This letter initiates a six week consultation period for:

- Ofgem's 'minded to' decision;
- Ofgem's Impact Assessment;
- The GB Grid Code drafting that incorporates the H/04 and SA/2004 proposals; and
- the Supplementary Changes proposals.

[13] CAP047: "Introduction of a competitive process for the provision of Mandatory Frequency Response" Alternative Amendment A.

Responses to this consultation should be sent to Gareth Evans at gareth.evans@ofgem.gov.uk or by post to 9 Millbank, London, SW1P 3GE by **28 February 2005.**

Yours sincerely

John Scott
Technical Director
Signed on behalf of the Authority and authorised for that purpose by the Authority

Attachment 1
Supplementary Changes

Proposed Grid Code Modifications H/04 and SA/2004

Supplementary Changes

January 2005

Ofgem Introduction

As described in Ofgem's Impact Assessment and 'minded to' decision letters relating to the H/04 and SA/2004 Reports to the Authority, Ofgem requested National Grid Company Plc to consider the comments made by SKM and Ofgem on their Grid Code change proposals.

The report that follows this Ofgem Introduction has been produced by NGC at Ofgem's request. It is divided into three sections:

- An Introduction;
- Commentary and proposals that are supported by NGC (the "Supplementary Changes"); and
- Commentary explaining the reasons why certain suggestions made by SKM are not supported by NGC.

Ofgem has stated in its H/04 and SA/2004 'minded to' decision letters that it is minded to accept these Supplementary Changes subject to certain caveats. These are as follows.

Option 2 of the revised FRT drafting restricts the exemption from the FRT requirement originally proposed by the licensees. Ofgem is aware that this potentially makes this requirement more onerous and welcomes comments as to whether this is the case in practice.

Option 4 relates to the reference voltage to be used for determining MW output during and following a supergrid voltage dip. This option has a technical rationale and comments would be welcome on its impact for wind generators connected to distribution systems.

Ofgem would welcome comments on any other aspect of these Supplementary Changes.

National Grid Response to Issues Raised by Ofgem and SKM Report

1. Introduction

The report commissioned by Ofgem from independent consultants SKM raised a number of issues with regard to the proposals in SA2004 and H/04. Ofgem have asked the Transmission Licensees to provide a document setting out:

i) those issues raised by Ofgem/SKM and accepted by National Grid as well as alternative drafting to allow Ofgem to consider incorporation into the GB Code; and,

ii) the SKM/Ofgem issues that National Grid do not support together with the reasons.

This document provides the requested information.

2. Suggestions And Issues Acceptable With Alternative Code Drafting

Generation Capacity Thresholds

The SKM Report discusses the use of different generation capacities and thresholds in the three Transmission Areas. As agreed with Ofgem, review of different generation capacities and thresholds are beyond the scope of SA2004 and H/04 and if necessary, should be reviewed as a separate issue. However the treatment of "Small Power Stations" in relation to the modification of the renewables exclusion in CC.6.3.1 as part of H/04 could be considered.

The NGC Grid Code has always excluded Small Power Stations from having to comply with the Generating Unit Requirements (Section 6.3 of the Connection Conditions. The drafting of the Scottish Grid Code applies the Connection Conditions to all Generating Units. Consequently the BETTA Grid Code excludes Small Power Stations in England and Wales but includes Small Power Stations in Scotland.

The Scottish Transmission Licensees do not apply the Scottish Grid Code Connection Conditions to generators smaller than the dispatch limit i.e. <5MW. This was achieved using section 1.6 of the Scottish Grid Code Connection Conditions allowing the Scottish Transmission Licensees freedom to vary the conditions. While this is beyond the scope of the Generic Provisions work, National Grid would support the removal of "in England and Wales" from the GB drafting of CC.6.3.1 which would then read as follows:

CC.6.3.1 *This section sets out the technical and design criteria and performance requirements for **Generating Units**, **DC Converters** and **Power Park Modules** (whether directly connected to the **GB Transmission System** or **Embedded**) which each **Generator** or **DC Converter Station** owner must ensure are complied with in relation to its **Generating Units**, **DC Converters** and **Power Park Modules** but, does not apply to **Small Power Stations** or individually to **Power Park Units**. References to **Generating Units**, **DC Converters** and **Power Park Modules** in this CC.6.3 should be read accordingly.*

Power Frequency Characteristic for DC Converters

SKM suggested that the Power / Frequency Characteristic proposed for DC Converters whilst importing active power (analogous to demand) in CC.6.3.3 (d) is more onerous below 49.5Hz and more relaxed below 48.8Hz when considered against the settings of the emergency Low Frequency Demand Disconnection Scheme. Emergency demand disconnection by under frequency relays commences at 48.8Hz whilst the proposals in H/04 require deloading of a DC Converter Station at frequencies below 49.5Hz. The scheme also requires 60% of demand to be disconnected by 47.8Hz while the proposals in H/04 require 60% deloading of a DC Converter at 47.0Hz.

National Grid agrees with SKM that the power/frequency characteristic of DC Converter Stations at the lower frequency range should align with that used by the emergency Low Frequency Demand Disconnection Scheme that disconnects 60% of demand when the system frequency falls to 47.8Hz.

CC.6.3.3 (d) could be amended to read as follows.

CC.6.3.3 (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%.*

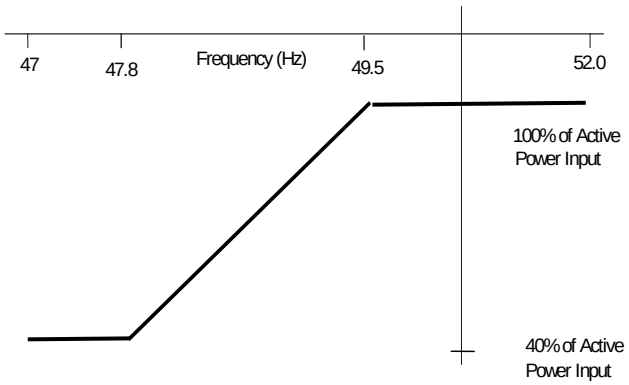


Figure 3

Voltage Characteristic

SKM proposed that as there was only one paragraph in CC.6.3.4 the label "(a)" should be removed.

The paragraph would therefore read as follows:

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*** *in England and Wales at 33kV and below) where the requirement shown in Figure 4 applies.*

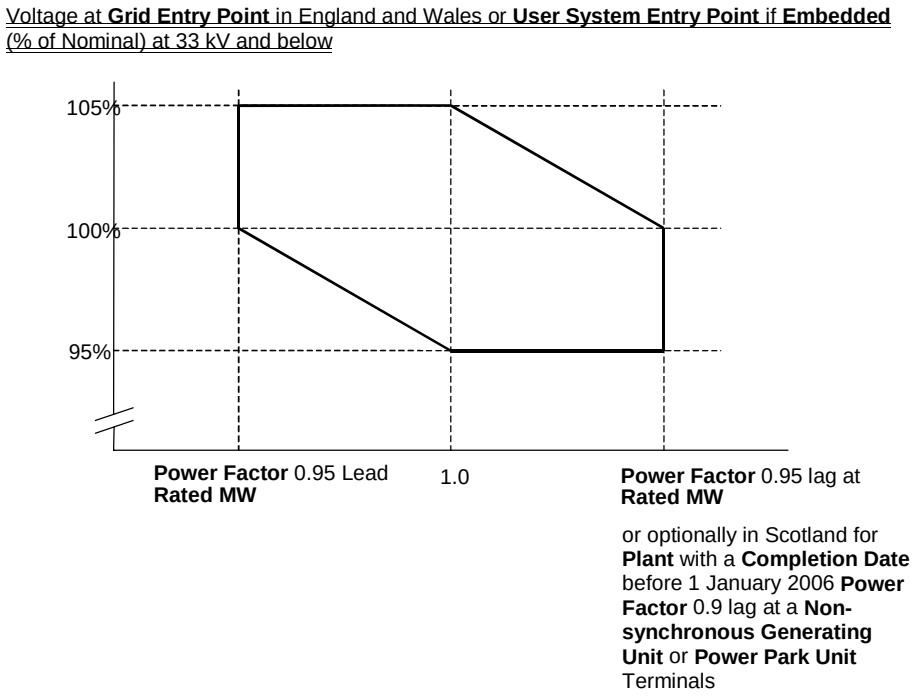


Figure 4

Governor Requirements

SKM proposed that CC.6.3.7(a) should be revised to state that a manufacturer standard was acceptable when other standards were not available.

The phrase "manufacturer specification" could be explicitly added resulting in text as follows.

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 in a* ***Power Station*** *in Scotland with a* ***Registered Capacity*** *less than 30MW) 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**). The **Frequency** control device (or speed governor) 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 **NGC** as:*

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

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

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

Frequency Response

SKM suggested that CC.6.3.6(a) and CC.6.3.7 (e)(f) that are drafted to apply to Power Park Modules in England and Wales "in operation" after 1 January 2006 should be changed to "with a completion date" after 1 January 2006. SKM acknowledge that since license exempt medium power stations are covered by Licence Exempt Generation Agreements (LEGA) and not the Grid Code, this change has no effect on users.

National Grid agree to the change to a completion date after 1 January 2006 only in England and Wales because of the reasons given but this does result in a regional difference on date. However different implementation dates for frequency response in Scotland and England & Wales are acknowledged in the SKM Report (Page 28) as justifiable regional differences given the more advanced status of wind farm projects in Scotland and that these do not disadvantage any customer in Scotland or England & Wales.

The suggested revision from "in operation" to "with a completion date" in England & Wales would result in the following text.

CC.6.3.6 (a) Each:

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

*(ii) **DC Converter** with a **Completion Date** on or after [change implementation date] ; 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 30MW or above),*

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****.*

…….

(e) ……..

(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 30MW or greater) must be capable of meeting the minimum* ***Frequency*** *response requirement profile subject to and in accordance with the provisions of Appendix 3.*

(f) For the avoidance of doubt, the requirements of Appendix 3 do not apply to:-

…….

(iii) ***Power Park Modules*** *in England and Wales with a* ***Completion Date*** *before 1 January 2006 for whom only the requirements of* ***Limited Frequency Sensitive Mode*** *(BC.3.5.2) operation shall apply; or*

(iv) ***Power Park Modules*** *in operation in Scotland before 1 January 2006 for whom only the requirements of* ***Limited Frequency Sensitive Mode*** *(BC.3.5.2) operation shall apply; or*

(v) ***Power Park Modules*** *in operation after 1 January 2006 in Scotland which have a* ***Completion Date*** *before 1 April 2005 for whom the remaining requirements of this clause CC.6.3.7 shall continue to apply unchanged.*

……..

