



**GRID CODE
CONSULTATION DOCUMENT**

**Grid Code Requirements for Power Park Modules –
Voltage Control and Reactive Power**

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

Consultation Ref	B/08
Issue	1.0
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Responses required by	23 June 2008
Prepared by	National Grid

DOCUMENT LOCATION

National Grid website:

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

DISTRIBUTION

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

A. INTRODUCTION

1. Paragraph 2 of Condition C14 of the Transmission Licence granted to the National Grid Electricity Transmission plc ("National Grid") provides that National Grid shall, in consultation with Authorised Electricity Operators liable to be materially affected thereby, periodically review the Grid Code and its implementation. That paragraph also requires National Grid, following such review, to send to the Authority:-
 - (a) a report on the outcome of such review;
 - (b) any proposed revisions to the Grid Code as National Grid (having regard to the outcome of such review) reasonably thinks fit for the achievement of the objectives set out in sub-paragraph (b) of Condition C14 of the Transmission Licence; and
 - (c) any written representations or objections from Authorised Electricity Operators (including any proposals by such operators for revisions to the Grid Code not accepted by National Grid in the course of the review) arising during the consultation process and subsequently maintained.
2. This review examines inconsistencies introduced into the Grid Code Connection Conditions following the implementation of the changes proposed by the Power Park Modules and Synchronous Generating Units Working Group.
3. The proposed changes to the Grid Code were discussed with the GCRP on 15th May 2008. Panel Members agreed that National Grid should issue a Consultation Paper regarding the proposed changes.
4. Comments upon the proposed changes within this consultation should be sent to National Grid by **23 June 2008** as detailed in section C. The comments will be reviewed and responded to.
5. Following this consultation, National Grid will prepare a Report to the Authority detailing National Grid's recommended changes to the Grid Code and all comments/responses received from Authorised Electricity Operators through this consultation. Once sent to the Authority this report will be made available on National Grid's website.
6. Where Authorised Electricity Operators' responses have been marked as confidential they will not be published within the version of the Report to the Authority placed on the National Grid website.
7. The revisions to the Grid Code proposed by National Grid and sent to the Authority, require approval by that body and will, if approved, come into force on such date (or dates) of which you will be notified by National Grid, in accordance with the Authority's approval.

B. DESCRIPTION OF THE PROPOSED AMENDMENTS AND THEIR EFFECTS

8. Background

- 8.1 On April 1st 2008 Issue 3, Revision 26 of the Grid Code came into effect. This revision included the modifications proposed following the work of the Power Park Modules and Synchronous Generating Units Working Group. These proposals were consulted on in the G/06 consultation¹, modified in response to consultation comments and submitted to OFGEM in December 2007², and further modified to retain the reactive capability requirements at the HV side of the connection transformer in Scotland as directed by OFGEM following its decision³ on the proposals.
- 8.2 The Grid Code specifies in clause CC.6.3.4 the voltage range over which the Reactive Power output of a Generator should be fully available. This clause contains relaxations for Power Park Modules and non-synchronous generating units that are embedded at 33kV or below and, until revision 26, for such generation directly connected at 33kV in England and Wales. Figure 4 of the connection conditions shows the effect of the relaxations on the reactive power capability requirement. One of the proposals of the working group was to extend this relaxation to include Power Park Modules and non-synchronous generating units directly connected at 33kV in Scotland.
- 8.3 The text of CC.6.3.4 has been modified appropriately in revision 26. However, the title of Figure 4 and the labels on the reactive power output have not been modified and are inconsistent with the text of C.6.3.4 and the reactive capability requirements of CC.6.3.2(c). The title still refers to England and Wales rather than the whole of the GB transmission system and the axis does not reflect the fact that, in Scotland, the reactive power capability requirement of 33kV connected generation is specified at the HV side of the transformer rather than the Grid Entry Point and may not be 0.95 power factor lead/lag at the Grid Entry Point.
- 8.4 Appendix 7 to the connection conditions was introduced by the proposals of the Power Park Modules and Synchronous Generating Units working group. This appendix specifies the voltage control system performance requirements for Power Park Modules and non-synchronous generating units. Figures CC.A.7.2.2b and CC.A.7.2.2c show the required operating envelopes for the control system and include the GB wide relaxations of CC.6.3.4. The figures are described in CC.A.7.2.2.4. This clause only applies the relaxations to England and Wales, and not Scotland. This is not consistent with the recommendations of the working group and the Authority decision.
- 8.5 Clause CC.A.7.2.2.7 specifies the reactive capability requirements for Power

