

Stage 02: Industry Consultation

Grid Code

GC0050 Demand Control And OC6

What stage is this document at?

01	Workgroup Report
02	Industry Consultation
03	Report to the Authority

This proposal seeks to modify the Grid Code to meet the existing capabilities and requirements of the Distribution Network Operators to implement Demand Control Instructions

This document is open for Industry Consultation. Any interested party is able to make a response in line with the guidance set out in Section 5 of this document.

Published on: 30 January 2014
Length of Consultation: 20 Working Days
Responses by: 28 February 2014

	National Grid recommends: That the technical requirements are taken forward for Industry Consultation as they better facilitate National grid's development and operation of the Transmission System.
	High Impact: Network Operators.
	Medium Impact: None identified
	Low Impact: None identified

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Any Questions?

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About this document

This Industry Consultation outlines the information required for interested parties to form an understanding of a defect within the Grid Code seeks the views of interested parties in relation to the issues raised by this document.

Parties are requested to respond by **28 February 2014** to:

grid.code@nationalgrid.com

Document Control

Version	Date	Author	Change Reference
1.0	30 January 2014	National Grid	Final Industry Consultation

GC0050 Industry
Consultation

30 January 2014

Version 1.0

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1 Executive Summary

- 1.1 GC0060 was raised following the submission of The Grid Code paper (pp11/02) on “Demand Control and OC6” (Annex 2). This paper described the existing Distribution Network Operators (DNOs) capability, and put forward the benefits for customers of using Voltage Reduction as a means of reducing the demand on the transmission system. This paper proposed a revision of the Grid Code obligations relating to Demand Control OC6.
- 1.2 The GCRP recommended that a Grid Code Workgroup be established to consider the issues further and relevant Terms of Reference (ToR) (Annex 3) were agreed in September 2012.
- 1.3 The Workgroup has reviewed the requirements of the Grid Code OC6 and recommends that:
 - Changes to the Grid Code identified in Annex 1 should be implemented. The objective of these changes is to explicitly distinguishing between Voltage Reduction and Demand Disconnection services, and to clarify the implementation timescales.
 - Annual Voltage Reduction tests should be carried out by each DNO to confirm the demand reduction achievable via Voltage Reduction. These tests will be coordinated by National Grid.
 - DNO and Electricity National Control Centre (ENCC) procedures and documentation are reviewed, and any required changes implemented, to clarify that where a DNO makes Voltage Reduction services available to National Grid, the Demand Control instruction clearly states whether it requires a DNO to implement Voltage Reduction or Demand Disconnection.
 - The Week 24 Guidance Document published by National Grid to provide guidance to DNOs is updated to reflect the changes in the Grid Code OC6.

2 Why Change?

- 2.1 The GCRP paper (pp11/02) summarised the existing DNO capability in terms of the delivery of Demand Control implemented by Voltage Reduction.
- 2.2 The historic expectation has been that a 3% Voltage Reduction would deliver a demand reduction of 5%. The current drafting of the Grid Code requires a 5% reduction in demand to be delivered by the DNO within 5 minutes of receiving the instruction from National Grid. Studies carried out in 2008 suggested that a 5% Voltage Reduction was likely to deliver a 3% reduction in demand, but more recent assessments showed that a 3% Voltage Reduction is likely to deliver only 1.5% reduction in demand and that this would be delivered within a 10 minute period.

Background

- 2.3 The Grid Code obligations relating to Demand Control are documented in OC6.5. OC6.5.3 specifies the functional requirements of the scheme:
- 2.4 OC6.5.3
 - (a) Whether a National Electricity Transmission System Warning – High **Risk of Demand Reduction** or **National Electricity Transmission System Warning - Demand Control Imminent** has been issued or not:-
 - (i) provided the instruction relates to not more than 20 per cent of its total **Demand** (measured at the time the **Demand** reduction is required); and
 - (ii) if less than that, is in four integral multiples of between four and six per cent, each **Network Operator** will abide by the instructions of **NGET** with regard to **Demand** reduction under OC6.5 without delay.
 - (b) The **Demand** reduction must be achieved within the **Network Operator's System** as far as possible uniformly across all **Grid Supply Points** (unless otherwise specified in the **National Electricity Transmission System Warning - High Risk of Demand Reduction**) either by **Customer** voltage reduction or by **Demand Disconnection**, as soon as possible but in any event no longer than five minutes from the instruction being given by **NGET**.
- 2.5 The GCRP paper pp11/02 highlighted that most DNOs plan to achieve the Grid Code requirements by a combination of Voltage Reduction and Demand Disconnection. In relation to Voltage Reduction, there are two factors associated with the requirement i.e. demand reduction achieved (which in practice is likely to be less than previously expected) and the implementation time (which in practice is likely to be longer than as currently defined in the Grid Code).

3 Solution

- 3.1 The proposed solution is to amend OC6.5 and OC6.7 to explicitly distinguishing between Voltage Reduction and Demand Disconnection services, and to improve clarity with regard to the implementation timescales.
- 3.2 The text required to give effect to the proposal is contained in Annex 1 of this document.
- 3.3 Annual Voltage Reduction tests should be carried out by each DNO to confirm the demand reduction achievable via Voltage Reduction. These tests will be coordinated by National Grid.