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

CC.A.3.1 SCOPE

*The **Frequency** response capability is defined in terms of **Primary Response**, **Secondary Response** and **High Frequency Response**. This appendix defines the minimum **Frequency** response requirement profile for:-*

*(a) each **Generating Unit** and/or **CCGT Module** which has a **Completion Date** after 1 January 2001 in England and Wales and 1 April 2005 in Scotland and/or*

*(b) each **DC Converter** at a **DC Converter Station** which has a **Completion Date** on or after [change implementation date] and/or*

*(c) each **Power Park Module** in England and Wales with a **Completion Date** on or after 1 January 2006.*

*(d) each **Power Park Module** in operation in Scotland after 1 January 2006 with a **Completion Date** after 1 April 2005 and in **Power Stations** with a **Registered Capacity** of 30MW or above.*

For the avoidance of doubt, this appendix does not apply to:-

*(i) **Generating Units** and/or **CCGT Modules** which have a **Completion Date** before 1 January 2001 in England and Wales and before 1 April 2005 in Scotland and/or*

*(ii) **DC Converters** at a **DC Converter Station** which have a **Completion Date** before [change implementation date] and/or*

*(iii) **Power Park Modules** in England and Wales with a **Completion Date** before 1 January 2006 and/or*

*(iv) **Power Park Modules** in operation in Scotland before 1 January 2006 or **Power Park Modules** in Scotland with a **Completion Date** before 1 April 2005 and **Power Park Modules** in Scotland in **Power Stations** with a **Registered Capacity** less than 30MW and/or*

*(v) To **Small Power Stations** or individually to **Power Park Units**.*

……..

BC3.5.3 …..

(b) Power Park Modules **in operation before 1 January 2006**
NGC will permit **Power Park Modules** in operation before 1 January 2006 to operate in **Limited Frequency Sensitive Mode** at all times. For the avoidance of doubt **Power Park Modules** in England and Wales with a **Completion Date** on or after 1 January 2006 and **Power Park Modules** in operation in Scotland after 1 January 2006 with a **Completion Date** after 1 July 2004 or in a **Power Station** with a **Registered Capacity** of 30MW and greater will be required to operate in both **Limited Frequency Sensitive Mode** and **Frequency Sensitive Mode** of operation depending on **System** conditions.

BC3.5.4 *Frequency Sensitive Mode*

(f) **NGC** will not so instruct **Generators** in respect of **Power Park Modules**:
- (i) in Scotland with a **Completion Date** before 1 July 2004; or,
- (ii) in **SHETL's Transmission Area** in a **Power Station** with a **Registered Capacity** of less than 30MW; or
- (ii) in England and Wales with a **Completion Date** before 1 January 2006

Fault Ride Through

SKM recommended that the drafting of the Fault Ride Through paragraphs [CC.6.3.15(a) & CC.6.3.15(b)] should be revised as the requirements and application to classes of user was still unclear. National Grid accept that an alternative to the proposed wording might be considered to improve clarity. The revised drafting below reflects the intentions of the SA2004 and H/04 consultation reports.

SKM proposed that CC.6.3.15(a)(ii) should be split so that the fault ride through requirement for a DC Converter appeared as a separate sub clause.

SKM recommended that the drafting of CC.6.3.15(b)(ii) should be revised to remove ambiguity between "proportional to" and "within 1 second". National Grid believes that the intended application was clear in the reports SA2004 and H/04. However the alternative drafting below addresses the SKM recommendation by dividing the paragraph into the provision of power during the voltage dip and the recovery of active power after the voltage has returned to the minimum normal range.

SKM suggested that the relaxation against fault ride through under high wind speed shutdown conditions in CC.6.3.15(c)(i) is not supportable and should be removed. Whilst National Grid accepts the recommendation we believe that some users may see this as a tightening of the requirement on wind farm developers. However if the change suggested by SKM was made by Ofgem the paragraph CC.6.3.15(c)(i) would appear as shown in Option 2 below.

SKM noted that CC.6.3.15(a)(ii) requires immediate power recovery after a fault cleared in normal clearance times whilst CC.6.3.15(b)(ii) requires power recovery within 1 second and considered that the former is unreasonable for some new generation technologies. The difference is due to the fact that the former deals with normal system fault clearance, events that occurs several hundred times a year while the latter is drafted to provide a resilient and robust system for relatively rare but prolonged voltage depression events.

National Grid accepts that the word "immediate" does not in reality need to correspond with instantaneous and that a few hundred milliseconds would be acceptable as supported by studies. Studies with these time delays show negligible impact on system stability and security under normal operating conditions. Therefore, National Grid agree to change the drafting to allow an explicit short time delay of 0.5 seconds.

However, introducing a delay greater than 0.5 seconds would not be acceptable as it would impact on customers through increased frequency deviations, greater risk of

demand disconnection and the potential for restricting the siting of wind farm connections. Studies have shown that relatively small reductions in power spread over a number of wind farms will have a significant detrimental impact on system frequency control and stability. If Ofgem requires NGC to maintain current statutory standards of frequency control and stability, an increase in frequency response holdings and hence in system balancing costs would be required. Incorporating the SKM suggestion using 0.5 seconds as the delay would give the text shown in Option 3 below.

The SKM Report questions the appropriateness of the requirement for proportionality of active power during the voltage dip to the reduced Supergrid Voltage for all generators. The report goes on to state that the voltage in lower voltage networks will also be depressed when the Supergrid is subject to voltage dips and that the requirement could therefore be more onerous on embedded generators. National Grid agrees that the voltage is usually higher in distribution networks where embedded generation is connected due to the presence of the power station and the impedance to the source of the voltage depression. National Grid would accept a change to make the Active Power provision of embedded generation proportional to the local voltage at the distribution system entry point. The suggested revision would result in the text shown in Option 4 below.

CC.6.3.15 Fault Ride Through

*(a) Short circuit faults at **Supergrid Voltage** up to 140ms in duration*

*(i) Each **Generating Unit, DC Converter,** or **Power Park Module** and any constituent element thereof shall remain transiently stable and connected to the **System** without tripping of any **Generating Unit, DC Converter** or **Power Park Module** and / or any constituent element, for a close-up solid three-phase short circuit fault or any unbalanced short circuit fault on the **GB Transmission System** operating at **Supergrid Voltages** for a total fault clearance time of up to 140 ms. A solid three-phase or unbalanced earthed fault results in zero voltage on the faulted phase(s) at the point of fault. The duration of zero voltage is dependent on local protection and circuit breaker operating times. This duration and the fault clearance times will be specified in the **Bilateral Agreement**. Following fault clearance, recovery of the **Supergrid Voltage** to 90% may take longer than 140ms as illustrated in Appendix 4 Figures CC.A.4.1 (a) and (b).*

*(ii) Each **Generating Unit** or **Power Park Module** shall be designed such that upon both clearance of the fault on the **GB Transmission System** as detailed in CC.6.3.15 (a) (i) and restoration of the **Supergrid Voltage** to the minimum levels specified in CC.6.1.4, **Active Power** output shall be immediately restored to at least 90% of the level available immediately before the fault. During the period of the fault as detailed in CC.6.3.15 (a) (i) each **Generating Unit** or **Power Park Module** shall generate maximum reactive current without*

*exceeding the transient rating limit of the **Generating Unit** or **Power Park Module** and / or any constituent element.*

*(iii) Each **DC Converter** shall be designed to meet the **Active Power** recovery characteristics as specified in the **Bilateral Agreement** upon clearance of the fault on the **GB Transmission System** as detailed in CC.6.3.15 (a) (i).*

*(b) **Supergrid Voltage** dips greater than 140ms in duration*

*In addition to the requirements of CC.6.3.15 (a) each **Generating Unit** or **Power Park Module** and / or any constituent element, each with a **Completion Date** on or after the [**Grid Code** change implementation date] shall:*

*(i) remain transiently stable and connected to the **System** without tripping of any **Generating Unit** or **Power Park Module** and / or any constituent element, for balanced **Supergrid Voltage** dips and associated durations anywhere on or above the heavy black line shown in Figure 5. Appendix 4 and Figures CC.A.4.3 (a), (b) and (c) provide an explanation and illustrations of Figure 5; and,*

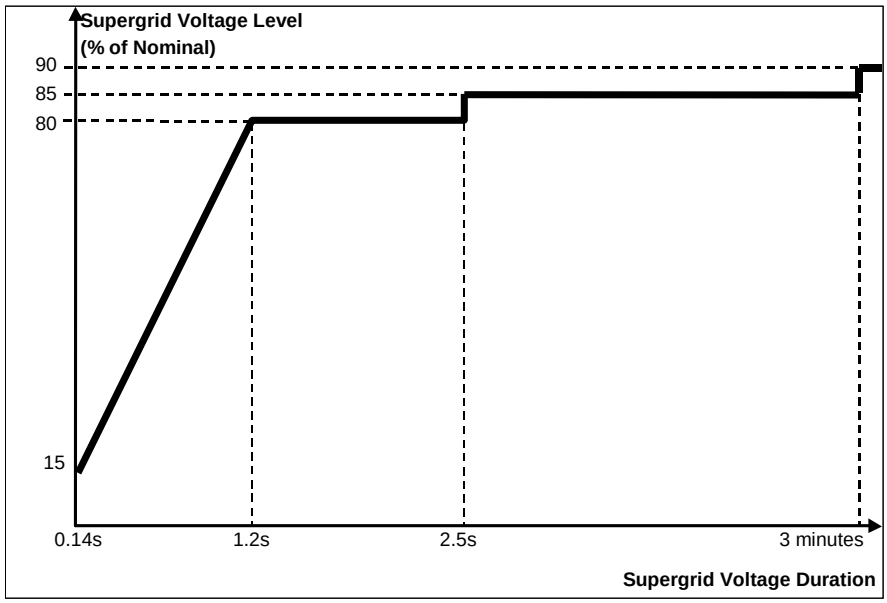


Figure 5

*(ii) provide **Active Power** output, during **Supergrid Voltage** dips as described in Figure 5, at least in proportion to the retained balanced **Supergrid Voltage** and shall generate maximum reactive current without exceeding the transient rating limits of the **Generating Unit** or **Power Park Module** and any constituent element; and,*

