



INTERCONNECTOR FREQUENCY RESPONSE REPORT

**Prepared by the Interconnector Frequency Response Working Group
on behalf of the Balancing Services Standing Group
for submission to the Amendments Panel**

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1.0 SUMMARY AND RECOMMENDATIONS

Executive Summary

- 1.1 The setting up of the Interconnector Frequency Response Working Group, here after known as the IFRWG, as part of the Balancing Services Standing Group, was proposed by National Grid and agreed by the CUSC Amendments Panel to be progressed at their meeting on the 27th November 2009.
- 1.2 The setting up of the IFRWG, as part of the BSSG, was proposed by National Grid to examine the suitability of the existing commercial framework relating to the provision of mandatory frequency response from new Interconnectors. Grid Code modification H/04, approved by the authority on the 23rd November 2005, obligated interconnectors completed after the 1st April 2005 to be capable of providing mandatory frequency response.
- 1.3 The IFRWG has examined and considered the commercial framework, and in particular considering the requirements of the CUSC, Grid Code and BSC, around interconnectors providing frequency response and agreed preferred solutions to enabling equitable service provision from Interconnectors. To achieve this, the IFRWG believes amendments should be made to both the CUSC and the BSC. The IFRWG now believes the preferred solutions should be raised and processed through the appropriate industry code governance.
- 1.4 Specifically within the CUSC, the IFRWG believes that a CUSC Amendment Proposal to address CUSC facilitation of interconnector frequency response should be raised. The proposal should seek to include relevant references to interconnectors within Section 4 of the CUSC and the Mandatory Service Agreement in order to ensure that contractual arrangements with interconnector providers can be agreed. The IFRWG is not recommending any alternatives at this time, although the group explored a different contractual model, where, in essence the interconnector users would provide the service and would consequently be the contractual parties. However, at this stage, the group believed that this model would be significantly more complex to implement.
- 1.5 The IFRWG also considered how interconnector providers could be treated equitably within the settlement systems. The group agreed a high level solution and believes that a Modification Proposal should be raised under the BSC to address this.
- 1.6 It should also be noted that outside of the industry code governance, as part of the preferred solution, National Grid will be required to alter its Information Systems that calculate and provide the expected frequency response volume to the settlement system. For the avoidance of doubt the changes to National Grid Information Systems will not impact other parties.

Standing Group Recommendation

- 1.7 The Balancing Services Standing Group believes its Terms of Reference have been completed. The BSSG, sitting as the IFRWG, has fully considered the commercial framework around interconnectors providing frequency response and recommends to the CUSC Panel that an Amendment Proposal should be raised and taken to at least one Working Group meeting. In addition, the BSSG, sitting as the IFRWG, recommends that a BSC Modification Proposal be raised to ensure equitable treatment of interconnector providers.