Purpose & Scope of Workgroup

- 4.1 At the September 2011 GCRP, Alan Creighton presented pp11/02 which provided additional clarity on the effectiveness of the Voltage Reduction schemes deployed by most DNOs, identified the customer benefits of using Voltage Reduction as a means of delivering Demand Control and suggested a possible change to the drafting of OC6.5. The GCRP agreed that a Workgroup should be established to examine implementation timescales for Demand Control instructions.
- 4.2 The GCRP agreed that this issue required further investigation and approved the Terms of Reference.
- 4.3 The Workgroup met five times over the period between 05 December 2012 and 21 November 2013 where the following topics were discussed

Grid Code Requirements in relation to OC6 and Demand Control

- 4.4 The Workgroup focused on Section OC6.5 of the Grid Code that allows National Grid to instruct DNOs to reduce demand by up to 20% in four stages, or under certain circumstances up to 40% in 8 stages. Each stage is nominally 5% to be delivered within 5 minutes of instruction. This facility is only used under extreme conditions when all available sources of generation have been exhausted and the only option available to balance the system is to reduce demand.
- 4.5 Discussions commenced around Demand Control and whether this can be achieved either through Voltage Reduction or the disconnection of customer demand. It has historically been assumed that the first two Demand Control stages can be achieved through Voltage Reductions with a 3% Voltage Reduction providing a 5% demand reduction, and a 6% Voltage Reduction providing a 10% demand reduction. Further demand reduction would require direct disconnection of customer demand.
- 4.6 Further discussions focused on the requirements within Grid Code OC6.5.3 which states that Demand Control should be implemented as soon as possible but no longer than five minutes from the instruction being given by National Grid.
- 4.7 Uncertainty was expressed over where the five minutes timescale originated. One thought was that the requirement was originally worded as 'promptly', meaning the time taken for the DNO to receive the instruction and respond. Other thoughts were that the five minutes timeframe comes from the same root as five minute reserve, in that it's the point in time when National Grid can reasonably expect to implement manual action following on from the implementation of primary response (10 seconds) and secondary response (30 seconds to 30 minutes) to ensure that the system frequency is restored back within operational limits. Manual intervention is required when there is no further reserve service that can be called upon.
- 4.8 The Workgroup reached a view that not enough was known about the ability of Voltage Reduction to reduce demand and the timescale taken to implement it.

Timeline

Workgroup Meeting

Dates

- M1 – 05 December 2012
 - M2 - 01 February 2013
 - M3 - 10 April 2013
 - M4 - 30 May 2013
 - M5 - 21 November 2013
-

Voltage Reduction

- 4.9 The Workgroup discussed that Voltage Reduction is implemented at DNO primary substations and that the implementation time with modern SCADA systems is probably faster than in the past.
- 4.10 Alan Creighton summarised the paper that had been presented to the GCRP (pp11/02) to the Workgroup explaining DNOs positions around Demand Control being implemented with five minutes, and investigations on the timing of each of the steps that need to be taken to implement Voltage Reduction. The following points were discussed:
- The historic expectation was that a 3% Voltage Reduction would deliver a demand reduction of 5%; however studies in 2008 had indicated that the demand reduction for a 3% Voltage Reduction was variable, and more likely to be in the region of 3%.
 - The Grid Code is drafted to require 5% reduction in the demand on the system at the time at which the instruction is given and this also introduced a degree of uncertainty around what would actually be delivered.
 - The information collated by the DNO's suggested that one DNO might be able to deliver a 3% Voltage Reduction within five minutes, however it was agreed that in general demand reduction is more likely to be delivered in a period between 5 and 15 minutes. The paper illustrated that all DNOs cannot achieve this 5 minute timescale and it was suggested by the DNOs that implementation of a Voltage Reduction instruction within five minutes has never actually been achievable..
- 4.11 The Workgroup agreed that the key advantage of Voltage Reduction as a means of Demand Control was that it generally has no observable impact on domestic, industrial or commercial customers and in particular does not result in disconnection of customer supplies. It was generally accepted that because of this Demand Control via Voltage Reduction, is a valuable tool that can be used in a system event to reduce the prospects of implementing Demand Control via Demand Disconnection. The key to its value is to understand the demand reduction that it is likely to deliver, the timescales in which that reduction can be delivered and how it should be used in conjunction with other demand management tools available to National Grid.
- 4.12 The Workgroup also debated feedback following internal discussions within National Grid concerning Voltage Reduction / Demand Disconnection requirements. The National Grid Electricity National Control Centre's (ENCC) view was that the 5 minute timescale from instruction by National Grid is a requirement based on being able to stabilise and secure the National Electricity Transmission System in emergency situations. This was based on an assumption of the initial time required to analyse incidents and instigate manual actions which would take 5 minutes, leading to a total implementation time of 10 minutes. It was considered that timescales greater than 10 minutes from an initial incident could place the system at increased risk. However, the ENCC accepted that they could relax this requirement to 10 minutes if the majority of available Voltage Reduction was delivered within 5 minutes.