*(iii) restore **Active Power** output, following **Supergrid Voltage** dips as described in Figure 5, within 1 second of restoration of the **Supergrid Voltage** to the minimum levels specified in*

*CC.6.1.4, to at least 90% of the level available immediately before the occurrence of the dip except in the case of a **Non-Synchronous Generating Unit** or **Power Park Module** where there has been a reduction in the **Intermittent Power Source** in the time range in Figure 5 that restricts the **Active Power** output below this level.*

*For the avoidance of doubt a balanced **Supergrid Voltage** meets the requirements of CC.6.1.5 (b) and CC.6.1.6.*

(c) ***Other Requirements***

*(i) In the case of a **Power Park Module** (comprising of wind-turbine generator units), the requirements in CC.6.3.15(a) and CC.6.3.15(b) do not apply when the **Power Park Module** is operating at less than 5% of its **Rated MW** or during very high wind speed conditions when more than 50% of the wind turbine generator units in a **Power Park Module** have been shut down or disconnected under an emergency shutdown sequence to protect **User's Plant** and **Apparatus**.*

*(ii) In addition to meeting the conditions specified in CC.6.1.5(b) and CC.6.1.6, each **Non-Synchronous Generating Unit** or **Power Park Module** and any constituent element thereof will be required to withstand, without tripping, the negative phase sequence loading incurred by clearance of a close-up phase-to-phase fault, by **System Back-Up Protection** on the **GB Transmission System** operating at **Supergrid Voltage**.*

*(iii) In the case of a **Power Park Module** in Scotland with a **Completion Date** before 1 January 2004 and a **Registered Capacity** less than 30MW the requirements in CC.6.3.15 (a) do not apply. In the case of a **Power Park Module** in Scotland with a **Completion Date** on or after 1 January 2004 and before 1 July 2005 and a **Registered Capacity** less than 30MW the requirements in CC.6.3.15 (a) are relaxed from the minimum **Supergrid Voltage** of zero to a minimum **Supergrid Voltage** of 15% of nominal. In the case of a **Power Park Module** in Scotland with a **Completion Date** before 1 January 2004 and a **Registered Capacity** of 30MW and above the requirements in CC.6.3.15 (a) are relaxed from the minimum **Supergrid Voltage** of zero to a minimum **Supergrid Voltage** of 15% of nominal. In the case of a **Power Park Module** in Scotland with a **Completion Date** before 1 January 2005 the requirements in CC.6.3.15 (b) do not apply.*

*(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:-*

(i) Frequency above 52Hz for more than 2 seconds
(ii) Frequency below 47Hz for more than 2 seconds
*(iii) Voltage as measured at the **Connection Point** or **User System***

Entry Point *below 80% for more than 2 seconds-*

(iv) 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 (i) and (ii) are maximum trip times. Shorter times may be used to protect the ***Non-Synchronous Generating Units*** *or* ***Power Park Modules.***

Option 2 Paragraph CC.6.3.15(c)(i).

(c) Other Requirements

(i) In the case of a ***Power Park Module*** *(comprising of wind-turbine generator units), the requirements in CC.6.3.15(a) and CC.6.3.15(b) do not apply when the* ***Power Park Module*** *is operating at less than 5% of its* ***Rated MW.***

Option 3 Paragraph CC.6.3.15(a)(ii).

(ii) *Each* ***Generating Unit*** *or* ***Power Park Module*** *shall be designed such that upon both clearance of the fault on the* ***GB Transmission System*** *as detailed in CC.6.3.15 (a) (i) and within 0.5 seconds of the restoration of the* ***Supergrid Voltage*** *to the minimum levels specified in CC.6.1.4,* ***Active Power*** *output shall be restored to at least 90% of the level available immediately before the fault. During the period of the fault as detailed in CC.6.3.15 (a) (i) each* ***Generating Unit*** *or* ***Power Park Module*** *shall generate maximum reactive current without exceeding the transient rating limit of the* ***Generating Unit*** *or* ***Power Park Module*** *and / or any constituent element.*

Option 4 Paragraph CC.6.3.15(b)(ii) and (iii)

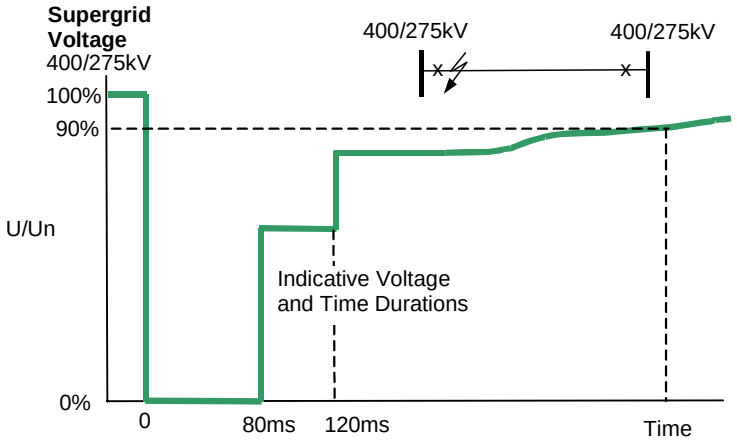
(ii) provide ***Active Power*** *output, during* ***Supergrid Voltage*** *dips as described in Figure 5, at least in proportion to the retained balanced* ***Supergrid Voltage*** *(or the retained balanced voltage at the* ***User System Entry Point*** *if* ***Embedded****) and shall generate maximum reactive current without exceeding the transient rating limits of the* ***Generating Unit*** *or* ***Power Park Module*** *and any constituent element; and,*

(iii) restore ***Active Power*** *output, following* ***Supergrid Voltage*** *dips as described in Figure 5, within 1 second of restoration of the* ***Supergrid Voltage*** *to the minimum levels specified in CC.6.1.4 (or within 1 second of restoration of the voltage at the* ***User System Entry Point*** *to 90% of nominal or greater if* ***Embedded****), to at least 90% of the level available immediately before the occurrence of the dip except in the case of a* ***Non-Synchronous Generating Unit*** *or* ***Power Park Module*** *where there has been a reduction in the* ***Intermittent***

Power Source *in the time range in Figure 5 that restricts the* ***Active Power*** *output below this level.*

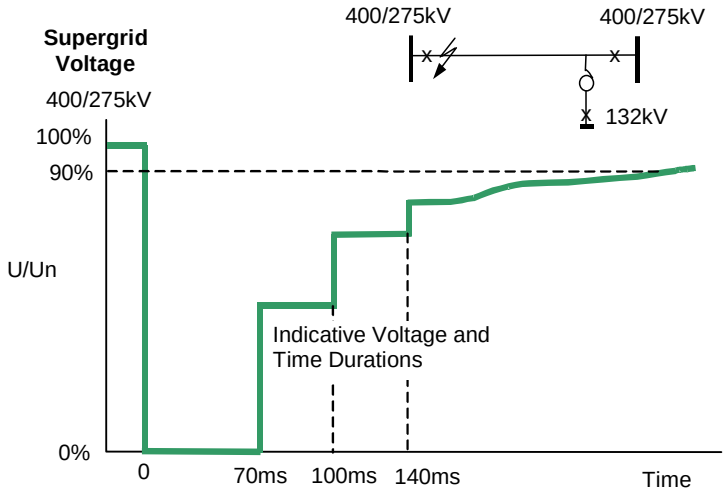
Appendix 4

SKM proposed that the illustrative figures in CC.A.4.2 be revised by removal of vertical arrows and addition of 400/275kV to the labels on the vertical axes. National Grid agrees and the revised the diagrams would appear as follows.



Typical fault cleared in less than 140ms: 2 ended circuit

Figure CC.A.4.1 (a)



Typical fault cleared in 140ms:- 3 ended circuit

Figure CC.A.4.1 (b)

3. Suggestions Rejected And Reasons For Rejection

Generation Capacity Thresholds

The SKM Report discusses the use of different generation capacities and thresholds in the three Transmission Areas. As agreed with Ofgem, review of different generation capacities and thresholds are beyond the scope of SA2004 and H/04 and if necessary, should be reviewed as a separate issue.

Reactive Range and Voltage Control

SKM note that there are regional differences until 1 January 2006 on the provision of reactive power range and voltage control. As acknowledged by SKM on Page 28 of their report, earlier implementation dates in Scotland than England & Wales are justifiable regional differences given the more advanced status of wind farm projects in Scotland. The two technical options available to developers in Scotland prior to 1 January 2006 is to cater for the more advanced projects where earlier reactive range requirements were specified at the time equipment was ordered. As acknowledged by SKM, these regional differences do not disadvantage any customer in Scotland or England & Wales so there is no requirement to alter the proposals.

Different implementation dates for frequency response in Scotland and England & Wales are justifiable regional differences given the more advanced status of wind farm projects in Scotland and that these differences do not disadvantage any customer in Scotland or England & Wales.

Power Frequency Characteristic for DC Converters

SKM suggested that the Power / Frequency Characteristic proposed for DC Converters whilst importing active power (analogous to demand) in CC.6.3.3 (d) is more onerous below 49.5Hz and more relaxed below 48.8Hz when considered against the settings of the emergency Low Frequency Demand Disconnection Scheme. Emergency demand disconnection by under frequency relays commences at 48.8Hz whilst the proposals in H/04 require deloading of a DC Converter Station at frequencies below 49.5Hz. The scheme also requires 60% of demand to be disconnected by 47.8Hz while the proposals in H/04 require 60% deloading of a DC Converter at 47.0Hz.

Whilst National Grid agrees with SKM that the power/frequency characteristic of DC Converter Stations at the lower frequency range should align, National Grid believes commencing demand reduction at 49.5Hz offers security of supply benefits to consumers in Great Britain. The proposed reduction in power demand between 49.5 Hz and 48.8 Hz is beneficial to our transmission system whilst not being detrimental to the external system (roughly about 200MW for a 1000MW HVDC link). In addition, drawing the suggested line from 48.8 Hz to 47.8Hz would disadvantage customers in England in Wales because as the SKM figure suggests, this would mean that customers in E&W would be disconnected first whilst continuing to supply demand in the external system. There are very few frequency excursions below 49.5Hz and the duration of such events is a few tens of seconds so the impact on DC Converter Station owners should be minor.

Control Arrangements – Governor System

Different implementation dates for frequency response in Scotland and England & Wales are justifiable regional differences as acknowledged by SKM in their report (Page 28) given the more advanced status of wind farm projects in Scotland and that these do not disadvantage any customer in Scotland or England & Wales. Therefore the Licensees do not believe this is an issue that requires a change to the proposals.