¹ Power Park Modules and Synchronous Generating Units Working Group Report is available on National Grid's Industry Information Website:
https://www.nationalgrid.com/NR/rdonlyres/26A123D0-2CC4-4D16-992F-8143719B911F/13621/CP_G06_Power_Park.pdf

² Power Park Modules and Synchronous Generating Units Report to the Authority is available on National Grid's Industry Information Website:
https://www.nationalgrid.com/NR/rdonlyres/D478E2DC-DDBE-4E92-9332-EA9ED330977E/22321/ReporttotheAuthorityG06PPM_issued.pdf

³ Power Park Modules and Synchronous Generating Units Decision Letter is available on National Grid's Industry Information Website:
https://www.nationalgrid.com/NR/rdonlyres/A630E4B4-6120-46E0-83BC-046897560771/24386/108_008GridCodeG06decision.pdf

Park Modules, DC converters and non-synchronous generating units. It aims to ensure that reactive compensation plant is not switched out if the voltage becomes very high or very low. As the reactive power output of compensation equipment often depends on voltage, the requirements of this clause are specified in terms of reactive current rather than reactive power. The last sentence of the clause incorrectly refers to leading Reactive Power rather than leading reactive current.

9. Proposed Grid Code Changes

9.1 It is proposed to amend the Connection Conditions of the Grid Code to ensure that they consistently reflect the proposals of the Power Park and Synchronous Generating Units Working Group and the Authority decision.

9.2 The proposed amendments to the Connection Conditions are shown in Appendix A, which can be summarised as follows:

- i. The title of Figure 4 refers to the Grid Entry Point rather than the Grid Entry Point in England and Wales;
- ii. The reactive power axis labels of Figure 4 acknowledge that the Grid Entry Point requirement in Scotland may not be 0.95 power factor lead/lag;
- iii. The text of CC.A.7.2.2.4 applies the relaxations to the whole GB transmission system rather than England and Wales; and
- iv. The text of clause CC.A.7.2.2.7 requires the generator to maintain maximum leading reactive current output for voltage rises above 105%.

10. Impact on GB Transmission System

10.1 The proposed changes would not have any adverse impact on the GB Transmission System. Analysis has indicated that the reactive power capabilities on leading side at not required at low voltage, and similarly on the lagging side at high voltages, to operate the GB Transmission System securely.

11. Impact on Grid Code Users

11.1 The proposals will provide additional clarity for Users and ensure that Generators are not required to make unnecessary investment.

11.2 The proposals will also ensure the provisions consistently reflect the intentions of the Power Park and Synchronous Generating Units Working Group and the Authority decision.

12. Assessment Against Grid Code Objectives

12.1 The proposed changes outlined in B/08 Report to the Authority would better facilitate Grid Code Objectives:

- i) to permit the development, maintenance and operation of an efficient, co-ordinated and economical system for the transmission of electricity
- and

ii) to facilitate competition in the generation and supply of electricity

by removing the inconsistencies regarding the voltage control and reactive power requirements for Power Park Modules and non-synchronous Generating Units directly connected at 33kV in Scotland.

13. Impact on Industry Documents

13.1 *Impact on Core Industry Documents*

13.1.1 None.

13.2 *Impact on other Industry Documents*

13.2.1 None.

C. RESPONSES

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

15. Views are invited upon the proposals outlined in this report. Especially views on the following areas would be welcomed:

- Impact of the proposals on Grid Code users.

16. Your formal responses may be:-

Posted to: Lilian Macleod
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Appendix A: Proposed Grid Code Changes

Connection Conditions Changes

CONNECTION CONDITIONS CODE

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 $\pm 5\%$ 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** at 33kV and below) where the requirement shown in Figure 4 applies.