4.13 Much of the discussion and suggestions at this point had been based on assumptions, as little or no testing has taken place in this area. The Demand Control response has never been formally tested (as black start is); it has only been used on relatively rare occasions, when actually required, to secure the system. It was highlighted that a benchmarking exercise with all DNOs could be beneficial.

Emergency STOR

4.14 In light of the above debate, emergency STOR was discussed. National Grid's current tender volumes equate to around 6GW of which 2.8GW is presently contracted. STOR generation available in the market which is capable of running within the implementation timescale totals less than 50MW/hr which is far below the emergency requirement. On a peak demand day, as a worst case scenario, this would only equate to a small proportion of the 20% of overall demand (60GW) needed in an emergency situation.

4.15 It was agreed by the Workgroup that STOR has potential to be part of the solution and the idea of emergency STOR is worth pursuing within other forums where National Grid participate, but not the whole answer for the demand control requirements of the Workgroup.

Review of Current Processes

4.16 The Workgroup discussed an option of explicitly separating the Voltage Reduction and Demand Disconnection elements of the present OC6 obligation such that these services could be called upon separately by National Grid depending on the rate at which a system incident develops; Voltage Reduction could be used in a slower developing incident (as this would take longer to implement and deliver a less certain demand reduction). Demand Disconnection however, could be used in a rapidly developing incident (as it would be implemented quicker and deliver a more certain demand reduction – although customer supplies would be interrupted). On the basis that the two Voltage Reduction stages were (at the time of the discussion) thought likely to deliver say 3% Demand Reduction each, to maintain the existing OC6 functionality of 20% Demand Reduction, this would require three 5% Demand Disconnection stages. In summary:

- VR Stage 1 - 3% Voltage Reduction¹
- VR Stage 2 - 3% Voltage Reduction
- DD Stage 1 – 4-6% demand reduction via Demand Disconnection
- DD Stage 2 – 4-6% demand reduction via Demand Disconnection
- DD Stage 3 – 4-6% demand reduction via Demand Disconnection

4.17 Following discussion, it was agreed that Voltage Reduction stages should be substantially implemented within ten minutes of instruction from National Grid. Demand Disconnection stages should be completed within five minutes of instruction from National Grid.

¹ As a result of the voltage reduction tests, 3% is more likely to be 1.5%

Implementation Procedures

- 4.18 The Workgroup discussed the merits of an educational process with a familiarisation of Demand Control implementation procedures to identify where any improvements could be made prior to any national testing. DNOs and National Grid reviewed the existing processes and made some minor procedural updates before the formal exercise took place.
- 4.19 DNOs and National Grid reviewed current procedures for managing a system event (rather than specifically implementing a demand reduction instruction which is discussed earlier), and the existing information that might be available such that DNOs could be made more aware of an unfolding incident so that they were better prepared to respond to a Demand Control instruction if it was issued. DNOs asked whether National Grid could share the document which is used in this situation, suggesting that this document should be very high-level and include process diagrams to clearly define procedures and management approvals. National Grids internal process was presented at the Working Group meeting 2.

European Codes

- 4.20 The Workgroup discussed potential changes required to comply with European Code changes. Currently there are no code requirements covering Demand Reduction criteria. There is reference in Article 7, Frequency Control Management, of the Network Code for Operational Security requiring that “Each TSO shall implement the necessary Remedial Actions, including Demand Side Management or Load Shedding in order to maintain the frequency quality within Operational Security Limits in its Responsibility Area.”

Voltage Reduction Testing

- 4.21 The Workgroup discussed that a trial would enable the actual demand reduction delivered by a 3% Voltage Reduction to be established. The tests were carried out during different load windows, morning (10:00am-12:00pm) and afternoon (14:00pm-16:00pm) during periods of relative flat demand. Results from these tests can be found in Annex 4.

Workgroup Report

- 4.22 A copy of the full Workgroup Report can be found on the National Grid website at:

<http://www2.nationalgrid.com/UK/Industry-information/Electricity-codes/Grid-code/Modifications/GC0050/>

Workgroup Recommendations

- 4.23 The Workgroup recommend that the changes to the Grid Code identified in Annex 1 should be progressed to Industry Consultation. The objective of these changes is to explicitly distinguishing between Voltage Reduction and Demand Disconnection services, and to improve clarity with regard to the implementation timescales.
- 4.24 The Workgroup recommend that annual Voltage Reduction tests should be carried out by each DNO to confirm the demand reduction achievable via Voltage Reduction. These will be coordinated by National Grid.
- 4.25 The Workgroup recommend that DNO and ENCC procedures and documentation are reviewed, and required changes implemented, to clarify that where a DNO makes Voltage Reduction services available to National Grid, the Demand Control instruction clearly states whether it requires a DNO to implement Voltage Reduction or Demand Disconnection. These changes should take effect upon implementation of Grid Code changes identified in Annex 1.
- 4.26 The Workgroup recommend that the Week 24 Guidance Document published by National Grid to provide guidance to DNOs is updated to reflect the changes in 6.1. In particular this will require a minor revision to section 4.2 and the proforma Table 12B provided by National Grid. These changes should take effect upon implementation of Grid Code changes identified in Annex 1.