SKM suggested that CC.6.3.6(a) and CC.6.3.7 (e)(f) that are drafted to apply to Power Park Modules in England and Wales "in operation" after 1 January 2006 should be changed to "with a completion date" after 1 January 2006 or to a later date such as 1 July 2006.

Whist National Grid accepts that a completion date for plant in England & Wales may be acceptable, the suggestion of moving the date back beyond 1 January 2006 is not. National Grid believes that the change to a completion date after 1 January 2006 is not technically supported if the reason is that plant manufacturers can not provide the capability. Plant currently commissioning in Scotland does have the frequency response capability and the connection agreements already signed with licensed generators in England and Wales include frequency response.

SKM suggested removal of CC.6.3.7 (c)(i) as a meaningless clause. National Grid is aware that this clause is poorly worded but our experience in witnessing governor tests over the last 14 years shows that the requirement is important. The clause ensures satisfactory part-load rejection capability i.e. essentially the ability to reduce power output in accordance with the operational requirements contained in BC.3.7.1 and BC.3.7.2. The importance and applicability to existing synchronous generation lead us to the conclusion that this clause must not be removed.

Fault Ride Through

Different implementation dates for Fault Ride Through in Scotland and England & Wales are justifiable regional differences as acknowledged by SKM in their report (Page 28) given the more advanced status of wind farm projects in Scotland and that these differences do not disadvantage any customer in Scotland or England & Wales.

Manned Control Points and Communication Requirements

The SKM Report highlights the relaxations for Power Park Modules in the Scottish Grid Code proposals (SA2004) regarding manned control points and communications. While National Grid respects these relaxations in relation to the new technologies including Power Park Modules as consulted on under SA2004 the idea that these exemptions should be generally extended to existing Medium and Large Power Stations is rejected on the grounds of being beyond the scope of SA2004 and H/04. Again, like the Generation Capacity Thresholds issue, these should, if necessary, be reviewed separately, possibly in conjunction with generation capacities and thresholds.

Attachment 2
Impact Assessment

Proposed Grid Code Modifications H/04 and SA/2004

Impact Assessment (IA)

January 2005

Summary

The purpose of this document is to consult on Ofgem's Impact Assessment (IA) on the Grid Code modifications submitted to the Authority for approval by the three GB transmission licensees, Scottish Hydro Electric Transmission Ltd (SHETL), Scottish Power Transmission Ltd (SPTL) and National Grid Company Plc (NGC) relating to the connection of wind generation and other new technologies.

The original proposals submitted by the transmission licensees are contained in two reports to the Authority:

- H/04[1]; "Grid code changes to incorporate new generation technologies and DC inter-connectors (generic provisions)" relating to England and Wales, submitted by NGC, and

- SA/2004[2]; "Report on Consultation SA/2004" relating to Scotland, jointly submitted by the two Scottish transmission licensees (STL) SHETL and SPTL.

This IA provides support to Ofgem's "minded to" decision letters relating to NGC's and the STL's proposed Grid Code changes, which are published today. It should be noted that arriving at this "minded to" position in no way fetters the Authority's discretion in making its final decisions and it will take all factors into account when making this decision including the responses to this consultation. This IA sets out the impacts of approving the Grid Code changes together with the Supplementary Changes that Ofgem is also consulting on.

It is Ofgem's understanding that the technical requirements proposed by the licensees for non-synchronous generators can already or soon will be able to be met by manufacturers and that the cost impact on a typical generator is likely to be small. Evidence is also provided that shows it to be more cost effective to improve the performance of these types of generator rather than compensating for them using operational measures.

[1] http://www.nationalgridinfo.co.uk
[2] http://www.scottish-southern.co.uk/ssegroup/PowerSystemsDocuments.asp or http://gso.scottishpower.com/publicdocs/

The IA also discusses the Grid Code proposals relating to DC Interconnectors contained in H/04. Ofgem is not aware of any significant impacts in relation to these proposals.

A six week consultation period commences today for Ofgem's 'minded to' decisions, the Supplementary Changes and this IA. Comments must be received by 28 February 2005.

The Authority intends to make its final decisions in March so that they can be implemented in the GB Grid Code at the proposed BETTA Go-Live date.

Table of contents

1. Introduction

Purpose of this document

1.1. The purpose of this document is to consult on Ofgem's Impact Assessment (IA) on the proposed Grid Code modifications submitted to the Authority for approval by the three GB transmission licensees, Scottish Hydro Electric Transmission Ltd (SHETL), Scottish Power Transmission Ltd (SPTL) and National Grid Company Plc (NGC) relating to the connection of wind generation and other new technologies.

1.2. The original proposals submitted by the transmission licensees are contained in two reports to the Authority:

- H/04[1]; "Grid code changes to incorporate new generation technologies and DC inter-connectors (generic provisions)" relating to England and Wales, submitted by NGC, and
- SA/2004[2]; "Report on Consultation SA/2004" relating to Scotland, jointly submitted by the two Scottish transmission licensees (STL) SHETL and SPTL.

1.3. This IA provides support to Ofgem's "minded to" decision letters relating to NGC's and the STL's proposed Grid Code changes, which are published today. It should be noted that arriving at this "minded to" position in no way fetters the Authority's discretion in making its final decisions and it will take all factors into account when making these decisions including the responses to this consultation.

1.4. Although two separate proposals have been made to the Authority, H/04 and SA/2004, Ofgem is conducting a single IA based on the combined impact of

[1] http://www.nationalgridinfo.co.uk
[2] http://www.scottish-southern.co.uk/ssegroup/PowerSystemsDocuments.asp or http://gso.scottishpower.com/publicdocs/

both proposals. This is justified on the grounds that both proposals address the same issue, the connection of new generation technologies. In addition, as a result of the BETTA process (discussed in more detail later in this IA) both proposals, if accepted, will result in a single direction to NGC to amend the GB Grid Code.

1.5. Section 5A of the Utilities Act 2000 places a duty on the Authority to carry out IAs in certain cases. Where the Authority is proposing to undertake an action for the purposes of, or in connection with, the carrying out of its functions under Part I of the Gas or Electricity Acts and it appears to the Authority that the proposal is "important", the Authority must carry out and publish an IA, or publish a statement setting out the reasons why it considers that it is unnecessary for it to carry out an IA. Ofgem has published a consultation document providing guidance on IAs[3].

1.6. Section 5A(2) defines a proposal as "important" where its implementation would be likely to do one or more of the following:

- involve a major change in the activities carried on by the Authority
- have a significant impact on market participants in the gas or electricity sectors
- have a significant impact upon persons engaged in commercial activities connected to the gas or electricity sectors, and
- have a significant impact on the general public in Great Britain or in part of Great Britain, or
- have significant effects on the environment.

1.7. Ofgem considers that Grid Code changes of this scope could have a significant impact upon persons engaged in commercial activities connected to the gas or electricity sectors because they set the requirements under which wind

[3] "Guidance on impact assessments" September 2004 229b/04

generation and other new generation technologies will be able to connect to the transmission system and, for certain embedded generators, the distribution system.

1.8. Therefore, the decisions, which the Authority will be taking in connection with NGC's H/04 and the STL's SA/2004 Grid Code modification proposals, are "important" and it is appropriate for an IA to be undertaken.

Structure of this document

1.9. This document is structured as follows:

- Chapter 2 provides background to the proposed Grid Code changes and a summary of the consultation process to date
- Chapter 3 sets out the objectives of the proposed modifications and Ofgem's current thinking regarding its decision
- Chapter 4 provides an overview of the proposed modifications
- Chapter 5 describes the different options that Ofgem has to respond to the proposals
- Chapter 6 describes the main impacts of the proposed modifications
- Chapter 7 evaluates the potential costs associated with the options that Ofgem has in making its decision
- Chapter 8 evaluates the potential benefits of Ofgem's options, and
- Chapter 9 sets outs Ofgem's initial conclusions.

Related documents

1.10. This document should be read in conjunction with the following documents also published by Ofgem today[4]:

- the Authority's H/04 "minded to" decision letter
- the Authority's SA/2004 "minded to" decision letter
- "New Generation Technologies and GB Grid Codes" produced by Sinclair Knight Merz (SKM) , Ofgem's consultants in this matter
- the proposed Supplementary Changes to the GB Grid Code drafting.

and in addition (available on their websites):

- NGC's report to the Authority H/04
- the STL's report to the Authority SA/2004, and
- the proposed GB Grid Code drafting[5] incorporating both H/04 and SA/2004.

Views invited

1.11. Ofgem would welcome views on this IA, to be received by close of business on 28 February 2005. All responses will normally be published on Ofgem's website and held in the Research and Information Centre. However, if respondents do not wish their response to be made public then they should clearly mark their response as confidential. Ofgem prefers to receive responses in an electronic form so they can be placed easily on the Ofgem website.

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[4] http://www.ofgem.gov.uk/ofgem/work/index.jsp?section=/areasofwork/distributiongridcodes

[5] This is available on NGC's website at http://www.nationalgridinfo.co.uk/grid_code/mn_consultation_papers.html

1.12. Responses should be addressed to:

Gareth Evans

Technical Advisor

Office of Gas and Electricity Markets

9 Millbank

London

SW1P 3GE

1.13. Electronic responses should be sent to gareth.evans@ofgem.gov.uk. If you wish to discuss any aspect of this IA please contact Gareth Evans (telephone 020 7901 7347) at Ofgem.

1.14. Comments or complaints on the manner in which this consultation process has been conducted should be sent to:

Mick Fews

Head of Licensing

Office of Gas and Electricity Markets

9 Millbank

London

SW1P 3GE

Email michael.fews@ofgem.gov.uk

Tel 020 7901 7085

Way forward

1.15. Ofgem will carefully consider responses received to this IA to help inform the Authority's final decision on NGC's and the STL's proposed Grid Code modifications. The initial views expressed in this IA and the "minded to" letters are without prejudice to the Authority's final consideration of whether to accept the proposals. Ofgem intends to make a decision on the proposed Grid Code modifications by March 2005.

2. Background

Introduction

2.1. The GB transmission licensees, SHETL, SPTL and NGC all have a licence obligation to "prepare and at all times have in force and shall implement and comply with" a Grid Code to be known as the licensee's Grid Code. The grid codes contain requirements relating to the technical operation of the licensee's transmission system including connection conditions, an operating code and a planning code.