Voltage at **Grid Entry Point** in England and Wales or **User System Entry Point if Embedded** (% of Nominal) at 33 kV and below

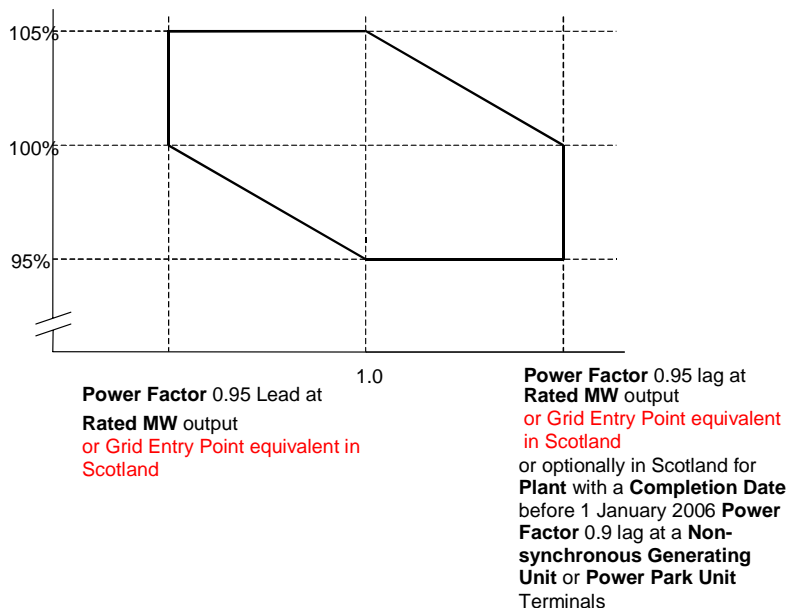


Figure 4

CC.A.7.2.2.4 Figure CC.A.7.2.2b shows the required envelope of operation for **Non-Synchronous Generating Units, DC Converters and Power Park Modules** except for those **Embedded** at 33kV and below or directly connected to the **GB Transmission System** in England and Wales at 33kV and below. It should be noted that where the **Reactive Power** capability requirement of a directly connected **Non-Synchronous Generating Unit, DC Converter or Power Park Module** in Scotland, as specified in CC.6.3.2 (c), is not at the **Grid Entry Point**, the values of Q_{min} and Q_{max} shown in this figure will be as modified by the

~~33/132kV or 33/275kV or 33/400kV transformer.~~ Figure CC.A.7.2.2c shows the required envelope of operation for **Non-Synchronous Generating Units, DC Converters and Power Park Modules Embedded** at 33kV and below or directly connected to the **GB Transmission System** in England and Wales at 33kV and below. It should be noted that where the **Reactive Power** capability requirement of a directly connected **Non-Synchronous Generating Unit, DC Converter or Power Park Module** in Scotland, as specified in CC.6.3.2 (c), is not at the **Grid Entry Point**, the values of Q_{min} and Q_{max} shown in this figure will be as modified by the 33/132kV or 33/275kV or 33/400kV transformer. The enclosed area within points ABCDEFGH is the required capability range within which the **Slope** and **Setpoint Voltage** can be changed.

- CC.A.7.2.2.7 For **Grid Entry Point** voltages (or **User System Entry Point** voltages if **Embedded**) below 95%, the lagging **Reactive Power** capability of the **Non-Synchronous Generating Unit, DC Converter or Power Park Module** should be that which results from the supply of maximum lagging reactive current whilst ensuring the current remains within design operating limits. An example of the capability is shown by the line DE in figures CC.A.7.2.2b and CC.A.7.2.2c. For **Grid Entry Point** voltages (or **User System Entry Point** voltages if **Embedded**) above 105%, the leading **Reactive Power** capability of the **Non-Synchronous Generating Unit, DC Converter or Power Park Module** should be that which results from the supply of maximum leading reactive current whilst ensuring the current remains within design operating limits. An example of the capability is shown by the line AH in figures CC.A.7.2.2b and CC.A.7.2.2c. Should the **Reactive Power** output of the **Non-Synchronous Generating Unit, DC Converter or Power Park Module** reach its maximum lagging limit at a **Grid Entry Point** voltage (or **User System Entry Point** voltage if **Embedded**) below 95%, the **Non-Synchronous Generating Unit, DC Converter or Power Park Module** shall maintain maximum lagging reactive current output for further voltage decreases. Should the **Reactive Power** output of the **Non-Synchronous Generating Unit, DC Converter or Power Park Module** reach its maximum leading limit at a **Grid Entry Point** voltage (or **User System Entry Point** voltage if **Embedded**) above 105%, the **Non-Synchronous Generating Unit, DC Converter or Power Park Module** shall maintain maximum leading ~~Reactive Power~~ reactive current output for further voltage increases.