5 Impact & Assessment

Impact on the Grid Code

- 5.1 GC0050 requires amendments to the following parts of the Grid Code:
- OC 6.5
 - OC 6.7
- 5.2 The text required to give effect to the proposal is contained in Annex 1 of this document.

Impact on National Electricity Transmission System (NETS)

- 5.3 The proposed changes will enhance the economic and efficient operation of the National Electricity Transmission System. The changes will clarify achievable timescales and levels of demand reduction enabling the ENCC to better manage demand control procedures.

Impact on Grid Code Users

- 5.4 The proposed modification will change the DNOs current operational practices hence the impact is high on Grid Code Users.

Impact on Greenhouse Gas emissions

- 5.5 The proposed modification will not have any impact on Greenhouse Gas emissions.

Assessment against Grid Code Objectives

- 5.6 National Grid considers that implementing the GC0050 recommendations would better facilitate the Grid Code objective:

- (i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;

This proposal better facilitates this objective by providing the information required to better manage the transmission system for the purposes of operating the transmission system in an emergency situation.

- (ii) to facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity 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);

The proposal has a neutral impact on this objective

- (iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and

The proposal better facilitates this objective by providing the information required to manage the transmission system.

- (iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.

The proposal has a neutral impact on this objective

Impact on core industry documents

5.7 The proposed modification does not impact on any core industry documents.

Impact on other industry documents

5.8 The proposed modification does not impact on any other industry documents.

Implementation

5.9 National Grid proposes GC0050 should be implemented by Week 17 2014 or 10 business days after an Authority decision.

5.10 This will allow time for the DNO to establish and implement additional Demand Disconnection stage if required and include the revised information in the 2014 Week 24 submission.

5.11 Views are invited on this proposed implementation date.

6 Consultation Responses

6.1 Views are invited upon the proposals outlined in this consultation, which should be received by **28 February 2014**.

Your formal responses may be emailed to:

grid.code@nationalgrid.com

6.2 Responses are invited to the following questions:

- (i) Do you support the proposed implementation approach?
- (ii) Do you believe that GC0050 better facilitates the appropriate Grid Code objectives?
- (iii) Do you have any further comments?

6.3 If you wish to submit a confidential response please note the following:

- (i) Information provided in response to this consultation will be published on National Grid's website unless the response is clearly marked "Private & Confidential", we will contact you to establish the extent of the confidentiality. A response marked "Private and Confidential" will be disclosed to the Authority in full but, unless agreed otherwise, will not be shared with the Grid Code Review Panel or the industry and may therefore not influence the debate to the same extent as a non confidential response.
- (ii) Please note an automatic confidentiality disclaimer generated by your IT System will not in itself, mean that your response is treated as if it had been marked "Private and Confidential".

Annex 1 - Proposed Legal Text

This section contains the proposed legal text to give effect to changes identified by the Workgroup. The proposed new text is in red and is based on Grid Code Issue 5 Revision 1.

OC6.5 PROCEDURE FOR THE IMPLEMENTATION OF DEMAND CONTROL ON THE INSTRUCTIONS OF NGET

OC6.5.1 A **National Electricity Transmission System Warning - High Risk of Demand Reduction** will, where possible, be issued by **NGET**, as more particularly set out in OC6.5.4, OC7.4.8 and BC1.5.4 when **NGET** anticipates that it will or may instruct a **Network Operator** to implement **Demand** reduction. It will, as provided in OC6.5.10 and OC7.4.8.2, also be issued to **Non-Embedded Customers**.

OC6.5.2 Where **NGET** expects to instruct **Demand** reduction within the following 30 minutes, **NGET** will where possible, issue a **National Electricity Transmission System Warning – Demand Control Imminent** in accordance with OC7.4.8.2(c) and OC7.4.8.6.

OC6.5.3 (a) Whether a **National Electricity Transmission System Warning - High Risk of Demand Reduction** or **National Electricity Transmission System Warning - Demand Control Imminent** has been issued or not:

(i) provided the instruction relates to not more than 20 per cent of its total **Demand** (measured at the time the **Demand** reduction is required); and

(ii) if less than that, is in

- two voltage reduction stages each of between two and four percent and
- three **Demand Disconnection** stages each of which can reasonably be expected to deliver between four and six percent **Demand** reduction,

Each **Network Operator** will abide by the instructions of **NGET**, which should specify whether a voltage reduction or **Demand Disconnection** stage is required; OR

(iii) if less than that, is in four ~~integral multiples of~~ **Demand Disconnection** stages each of which can reasonably be expected to deliver between four and six per cent **Demand** reduction,

Each **Network Operator** will abide by the instructions of **NGET** with regard to **Demand** reduction under OC6.5 without delay.

(b) The **Demand** reduction must be achieved within the **Network Operator's System** as far as possible uniformly across all **Grid Supply Points** (unless otherwise specified in the **National Electricity Transmission System Warning - High Risk of Demand Reduction**) either by **Customer** voltage reduction or by **Demand Disconnection**; ~~as soon as possible but in any event no longer than five minutes from the instruction being given by NGET.~~

(c) **Demand Control** initiated by voltage reduction shall be initiated as soon as possible but in any event no longer than two minutes from the instruction being received from **NGET**, and completed within 10 minutes of the instruction being received from **NGET**.