2.2. Ofgem's consideration of NGC's H/04 and the STL's SA/2004 Grid Code change proposals is taking place during a period of transition for the electricity markets in Great Britain. This relates to the introduction of the BETTA arrangements that are discussed later in this section.

2.3. Until 1 September 2004 (BETTA Go-Active) two grid codes governed the Great Britain (GB) transmission system. SHETL and SPTL jointly maintained a Grid Code for Scotland and NGC maintained a Grid Code for England & Wales. From the BETTA Go-Live date, planned for April 2005, a single GB Grid Code will replace these two grid codes. We are currently in the interim BETTA Go-Active period during which the Scottish Grid Code remains in place for Scotland while the GB Grid Code (with its Scottish provisions 'switched off') is in place for England and Wales.

2.4. The transmission licensees are also under an obligation to review periodically (including upon the request of the Authority) in consultation with authorised electricity operators the relevant grid codes and their implementation. Following any such review, the relevant licensee must send to the Authority:

- a report on the outcome of such review, and
- any proposed revisions to that licensee's Grid Code from time to time as that licensee (having regard to the outcome of such review) reasonably thinks fit for the achievement of the objectives set out in the licence, and

- any written representations or objections from authorised electricity operators liable to be materially affected thereby (including any proposals by such operators for revisions to the relevant licensee's Grid Code not accepted by the licensee in the course of the review) arising during the consultation process and subsequently maintained.

2.5. Any revision to a Grid Code proposed by the relevant licensee sent to the Authority requires the approval of the Authority. The Authority considers such proposals having regard to (amongst other things) any written representations or objections and may require further consultation where the Authority considers this appropriate. The Authority may issue directions requiring the licensee to revise the Grid Code in such manner as may be specified in the directions and the licensee in question must comply with any such direction.

Process to date

2.6. In March 2002, the STL's issued consultation paper SB/2002 containing a set of proposed modifications to the Scottish Grid Code (SGC) concerning the technical requirements that should be imposed on non-synchronous generators, particularly wind generators, in order to connect to the Scottish Transmission System. The responses to this consultation indicated that there existed widely different opinions regarding the technical requirements that generators should be required to meet. Following the consultation, in December 2002 the STLs submitted a set of modification proposals to Ofgem for approval.

2.7. In June 2003, NGC published a consultation document regarding changes to the England and Wales Grid Code (EWGC) entitled "Proposed Grid Code Changes to Incorporate New Generation Technologies and DC Inter-connections (Generic Provisions)". The proposed modifications were broadly similar to the changes proposed by the Scottish licensees (SB/2002). Following the consultation, in October 2003, NGC submitted modification proposals to Ofgem for approval.

2.8. Ofgem was aware at this stage that NGC's proposals and those of the Scottish licensees were not supported by all parties; in particular, the wind generation community had raised objections to the proposals.

2.9. In view of the objections raised by differing parties and of the potential impact that the proposals might have on these parties, in particular the wind generation community, Ofgem requested in November 2003 that NGC and the Scottish licensees carry out further work to achieve two objectives:

- a consistent approach to be adopted by NGC and the Scottish licensees, and
- further discussion with affected stakeholders to address their concerns and wherever possible reach agreement about the change proposals.

2.10. Following Ofgem's request to the three licensees a number of activities were initiated. All three GB transmission licensees worked together to align the proposals for Scotland and England and Wales. This work was completed early in 2004.

2.11. Secondly, a series of meetings with the major manufacturers of wind generators was arranged. At these meetings, the licensees explained the aligned proposals and the manufacturers fed back their views on their ability to comply with them and the cost of doing so. Ofgem attended these meetings in an observer capacity.

2.12. Finally, Ofgem convened two Forum meetings to discuss the aligned proposals in detail. They were attended by representatives of all affected parties. The minutes of the meetings can be found on Ofgem's website at: http://www.ofgem.gov.uk/ofgem/work/index.jsp?section=/areasofwork/distributiongridcodes

2.13. Following the Forum meetings, the licensees revised their Grid Code change proposals to take account of the views expressed where they considered this to be appropriate. On 23 June 2004, NGC published Consultation Document H/04. This consultation closed on 21 July 2004 and NGC subsequently produced its Report to the Authority dated 27 August 2004.

2.14. The Scottish licensees also published their Consultation Document SA/2004 on 23 June 2004. This consultation also closed on 21 July 2004 and the Scottish

Licensees subsequently produced their report to the Authority dated 2 September 2004.

2.15. It is Ofgem's belief that the further period of consultation has been productive. Affected parties were given the opportunity to express their views on the key issues and to make alternative proposals for consideration by the licensees. As a result the licensees' initial proposals to Ofgem have been further developed in a constructive way.

BETTA

2.16. Part three of the Energy Act 2004 includes provisions for the introduction of British Electricity Trading and Transmission Arrangements (BETTA). Ofgem and the Department of Trade and Industry (DTI) are working to implement BETTA fully by April 2005.

2.17. On 1 September 2004, amendments to the transmission licences made by the Secretary of State under powers given to her in the Energy Act 2004 came in to effect. One consequence of these amendments is that the EWGC has been amended to become the Great Britain Grid Code (GB Grid Code). The GB Grid Code covers Scotland, England and Wales.

2.18. Until the BETTA "Go Live" date (currently scheduled for 1 April 2005) Scotland is still subject to the SGC; the Scottish clauses in the GB Grid Code are "turned off" until this date. After BETTA "Go Live", the SGC will cease to exist and the appropriate Scottish clauses in the GBGC will be "turned on".

2.19. NGC has produced a revised version of the GB Grid Code[6] that incorporates both the H/04 and SA/2004 change proposals. The Authority will base its decision on the H/04 and SA/2004 proposals based on the proposed GB Grid Code drafting.

[6] See Related Documents, paragraph 1.10.

Supplementary Changes

2.20. Following a review of the H/04 and SA/2004 proposals by Ofgem and its technical consultants (SKM) a number of points of detail were raised by Ofgem with NGC. NGC gave careful consideration to the comments made and offered its support to them in specific areas.

2.21. Ofgem requested NGC to produce drafting for the GB Grid Code to show how the comments supported by NGC might be taken account of. NGC provided the Supplementary Changes to Ofgem on 10 December 2004.

2.22. This additional drafting, referred to here as the Supplementary Changes, did not form part of the H/04 proposals that were consulted on by NGC or the SA/2004 proposals that were consulted on by the STLs. However, Ofgem is of the view that they offer an improvement, with certain caveats, over the original. NGC supports the Supplementary Changes. This consultation offers all parties the opportunity to comment on the Supplementary Changes and these comments will be taken fully into account when the Authority makes its final decision.

3. Objectives

Objective of the proposals

3.1. The objective of the proposed Grid Code modifications contained in Consultation Documents H/04 and SA/2004 is to include specific provisions for non-synchronous generators. The H/04 proposals also include provisions for DC interconnectors.

3.2. The licensees believe that the current Grid Code provisions largely relate to synchronous generators and do not adequately cover non-synchronous technologies. The potential large increase in wind generation (predominantly non-synchronous generators) connected to the transmission system (or embedded in the distribution network) has been highlighted by the licensees as the key driver for the proposed Grid Code changes.

Ofgem's current thinking

Authority assessment

3.3. The Authority, in assessing whether to accept a modification proposal, is required to take into account the following criteria:

- whether the proposal will further the objectives set out in standard condition ("SC") C14(1)b of the transmission licence[7] for the GB System Operator and SC D9(1)(b) for the STLs, and

[7] The licensee's transmission licence defines the Grid Code objectives as follows:

(i) to permit the development, maintenance and operation of an efficient, co-ordinated and economical system for the transmission of electricity;
(ii) to facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the GB transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity); and
(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in Great Britain taken as a whole.

- whether the proposal is best calculated to further Ofgem's principal objective[8] having regard to its general duties.

Incorporation into the GB Grid Code

3.4. NGC's consultation H/04 and the corresponding report to the Authority related to changes to the EWGC. As already explained, the EWGC has now been amended to become the GB Grid Code.

3.5. The STL's consultation SA/2004 and the corresponding report to the Authority related to changes to the SGC. This will, subject to the achievement of BETTA Go-Live on 1 April 2005, be replaced by the GB Grid Code. It is Ofgem's intention that the Authority's final decision relating to both the H/04 and SA/2004 consultations will be made in the context of the proposed GB Grid Code that incorporates them and they will take force at BETTA Go-Live, planned to be 1 April 2005.

3.6. Ofgem is aware that NGC has had to exercise some judgment in combining both the H/04 and SA/2004 proposals into the GB Grid Code (due to differences in the drafting between H/04 and SA/2004). NGC has confirmed to Ofgem that in drafting the proposals into the GB Grid Code NGC's intention was that the proposed GB Grid Code drafting has no material difference from what was consulted on in the H/04 and SA/2004 consultations.

3.7. The one exception to this principle is the DC inter-connector provisions. These were not explicitly consulted on in Scotland. The issue of DC interconnectors has been discussed over a number of years at the SGCRP but as no further DC Interconnectors were expected in Scotland prior to the adoption of a GB Grid Code there was not seen to be a need to modify the SGC. Ofgem has agreed that the current consultation provides an appropriate opportunity for any party to comment on the impact of these provisions in Scotland.

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[8] Ofgem's principal objective is to protect the interests of consumers present and future, wherever appropriate by promoting effective competition.

3.8. This consultation provides an opportunity for parties to comment on the original H/04 and SA/2004 proposals, the incorporation of H/04 and SA/2004 proposals into the GB Grid Code, the DC inter-connector provisions for Scotland and the further Supplementary Changes to the GB drafting submitted by NGC, at Ofgem's request, which have not been consulted on previously.

3.9. This IA is conducted on the basis of the proposed GB drafting incorporating H/04, SA/2004 and the Supplementary Changes.

Ofgem's "minded to" position

3.10. As highlighted in the "minded to" letters Ofgem is minded to accept the view taken by NGC and the STLs that the original drafting of the grid codes made the implicit assumption that all generators connecting to the transmission system would be synchronous plant. Ofgem is minded to accept therefore that the GB Grid Code does need to be updated to recognise explicitly the particular characteristics of non-synchronous generating plant that parties are now seeking to connect to the transmission system at an increasing rate. The Forum discussions confirmed that all affected parties support this view.

3.11. Ofgem is aware of the considerable work that has been carried out to develop these important changes to the Grid Code. Ofgem considers that the views of all affected parties have been given proper consideration in developing these proposals. Ofgem is aware that a small number of objections to the proposals remain. However, Ofgem is now minded to take the view that the H/04 and SA/2004 proposals as amended by the Supplementary Changes (subject to certain caveats) now proposed to be incorporated in the GB Grid Code should be approved.