(d) **Demand** control initiated by **Demand Disconnection** shall be initiated as soon as possible but in any event no longer than two minutes from the instruction being received from **NGET**, and completed within five minutes of the instruction being received from **NGET**.

(e) Each **Network Operator** must notify **NGET** in writing by calendar week 24 each year, ~~of the integral multiples it will use with effect from the succeeding Financial Year onwards.~~ for the succeeding **Financial Year** onwards, whether **Demand Control** is to be implemented either:

i) by a combination of voltage reduction and **Demand Disconnection**; or

ii) **Demand Disconnection** alone;

together with the magnitude of the voltage reduction stages (where applicable) and for **Demand Disconnection** stages, the demand reduction anticipated.

Thereafter, any changes must be notified in writing to **NGET** at least 10 **Business Days** prior to the change coming into effect.

OC6.7 EMERGENCY MANUAL DISCONNECTION

OC6.7.1 Each **Network Operator** will make arrangements that will enable it, following an instruction from **NGET**, to disconnect **Customers** on its **User System** under emergency conditions irrespective of **Frequency** within 30 minutes. It must be possible to apply the **Demand Disconnections** to individual or specific groups of **Grid Supply Points**, as determined by **NGET**.

OC6.7.2 (a) Each **Network Operator** shall provide **NGET** in writing by week 24 in each calendar year, in respect of the next following year beginning week 24, on a **Grid Supply Point** basis, with the following information (which is set out in a tabular format in the Appendix):

(i) its total peak **Demand** (based on **Annual ACS Conditions**); and
(ii) the percentage value of the total peak **Demand** that can be disconnected ~~(and in the case of that in the first 5 minutes it must include that which can also be reduced by voltage reduction)~~ (and must include that which can also be reduced by voltage reduction, where applicable) within timescales of 5/10/15/20/25/30 minutes.

(b) The information should include, in relation to the first 5 minutes, as a minimum, the 20% of **Demand** that must be reduced on instruction under OC6.5.

OC6.7.3 Each **Network Operator** will abide by the instructions of **NGET** with regard to **Disconnection** under OC6.7 without delay, and the **Disconnection** must be achieved as soon as possible after the instruction being given by **NGET**, and in any case, within the timescale registered in OC6.7.

The instruction may relate to an individual **Grid Supply Point** and/or groups of **Grid Supply Points**.

OC6.7.4 **NGET** will notify a **Network Operator** who has been instructed under OC6.7, of what has happened on the **National Electricity**

Transmission System to necessitate the instruction, in accordance with the provisions of **OC7** and, if relevant, **OC10**.

- OC6.7.5 Once a **Disconnection** has been applied by a **Network Operator** at the instruction of **NGET**, that **Network Operator** will not reconnect until **NGET** instructs it to do so in accordance with **OC6**.
- OC6.7.6 Each **Network Operator** will abide by the instructions of **NGET** with regard to reconnection under OC6.7 without delay, and shall not reconnect until it has received such instruction and reconnection must be achieved as soon as possible and the process of reconnection must begin within 2 minutes of the instruction being given by **NGET**.
- OC6.7.7 **NGET** may itself disconnect manually and reconnect **Non-Embedded Customers** as part of a **Demand Control** requirement under emergency conditions.
- OC6.7.8 If **NGET** determines that emergency manual **Disconnection** referred to in OC6.7 is inadequate, **NGET** may disconnect **Network Operators** and/or **Non-Embedded Customers** at **Grid Supply Points**, to preserve the security of the **National Electricity Transmission System**.
- OC6.7.9 Pursuant to the provisions of OC1.5.6 the **Network Operator** will supply to **NGET** details of the amount of **Demand** reduction or restoration actually achieved.

Demand Control OC6

Industry Technical Code Group

Background

1. The Grid Code obligations relating to Demand Control are documented in OC6.5. OC6.5.3 specifies the functional requirements of the scheme:

OC6.5.3
(a) Whether a National Electricity Transmission System Warning – High Risk of Demand Reduction or National Electricity Transmission System Warning - Demand Control Imminent has been issued or not:-

(i) provided the instruction relates to not more than 20 per cent of its total Demand (measured at the time the Demand reduction is required); and

(ii) if less than that, is in four integral multiples of between four and six per cent, each Network Operator will abide by the instructions of NGET with regard to Demand reduction under OC6.5 without delay.

(b) The Demand reduction must be achieved within the Network Operator's System as far as possible uniformly across all Grid Supply Points (unless otherwise specified in the National Electricity Transmission System Warning - High Risk of Demand Reduction) either by Customer voltage reduction or by Demand Disconnection, as soon as possible but in any event no longer than five minutes from the instruction being given by NGET.
2. Key points to draw out from these requirements are:
 - The demand reduction is a percentage of the demand at the time of the instruction
 - The requirement is to reduce demand; voltage control is a method of achieving demand reduction as is demand disconnection
 - There is some flexibility (4-6%) in the size of each block
 - The demand reduction should be uniformly applied
 - The demand reduction needs to be implemented within 5 minutes
 - There is a need to consider time for the Control Engineer to receive and interpret and respond to the instruction from NGET and initiate the SCADA switching sequence.
3. Most DNOs plan to achieve the Grid Code requirements by a combination of voltage reduction and demand disconnection. There are two key factors associated with this requirement i.e. the demand reduction achieved and the implementation time.