3.12. Ofgem's current thinking is supported by Sinclair Knight Merz (SKM) who were commissioned by Ofgem to carry out a technical assessment of the proposals. SKM's report[9] recommended that the proposals[10] be accepted by Ofgem, with a

[9] See Related Documents, paragraph 1.10.

number of minor changes. The "minded to" decision letter addresses these minor changes which have been addressed in the Supplementary Changes.

[10] It should be noted that SKM's review was conducted on the basis of the H/04 and SA/2004 proposals, SKM was not required to report on the GB Grid Code drafting.

4. Proposed Grid Code modifications

Introduction

4.1. The proposed modifications relate primarily to the Connection Conditions (CC) section of the Grid Code. The CC Section specifies the minimum technical, design and operational criteria for users of the GB Transmission System.

4.2. The CC Section applies to all Generators connected to or seeking connection to the GB Transmission System or (other than in respect of Small Power Stations[11]) connected to or seeking connection to a User's System, which is located in Great Britain.

4.3. The England & Wales Grid Code (EWGC) and the Scottish Grid Code (SGC) were originally issued in 1990 based on decades of network design and operational experience. When the grid codes were developed the predominant source of generation on the grid system was the synchronous generator.

4.4. The current GB Grid Code and the Scottish Grid Code contain no reference to non-synchronous generation and all generators, regardless of the technologies they employ, are required to comply with the same technical requirements except those that are exempt or with derogations from the grid codes.

Overview of the modifications

4.5. The proposed Grid Code modifications include new definitions for a "Power Park Module (PPM)" (type of generating station to include non-synchronous generation such as wind farms) and a "DC Converter Station" (direct current interconnection to the transmission system). The proposals specify the existing Grid Code requirements that will now apply to Power Park Modules, other non-synchronous generators and DC converter stations. In addition, new or amended

[11] In England and Wales a Small Power Station is defined as a power station with a registered capacity of less than 50 MW and less than 5 MW in Scotland.

connection conditions are proposed to apply to these classes of plant and, for consistency, to synchronous generators where appropriate. These amendments predominantly relate to:

- Fault ride through (FRT) - the ability of a generating unit to return to normal operation following clearance of a fault on the transmission system
- Frequency range - the ability of a generating unit to be able to deliver power and remain connected to the network when the system frequency deviates from 50 Hz
- Frequency control - the ability of a generating unit to be able to increase or decrease power output with falling or rising frequency
- Reactive range and voltage control - the ability of a generating unit to supply leading/lagging reactive power and control the voltage at the grid connection point, and
- Negative phase sequence - the ability of a generating unit to be able to withstand negative phase sequence currents caused by phase voltage unbalance and phase-to-phase faults.

4.6. A number of the conditions for Power Park Modules and DC Converter Stations come into effect from specific dates (to allow technology to develop to meet the requirements). The dates vary depending on the capacity of the generating stations, the generating station's location and its completion date[12].

4.7. There are also regional differences in the proposals between Scotland and England and Wales as result of the different network characteristics and the level of wind generation activity and development. NGC considers that these differences are justifiable and do not disadvantage any generator in Scotland or England and Wales.

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[12] Completion date is defined in the GB Grid Code "as the meaning set out in the Bilateral Agreement with each User to that term or in the absence of that term to such other term reflecting the date when a User is expected to connect to or start using the GB Transmission System".

4.8. The licensees' reports to the Authority provide a detailed background and rationale for the proposed changes. This is contained in Appendix 2 of H/04 and Attachment 2 of SA/2004.

4.9. A technical assessment of the proposals has been conducted by SKM commissioned by Ofgem. SKM's report on the proposals also contains a technical description of the proposed changes.

5. Options

5.1. The Authority considers that it has three viable options to respond to these proposals. These are:

- to accept the proposed GB drafting as prepared by NGC including SA/2004 and make a direction to implement them
- to accept the proposed GB drafting as prepared by NGC including SA/2004 and the Supplementary Changes and make a direction to implement them, or
- to reject the proposals ("do nothing" option).

Accepting the proposals

5.2. As discussed in paragraph 3.11 Ofgem is currently minded to accept the proposals as amended by the Supplementary Changes. The main impacts and parties affected by accepting the proposals are discussed in Chapter 6 (Main impacts and affected parties).

Rejecting the proposals

5.3. For the Authority to reject the proposed Grid Code changes, the Authority would need to be satisfied that NGC and the STLs could meet all their licence obligations without changes to the Grid Code and that in rejecting the proposals Ofgem would be acting in accordance with its principal objective and statutory duties[13] (i.e. that rejecting the proposals would be the option best calculated to further the principal objective having regard to its general duties).

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[13] Ofgem's statutory duties are wider than the matters that NGC must take into consideration and include amongst other things social and environmental guidance provided to Ofgem by the government.

5.4. Ofgem considers that rejecting the proposals would have number of adverse impacts including:

- the three licensees potentially not being able to meet their licence obligations – it is not considered to be consistent with the objectives of the Grid Code for the connection requirements of a particular generating technology to be agreed on an ad hoc basis

- greater uncertainty for parties wishing to connect non synchronous generators due to the lack of transparency in their connection requirements - while the connection requirements for non-synchronous generators continue to be unspecified in the Grid Code manufacturers and developers will face a level of uncertainty for each new connection, and

- a potential reduction in the capacity of wind generation that could be connected to the network - a transmission licensee could have to limit the capacity connected at particular locations in order to meet the requirements of its security standards.

5.5. The technical requirements that are proposed for non-synchronous generators are intended to ensure that these generators can provide ancillary services to the system in a similar way to synchronous generators. If these requirements are not met it is likely that NGC would have to procure additional ancillary services from other sources. The most significant example of this relates to Fault Ride Through capability. The cost to NGC, which will ultimately be borne by customers, of procuring greater levels of reserve capacity to compensate for plant that does not have an FRT capability is estimated to exceed the cost of providing FRT capability. This is discussed later in this IA.

Further development of the ancillary services markets

5.6. Several parties, in responses to NGC's and the STL's consultations, have suggested that the further development of the ancillary services markets could allow generators to meet their obligations (for example, mandatory frequency response obligations) by purchasing services (either directly or via NGC) from

other participants. This could reduce the need to impose wide ranging technical requirements through the grid codes.

5.7. Ofgem is committed to the development of efficient markets, wherever possible and considers that there may be further scope for the development of ancillary services markets. For example, on the 28 September 2004, Ofgem directed a modification to the Connection and Use of System Code (CUSC) to introduce further competition in the provision of mandatory frequency response[14].

5.8. Ofgem considers that it is appropriate that the these technical requirements to provide ancillary services are placed upon non-synchronous generators in a similar way to synchronous generators to enable NGC to manage the system in an efficient manner and to avoid discriminating unduly between parties through the imposition of different mandatory requirements. However, in principle, Ofgem sees some merit in the suggestion by some respondents of moving away from mandatory requirements on all generators (non-synchronous and synchronous) for the provision of ancillary services.

5.9. Although, on the basis of existing cost and other technical data, it appears that the implementation of the proposed Grid Code modifications is efficient, a more flexible market based arrangement may prove more efficient, flexible and appropriate over the longer-term as new technologies emerge and/or existing technologies mature. Ofgem considers that such an approach would depend on the development of a mechanism for charging generators on a cost reflective basis the costs NGC incurs in procuring additional ancillary services from other sources, in the event that generators chose not to have the capability to provide ancillary services. Obviously, any such proposals would require some work and assessment to establish whether this is feasible for any/all of the current mandatory requirements.

5.10. Given the suggestion of some respondents, Ofgem intends to discuss with NGC and the other GB transmission licensees ways in which further discussions and

[14] CAP047: "Introduction of a competitive process for the provision of Mandatory Frequency Response" Alternative Amendment A.

analysis could be facilitated to consider the feasibility of removing mandatory requirements on all generators to provide ancillary services and replacing these with cost reflective market based arrangements.

6. Main impacts and affected parties

6.1. This chapter outlines the main impacts of the proposed Grid Code modifications, if approved by the Authority, and the parties that Ofgem considers to be affected by them. Ofgem welcomes any responses to this assessment of the main impacts and affected parties as discussed in this section.

6.2. The parties affected by the proposed Grid Code modifications can be divided into two groups:

- those directly affected, in particular parties wishing to connect generation and existing generation already bound by the Grid Code, and
- those indirectly affected, such as equipment manufacturers and operators of generators that are not required to comply with the Grid Code or any other (non-generation) parties connected to the transmission network, such as DNOs and consumers.

Impact on directly affected parties

6.3. The parties that could be directly affected by the proposed Grid Code modifications are:

- existing conventional synchronous generators
- existing non-synchronous generators (such as wind turbines)
- existing DC Interconnectors
- committed and planned conventional synchronous generators
- committed and planned generators using new generation technologies such as non-synchronous wind generation, and
- committed and planned DC Interconnectors.

Existing conventional synchronous generation

6.4. The only proposed change to the Grid Code that could affect existing synchronous generators relates to FRT. FRT is the ability of a generator to remain connected to a network in the event that a fault occurs on the system and is subsequently cleared by protection. The existing grid codes do not contain an explicit requirement for FRT as it is generally accepted that synchronous generators have this ability; a case supported by their operational history. The requirement for FRT is now proposed to ensure that non-synchronous generators also have this ability (most early wind turbine designs were vulnerable to disconnection from the system owing to short voltage depressions caused by grid faults). For consistency, and to avoid discrimination between different classes of generators, NGC and the STL have applied the FRT requirement to both synchronous and non-synchronous generators.

6.5. Ofgem understands that the new FRT requirements can be met by synchronous generators without modification or any kind of change in their operation. Ofgem also understands that it is not the intention of the licensees that the introduction of the new connection conditions should have any significant impact on existing generators. If cases are identified where this is not the case Ofgem and the appropriate licensee will work together to address them. Ofgem therefore considers that accepting the proposals would have no impact on existing conventional synchronous generators.

Existing non-synchronous generators

6.6. Currently the grid codes contain no explicit connection requirements for non-synchronous generators. The proposals define specific requirements for non-synchronous generators, a number of which apply regardless of completion date (i.e. parties bound by the Grid Code will be obliged to comply from date of implementation).