Voltage Reduction – Demand Reduction

4. The historic expectation was that a 3% voltage reduction would achieve a demand reduction of approximately 5% and that a further 3% voltage reduction would deliver a total demand reduction of 10%. Due to this expectation the standard industry approach is typically for voltage reduction to form the first two stages of demand control, thus providing a reduction in the demand on the transmission system whilst continuing to maintain supplies to all customers. This functionality is generally hardwired in to the voltage control schemes installed in approximately 3000 DNO primary substations (e.g. 66/11, 33/11 and 33/6kV substation).
5. Following the Black Start Exercise Phoenix, questions were raised about the effectiveness of voltage reduction given that distribution networks now supply an increasing population of non linear loads i.e. where the demand does not reduce

with the supplied voltage. Two Network Operators conducted limited tests on their live network during the summer and autumn of 2008 to attempt to establish the effectiveness of voltage reduction.

6. Tests were undertaken on three types of primary site; predominately domestic customers, commercial customers and finally large industrial customers.
7. The tests confirmed that voltage reduction will have an impact on the demand but as expected the results differ across the different types of customers. For a 3% voltage reduction instruction the resultant demand reduction ranged from 2.57% to 5.09%. In most cases the demand reduction was sustained for the period of the test, but a slight recovery in demand was observed at times.

Voltage reduction %	Demand reduction %
3.47	2.57
2.63	4.46
4.3	4.34
3.03	3.29
2.02	5
4.35	32.9 ¹
2.68	2.67
3.57	3.73
2.64	5.09

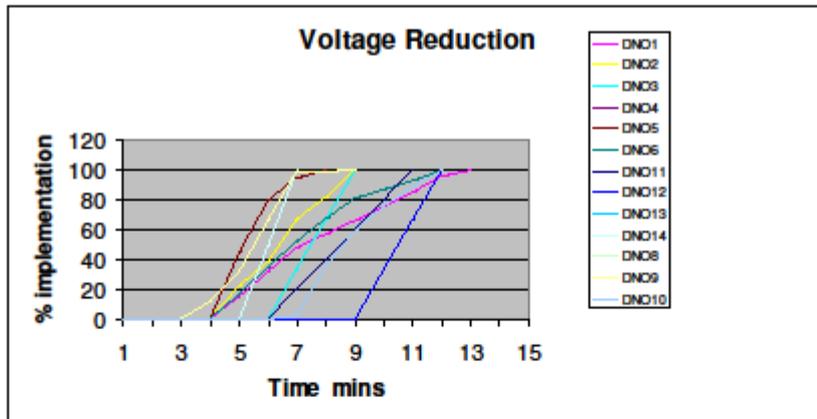
8. The results show that the demand reduction associated with a 3% voltage reduction is variable and could be as low as 2.6%; it might be more reasonable to assume from an operational management perspective that a 3% voltage reduction is more likely to result in a 3% demand reduction rather than the 5% that has been historically assumed.

Voltage Reduction – Implementation time

9. As part of the investigation of the 27 May 2008 incident DNOs were asked to provide information to Ofgem relating to the implementation time of the demand reduction scheme. This information provided indicated that the voltage reduction might take longer than the 5 minutes which is specified in Grid Code OC6.5. As a result of this finding DNOs carried out a further assessment of the time taken to implement a voltage reduction stage.
10. This assessment took into account the time taken for the voltage reduction instruction to propagate through their SCADA systems, the time taken for the voltage control scheme to respond and the time taken for the tap changer to progress through a tap change cycle.
11. The following graph summarises the responses from DNOs. The graph illustrates that a single voltage reduction could take up to 13 minutes to implement².

¹ Abnormal demand resulted in the high demand reduction

² These times include an additional two minute period for receiving an instruction from NGET and initiating the voltage reduction process. It is not clear if all the DNO responses already include for this activity, and it may be that some DNO voltage reduction schemes could be completed two minutes earlier than indicated in this graph.



12. The implementation time is influenced by several factors including:
- The time taken for the Control Engineers to respond to the NGET instruction.
The time for SCADA systems to convey the instruction from the Control Rooms to the substations. These timescales are largely influenced by the architecture of the SCADA and associated communications infrastructure.
The time for the tap change relay and tap changer to respond to the instruction.
This timescale is governed by the basic design of the voltage control scheme in each of substations.

Voltage Reduction – summary

13. The results of investigations carried out by DNOs provide a degree of transparency of the performance of the voltage reduction schemes which have been in place for many years. This additional transparency has identified that there is likely to be a technical non compliance with the Grid Code OC6.5 in terms of the demand reduction delivered by voltage reduction the timescale of delivery.
14. The systems that deliver voltage reduction form an intrinsic part of DNO SCADA and individual substation based systems.

Options

15. There are a range of options for addressing the potential technical compliance with Grid Code OC6.5 which are considered briefly below:
16. Option 1
Reflect the likely performance of the voltage reduction schemes currently employed in terms of the demand reduction likely to be achieved and the implementation time in an amended version of the Grid Code.
17. Option 2
Improve the performance of the voltage reduction schemes currently employed by DNOs by increasing the speed of operation. This could require extensive changes to SCADA systems and changes to substation voltage control schemes. Assuming that there was a need to update the voltage control scheme in 3000 substations this could cost £90m (based at a cost of £30k per substation). Updating the voltage control scheme might deliver an increased implementation time of between 1 – 2 minutes. Changing the substation voltage control scheme would not improve the propagation time through SCADA. More detailed studies would be required to establish if it would be possible to reduce the SCADA propagation times and, if feasible, the associated costs.

Enhancing SCADA and substation equipment would not address the magnitude of the demand reduction achieved.

18. **Option 3**
There is provision in OC6.5 for DNOs to deliver the prescribed Demand Control using demand disconnection rather than voltage reduction. It would be possible to comply with OC6.5 as currently drafted by using demand disconnection only. Where there is a requirement is for a relatively modest demand reduction on the transmission system, the present voltage reduction scheme can deliver material benefits without disconnecting or having a significant impact on customers.

Recommendation

19. The Grid Code Review Panel is invited to:
- Note the additional transparency on the effectiveness of the voltage reduction schemes used by most DNOs to deliver Demand Control as required by OC6.5.
 - Recognise that there are customer benefits from delivering some degree of demand control via voltage reduction rather than relying solely on demand disconnection.
 - Consider the acceptability of changing OC6.5 as proposed in Appendix 1 recognising the Demand Control facilities that are generally provided by DNOs.

Appendix 1

Potential changes to the Grid Code to implement Option 1

The Grid Code obligations relating to Demand Control are documented in OC6.5. OC6.5.3 specifies the functional requirements of the scheme:

OC6.5.3

(a) Whether a National Electricity Transmission System Warning – High Risk of Demand Reduction or National Electricity Transmission System Warning - Demand Control Imminent has been issued or not:-

(i) provided the instruction relates to not more than 20 per cent of its total Demand (measured at the time the Demand reduction is required); and

(ii) if less than that, is in four integral multiples of demand disconnection each of which is between four and six per cent, each Network Operator will abide by the instructions of NGET with regard to Demand reduction under OC6.5 without delay.
or

(iii) if less than that, is in two voltage reduction stages each of which being 3%, followed by two integral multiples of demand disconnection each of which is between four and six per cent, each Network Operator will abide by the instructions of NGET with regard to Demand reduction under OC6.5 without delay.

(b) The Demand reduction must be achieved within the Network Operator's System as far as possible uniformly across all Grid Supply Points (unless otherwise specified in the National Electricity Transmission System Warning - High Risk of Demand Reduction) either by Customer voltage reduction or by Demand Disconnection; as soon as possible but in any event no longer than five minutes from the instruction being given by NGET.

(i) Demand Control initiated by voltage reduction shall be initiated as soon as possible but in any event no longer than 2 minutes from the instruction being received from NGET, and completed within 15 minutes of the instruction being received from NGET.

(ii) Demand Control initiated by Demand Disconnection shall be implemented as soon as possible but in any event no longer than five minutes from the instruction being given by NGET.

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Implementation of Demand Control Instructions TERMS OF REFERENCE

Governance

1. The Implementation of Demand Control Instructions Workgroup was established by Grid Code Review Panel (GCRP) at the September 2012 GCRP meeting.
2. The Workgroup shall formally report to the GCRP.

Membership

3. The Workgroup shall comprise a suitable and appropriate cross-section of experience and expertise from across the industry, which shall include:

Name	Role	Representing
Audrey Ramsay	Chair	National Grid
Damien McCluskey	Technical Secretary	National Grid
Jason Bareham	National Grid Representative	National Grid
Paul Roebuck	National Grid Representative	National Grid
Bill D'Albertanson	DNO Representative	UK Power Networks
Alan Creighton	DNO Representative	Northern Powergrid
David Mobsby	DNO Representative	Scottish & Southern Energy
Andy Dixon	DNO Representative	Scottish Power
Nigel Buckland	DNO Representative	Western Power Distribution
Dan Randels	DNO Representative	Electricity North West
Lisa Waters	Generator Representative	Waters Wye Associates
Graeme Dawson	DNO Representative	npower
Julian Wayne	Observer - Distribution List	Ofgem

Meeting Administration

4. The frequency of Workgroup meetings shall be defined as necessary by the Workgroup chair to meet the scope and objectives of the work being undertaken at that time.
5. National Grid will provide technical secretary resource to the Workgroup and handle administrative arrangements such as venue, agenda and minutes.

6. The Workgroup will have a dedicated section on the National Grid website to enable information such as minutes, papers and presentations to be available to a wider audience.

Scope

7. The Workgroup will:
 - Review the need for, and requirements of, Demand Control Instructions.
 - Review the existing capabilities of the DNOs to implement Demand Control Instructions.
 - Take account of relevant international practice and the approach taken in European Code development.
 - Evaluate the costs, benefits and risks of any actions necessary to ensure that DNOs can implement the required Demand Control Instructions in the required timescales under future system conditions.