6.7. Ofgem understands that it is not the intention of the licensees that the introduction of the new connection conditions should have any significant impact on existing generators. If cases are identified where this is not the case Ofgem and the appropriate licensee will work together to address them.

Existing DC interconnectors

6.8. The proposed obligations on DC interconnectors will only apply to those with a completion date after 1st Jan 2004. They therefore do not impact any of the existing DC interconnectors in GB.

Committed and planned conventional synchronous generators

6.9. As discussed above for currently operating synchronous generators, the only new requirement for committed and planned synchronous generators relates to FRT.

6.10. Ofgem understands that the new requirements are within the capability of synchronous generators discussed in 6.4. Ofgem considers that accepting the proposals would have no significant impact on committed and planned synchronous generation and Ofgem understands that this is the intention of the licensees.

Committed and planned generators using new non-synchronous generation technologies

6.11. This section discusses the effects of the proposals on committed and planned non-synchronous generation technologies. The new technical requirements for non-synchronous generators and the cost of meeting them are discussed in Section 7.

6.12. It is Ofgem's understanding that it is not the intention of the licensees that the introduction of the new connection conditions should have any significant impact on generators that have signed Connection Agreements but are yet to be connected. If cases are identified where this is not the case Ofgem and the appropriate licensee will work together to address them.

6.13. For parties currently negotiating connections, it is Ofgem's understanding that all such parties have been informed by the licensees that connection offers will be based on the SA/2004 or H/04 proposals. If Ofgem's final decision approves these proposals there should therefore be no material impact on the parties currently negotiating connections.

6.14. It is recognised that developers/owners of non-synchronous generators bound by the proposed Grid Code changes will be at some operational risk. This is because compliance with certain Grid Code provisions cannot be proven at commissioning. This risk exists to some extent with all plant but it can be argued that it is somewhat greater for plant that is still being developed to improve its performance. The compliance process that the transmission licensees apply reduces this risk as far as is practical but does not eliminate it. Ofgem is of the view that, in the case of renewable generation, the ROC mechanism is an appropriate way of compensating for the higher costs and risks associated with these generating technologies. It would not be appropriate for the transmission licensees to effectively provide a further subsidy by the relaxation of the connection requirements.

Committed and planned DC interconnectors

6.15. Ofgem is not aware of any material impacts on future DC Interconnectors that will result from these proposals.

Impact on indirectly affected parties

Generator manufacturers

6.16. The impact of the proposed Grid Code modifications on generator manufacturers is dependent on the type of generator manufactured, conventional synchronous generators or non-synchronous generators (such as wind turbines) and the overall design of a PPM.

6.17. For manufacturers of conventional synchronous generators the proposed Grid Code requirements present no effective change. Ofgem considers that there is therefore no material affect on manufacturers of conventional synchronous generators.

6.18. For manufacturers of non-synchronous generators the proposals place more technically challenging performance requirements on their products. However, it can be argued that a benefit of introducing the proposed Grid Code

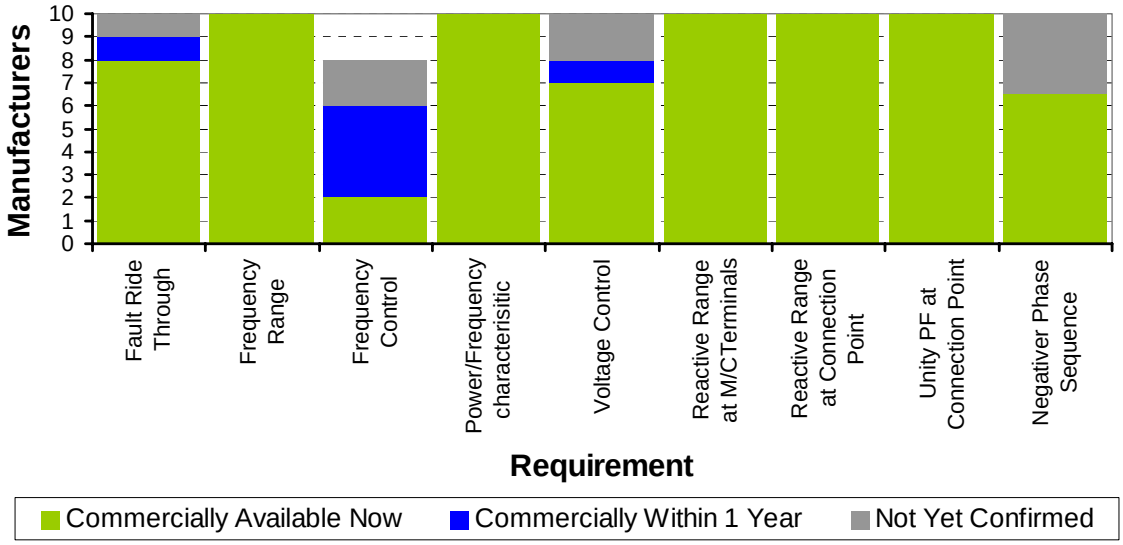
requirements for non-synchronous generators is that they achieve more technical clarity and certainty for developers and manufacturers.

6.19. It must be stressed that the proposed Grid Code requirements refer to the point of connection to the grid (or the distribution network where appropriate). It is therefore the overall design of the PPM that has to meet the requirements. Although the wind turbine generator is the most significant component of a PPM, auxiliary plant may be incorporated in the PPM design to meet the Grid Code requirements.

6.20. The recent consultation process included a series of meetings between the licensees, the leading manufacturers and Ofgem. Through this process, the manufacturers confirmed that the technology required to meet the proposals is currently available or soon will be, although at some increase in cost. Figure 1, produced by the licensees and included in their consultation reports (agreed by the manufacturers for publication) shows a summary of the current and future ability of manufacturers to meet the proposed Grid Code requirements[15].

[15] Note that this survey was conducted in February of 2004 and therefore does not relate precisely to the H/04 and SA/2004 proposals. However, the H/04 and SA/2004 proposals take account of the comments made by the manufacturers during the consultation process.

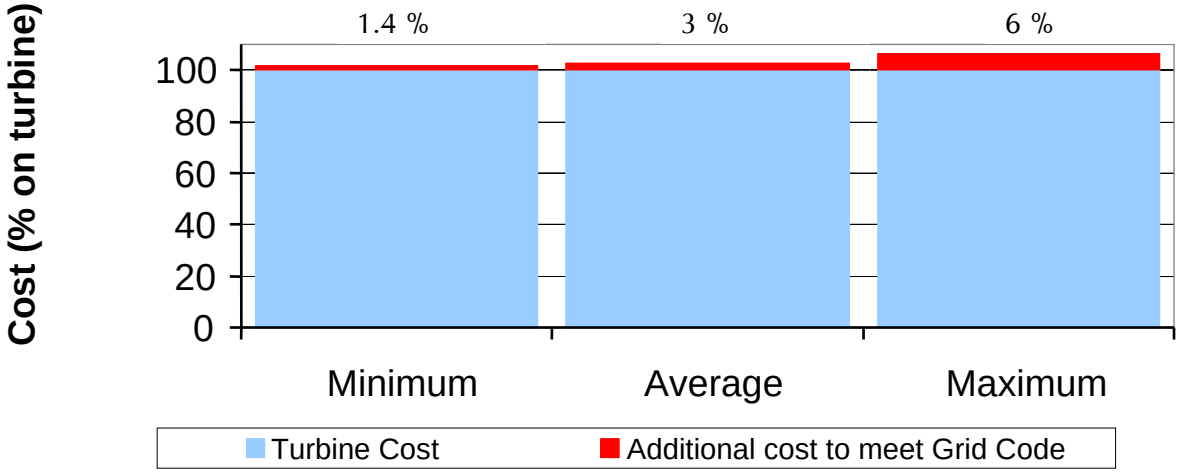
Figure 1 Manufacturers' ability to meet proposed Grid Code requirements



6.21. The increased cost of meeting the Grid Code proposals is estimated to add between 1.4% – 6% to the turbine cost as shown in Figure 2. This data was also derived from the discussions with manufacturers and presented in the licensees' consultation reports. As the turbines represent less than half the total cost of a windfarm these figures will reduce proportionately for the total installed cost.

6.22. It must be accepted that some manufacturers may not be able to produce fully compliant machines in the timescales indicated here. It is possible therefore that the introduction of the proposed Grid Code changes restricts to some degree the supplier base for wind turbines. Based on the evidence produced by the licensees this would seem to be a small risk but one that cannot be fully discounted.

Figure 2 Additional cost of wind turbines to meet all requirements of the proposed gird code changes



6.23. SKM has compared the proposals (H/04 and SA/2004) to the equivalent connection requirements being introduced in the grid codes of other countries/grid systems. This study examined the grid codes of E.ON in Germany (part of a larger, electrically stronger system than in GB) and ESB in Ireland (an island system comparable to GB but electrically much weaker). The study showed that NGC's and the STL's proposals are consistent with the equivalent technical requirements that apply in these contrasting systems.

Other network users

6.24. There are a number of other grid users who could be indirectly affected by the proposed changes. These include:

- the 14 Distribution Network Operators (DNOs)
- grid connected industrial users, and
- embedded generators not bound by the Grid Code.

6.25. As the proposals make very little if any changes to the operation or the performance of the transmission system as seen by these parties it is Ofgem's view that accepting the proposals will have no impact on these parties.

Security of supply

6.26. The transmission licensees maintain that the proposed changes to the grid codes represent the minimum obligations necessary to be placed on generators in order for them to meet their licence obligations relating to security of supply when taking account of the predicted increase in the capacity of wind generation connected to the GB network.

6.27. Ofgem considers that accepting the proposed modifications will have no negative impact on security of supply and will allow NGC to meet its licence obligations in respect of maintaining security of supply by including specific provisions for non-synchronous generators and other new generation technologies.

The Environment

6.28. The Government's energy policy was outlined in the Energy White Paper published in 2003. This outlined four goals for energy policy: one of which was to put the UK on a path to reduce CO_2 emissions by 60% by 2050, with real progress by 2020.

6.29. To support this goal the Government has set a target of 10% of UK electricity to be supplied from renewable generators by 2010 and an aspiration to double this by 2020. The Renewables Obligation is designed to achieve this target by providing support for renewable generators. For 2004 the target for renewable electricity is 4.9% and this increases every year to reach 10.4% in 2010. The Obligation provides support for a number of renewable technologies; however, it is expected that wind generation will be the highest growth area. This section examines the potential impact on the environment of the introduction of the proposed grid codes changes.