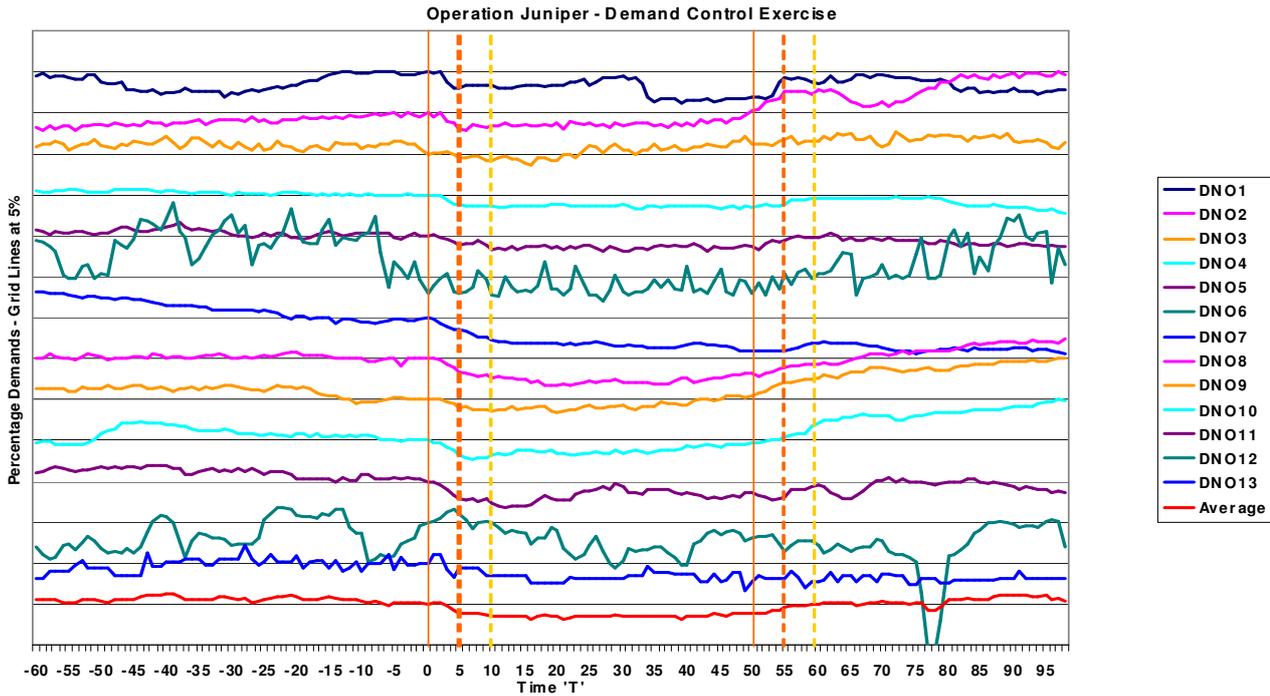
Deliverables

8. The Workgroup will provide updates and a Workgroup Report to the Grid Code Review Panel and Distribution Code Review Panel which will:
 - Detail the findings of the Workgroup;
 - Draft, prioritise and recommend changes to the Grid Code, Distribution Code and associated documents in order to implement the findings of the Workgroup; and
 - Highlight any consequential changes which are or may be required

Timescales

9. It is anticipated that this Group will discuss the issue and determine appropriate timescales. Once these timescales have been determined, the workgroup will confirm with the GCRP that they are suitable.
10. If for any reason the Workgroup is in existence for more than one year, there is a responsibility for the Workgroup to produce a yearly update report, including but not limited to; current progress, reasons for any delays, next steps and likely conclusion dates.

Annex 4 – Results from Operation Juniper Demand Control Exercise



The chart above illustrates the demand reduction achieved by the thirteen DNOs who participated in the Voltage reduction tests.

The magnitude of the reductions is detailed in the table below.

	T=0	T=5	T=10	T=50	T=55	T=60
DNO1	0.0%	2.0%	1.6%	0.0%	2.3%	1.7%
DNO2	0.0%	1.9%	1.7%	0.0%	2.3%	2.5%
DNO3	0.0%	0.4%	0.7%	0.0%	0.6%	0.4%
DNO4	0.0%	1.2%	1.4%	0.0%	0.3%	1.1%
DNO5	0.0%	1.2%	1.7%	0.0%	0.9%	1.2%
DNO6	0.0%	0.1%	0.2%	0.0%	2.3%	2.4%
DNO7	0.0%	1.4%	2.7%	0.0%	0.2%	1.1%
DNO8	0.0%	1.6%	2.4%	0.0%	0.6%	1.0%
DNO9	0.0%	1.0%	1.4%	0.0%	1.6%	2.1%
DNO10	0.0%	1.8%	1.8%	0.0%	0.7%	2.4%
DNO11	0.0%	2.0%	2.6%	0.0%	-0.6%	0.8%
DNO12	0.0%	-1.2%	0.0%	0.0%	-1.9%	-1.0%
DNO13	0.0%	0.6%	1.6%	0.0%	0.5%	0.2%
Average	0.0%	1.1%	1.5%	0.0%	0.8%	1.2%