6.30. The proposed Grid Code changes are not expected to have any direct impact on synchronous generators (which are mainly fossil-fuelled generators). They will however have an indirect effect resulting from their impact on new renewable generating capacity and its operating regime.

6.31. The modifications are expected to directly impact non-synchronous generators, which, in the short to medium term are likely to be mainly wind turbines.

6.32. As stated earlier in this IA, it is not the intention of the licensees for there to be any significant impact on the existing wind farms. The majority are currently exempted from the Grid Code due to their small size and/or as result of being embedded.

6.33. However, potential future developments that may be affected would be wind farms having a capacity that requires them to comply with the Grid Code and any licence exempt generator that is required to enter into a Licence Exempt Generator Agreement (LEGA). Currently, the largest onshore wind farms have a capacity of around 60MW. Larger wind farms, which will have to comply with the Grid Code, are expected to be commissioned in the next few years, predominantly offshore. All but one of the proposed fifteen Round 2 offshore wind farms will have an installed capacity of over 100MW with the largest envisaged to be 1,200MW. The Grid Code modifications may have an impact on these future developments.

6.34. The environmental impact of the Grid Code proposals should be considered in a number of stages. Firstly, it has to be judged whether the proposals will affect the rate of growth of renewable generation. Having done this, the overall emissions can be estimated knowing the capacity mix and likely operating regime.

6.35. Taking the rate of growth issue first, the rate of applications for the connection of wind generation, which are being made in the knowledge that the connection requirements are being developed, suggests they will not have a material negative impact. In fact, the reduced connection constraints and higher prospective load factors that could result from making wind generators more 'grid friendly' may actually increase the growth of capacity.

6.36. On the assumption that the effect on capacity growth rate is neutral, we can turn to operational aspects. The major issue here is security of supply and Fault Ride Through capability. If new wind generators cannot offer this capability then

NGC will in certain situations need to schedule more reserve plant to ensure that it meets its operational security standards. This could have a threefold impact:

- firstly, the provision of spinning reserve adds an additional fuel cost as the conventional plant runs at a lower efficiency
- secondly, the substitution of wind generation for conventional generation will add a fuel cost when it may be necessary to curtail wind generation to ensure system stability, and
- thirdly, part loading more generators and curtailing wind generation increases CO_2 emissions.

6.37. Work by the Centre for Distributed Generation and Sustainable Electrical Energy[16] to quantify the value of providing FRT capability has examined a number of scenarios. Taking a 10GW wind scenario as an example, if 5% of this capacity is at risk to supergrid faults, in addition to the 1320MW of conventional generation normally planned for, the additional annual cost of reserve would be between £14 million and £21 million. If 30% is at risk (where wind generation would not have fault ride through) the additional annual reserve costs were found to be between £106 million and £155 million. Additional CO_2 emissions were estimated to vary between about 0.5Mt and 4.5Mt.

Summary of key impacts and affected parties

6.38. Ofgem acknowledges that in accepting the proposed Grid Code modifications the cost of wind turbines may be increased by between 1.4%- 6% although this is likely to reduce in the future due to technological improvements and economies of scale. Ofgem is not currently aware of any other impacts or parties who are adversely affected by accepting the proposed Grid Code modifications.

[16] Centre for Distributed Generation and Sustainable Electrical Energy, (2004) *"Value of fault ride through capability of wind generation in the UK"*

6.39. In summary, the primary negative impacts of adopting the changes are the increased cost of wind turbines and the potential restriction of the supplier base for compliant machines. The important positive impacts are that overall system security will be assured, constraints on the connection and operation of wind generators will be reduced as will overall CO_2 emissions.

7. Costs

7.1. This section contains a summary of the estimated cost to the industry of accepting the proposed Grid Code modifications and the alternative options. Ofgem welcomes views on the analysis discussed in this section.

Cost of accepting the proposals

7.2. Ofgem's current view is that the only cost of accepting the proposals is the increase in the overcall cost of PPMs to meet the requirements.

7.3. Manufacturers of wind turbines have provided information to NGC indicating that the cost of wind turbines would be increased by between 1.4%-6% in order to meet all the requirements of the proposals.

7.4. Assuming a capital cost of £800/kW for a PPM the increased capital cost of meeting all the proposed Grid Code modifications is between £6–£24/kW (assuming the turbine cost is no more than 50% of the total cost).

Cost of rejecting the proposals

7.5. In order for NGC to maintain security of supply under a scenario of high wind generation development and assuming that the new generation is not able to meet the performance requirements in the proposed Grid Code (particularly FRT) NGC would have to procure more reserve to cover a risk higher than currently covered[17].

7.6. NGC has advised Ofgem that the incremental cost of response increases with the value of response held. At 1320MW, the incremental cost is around £60/kW/yr. At 2000MW, this increases to around £86/kW/yr and at 3000MW, NGC estimates approximately £140/kW/yr. Using the lowest cost quoted here a

[17]The largest loss of power in-feed that is planned for on the GB system is presently set at 1320 MW

simple estimate of the present value of the cost of reserve over the lifetime of a wind farm can be made. This is intended for illustration only.

7.7. Assuming that the annual average output from wind generation is 30% of the installed capacity and using a 25% wind power loss factor (WPLF)[18], each kW of plant unable to meet the proposals would give rise to additional risk of 0.075 kW of generation loss, to be covered by additional reserve. Assuming each kW of generation at risk requires 1 kW of additional reserve and assuming the cost of additional reserve is £60/kW/yr, each kW of non-compliant plant would require an additional £4.5/yr of additional reserve to be procured. The corresponding capitalised value (obtained by using a net present value calculation) is £48/kW (using a discount rate of 7% over a period of 20 years). This is significantly higher than the total additional capital cost of manufacturing wind turbines, which meet all proposed Grid Code changes.

Additional analysis

7.8. The Centre for Distributed Generation and Sustainable Electrical Energy has produced a report titled "Value of fault ride through capability of wind generation in the UK[19]". This report describes a detailed study of the cost of providing reserve as simply described above.

7.9. The analysis is conducted (using a model of a system primary response) on the additional cost of providing reserve to cover different percentages of wind generation which do not have FRT ability. A number of year round simulations were used to capture variations in wind and demand.

7.10. One of the conclusions is that "Overall, the work carried out clearly demonstrates that, if a significant amount of wind generation with relatively low robustness is to be installed (with more than 10% of wind generation output contributing to the maximum credible loss), this would lead to a very considerable increase in system costs. These additional costs would be

[18] Percentage of wind generation output that could be lost as result of not having FRT ability
[19] Available at www.sedg.ac.uk

significantly higher than the expected cost of engineering necessary to provide fault ride through capability. The results of the studies performed suggest that requiring sufficient fault ride through capability for large wind farms would be economically efficient".

Summary of cost analysis

7.11. Ofgem's analysis (although based on a number of assumptions) shows the cost of providing reserve just to cover for FRT non-compliant plant to be significantly higher than total the additional capital cost of manufacturing wind turbines which meet all proposed Grid Code changes.

7.12. Ofgem's view is supported by the Centre for Distributed Generation and Sustainable Electrical Energy.

8. Benefits

8.1. This section contains the summary of Ofgem's view of the benefits of accepting the proposals or adopting either of the alternative options. Ofgem welcomes views on the benefits of the various options.

Benefit of accepting the proposals

8.2. Ofgem considers the key benefits of accepting the proposals are:

- increases the amount of wind generation that can be connected to the grid without affecting security of supply and helping the Government's targets for renewable generation to be achieved
- by making the requirements clear and transparent it reduces uncertainty for wind generator manufacturers and developers
- removes the need for a case by case assessment of new wind generation
- avoids any discrimination between different classes of generators, and
- allows the licensees to meet their licence conditions.

Benefits of rejecting the proposals

8.3. Ofgem does not believe that there are benefits in rejecting outright the proposals. This course of action would cause a great deal of uncertainty for manufacturers, developers and the licensees. The licensees would have to interpret their licence obligations on a case-by-case basis. Connecting parties would have to enter bilateral negotiations with a transmission licensee for each application. The manufacturers would not be able to design their products to a common standard. This is not considered to be beneficial to any of the interested parties.

Benefits of modifying the proposals

8.4. The extended period of consultation that Ofgem initiated has resulted in a number of modifications being made to the original proposals submitted by the licensees to Ofgem. In addition, following a review of this GB Grid Code drafting by Ofgem and its technical consultants (SKM), a number of points of detail were raised by Ofgem with NGC. NGC gave careful consideration to comments made and as a result has now produced further Supplementary Changes to the GB Grid Code drafting that they support.

8.5. In reaching its 'minded to' decision, Ofgem has taken the view that an acceptable point has been reached in the development of the proposals (including the Supplementary Changes) and that further modification is not required. Ofgem will however take account of the responses to this IA and its 'minded to' decision letter before making its final decision.

9. Conclusion

9.1. There is a general agreement in the industry (Forum discussions confirmed that all affected parties support this view) that changes to the GB Grid Code to include wind generation are required as the original drafting of the GB Grid Code made the implicit assumption that all generators connecting to the transmission system would be synchronous plant.

9.2. Ofgem is therefore minded to agree that the GB Grid Code needs to be updated to recognise explicitly the particular characteristics of non-synchronous generating plant that parties are now seeking to connect to the transmission system at an increasing rate.

9.3. Ofgem has assessed the impacts of NGC's and the STL's proposed changes (including the Supplementary Changes) to the GB Grid Code and found there to be no significant adverse impacts on generators currently connected to the network or those having signed connection agreements. Those parties that are in the process of negotiating connection agreements have been advised of the development of these Grid Code proposals. No other parties connected to the grid are affected.

9.4. Ofgem's consultant, SKM, has supported the licensees' proposals and the comments made by them have been responded to constructively.

9.5. Ofgem acknowledges that accepting the proposals will, at least in the short-term, increase the cost of wind turbines (which are required to meet the GB Grid Code) by up to 6%. It could also restrict the supplier base able to produce fully compliant machines. However, the benefits of a more secure grid system and the ability to allow higher penetrations of wind generation are judged to outweigh these disadvantages.

9.6. The high level cost benefit analysis conducted by Ofgem supported by the detailed study conducted independently by the Centre for Distributed Generation and Sustainable Electrical Energy shows that the increased cost of compliant generators is likely to be significantly less than the additional system costs of procuring additional ancillary services to secure the system.

9.7. In conclusion therefore this IA is supportive of Ofgem's 'minded to' decision letters relating to the H/04 and SA/2004 Reports to the Authority.