2.0 PURPOSE AND INTRODUCTION

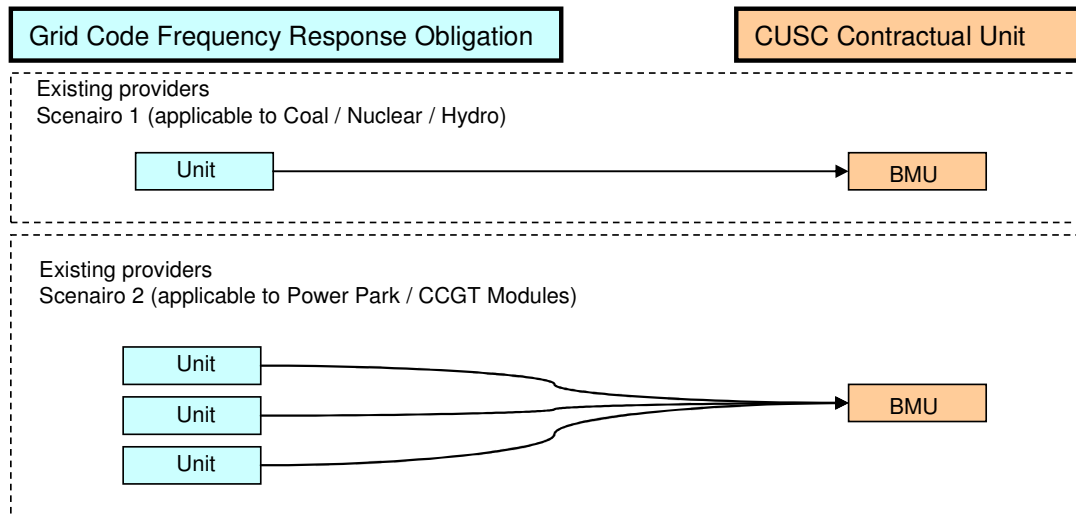
- 2.1 This Report has been prepared and issued by National Grid and summarises the deliberations and recommendations of the Balancing Services Standing Group, sitting as the IFRWG.
- 2.2 The setting up of the IFRWG, as part of the BSSG, was proposed by National Grid and taken to the Amendments Panel for consideration on the 30th October 2009. The CUSC Amendments Panel agreed to the additional requirements to the BSSG Terms of Reference. The additional obligation is to investigate and propose a recommendation to consider the commercial issues associated with Frequency Response provisions from future Interconnectors. The Terms of Reference are contained within Annex 1.
- 2.3 The Balancing Services Standing Group was tasked with examining the appropriateness and effectiveness of the existing CUSC obligations and commercial mechanisms for frequency response for future interconnectors. To assist it, the BSSG established the Interconnector Frequency Response Working Group (IFRWG) whose Terms of Reference are shown in Annex 1.

Why is this review necessary?

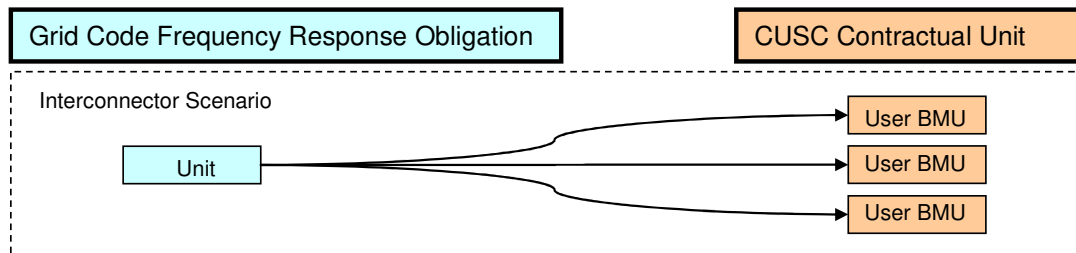
- 2.4 Firstly, Grid Code modification H/04 approved by the Authority on the 23rd November 2005 obligated DC Converters Stations (otherwise known as interconnectors) completed after the 1st April 2005 to meet certain requirements under the Grid Code; this included the capability to provide mandatory frequency response. Secondly, the first interconnector affected by this change is due to connect to the National Electricity Transmission System towards the end of 2010, namely the BritNed (England to Holland) Interconnector. Consequently, it is necessary to review the existing commercial frequency response arrangements in relation to interconnectors.

What's different about interconnectors?

- 2.5 The Balancing Settlement Code, Section K.3, specifies what constitutes a Balancing Mechanism Unit (BMU), and generally speaking defines a BMU as the smallest controllable unit. This brings a natural link between the technical conditions placed upon apparatus connecting to the National Electricity Transmission System, as specified in the Grid Code, and the settlement of energy associated with that apparatus. This link continues through to the CUSC in regard to, for example, the procurement of services by National Grid from Users in relation to these BMUs in terms of frequency response. This is illustrated in the two scenarios below.



2.6 Interconnectors however, do not have the same link between the technical mandatory frequency response conditions placed upon the unit in the Grid Code and the settlement of energy. Specifically, the difference can be seen in the fact that there are multiple BMUs associated with a single interconnector. This circumstance represents the unique nature of interconnectors, in that the interconnector sells capacity to the wholesale electricity market rather than generating it itself, and those purchasing the capacity get allocated the energy volume in the settlement systems. This therefore means that the net flow across the interconnector is equal to the sum of the interconnector user BMUs¹. This is illustrated below.



2.7 Following evaluation of the relevant issues, this report details the recommendations from the IFRWG. This report has been prepared in accordance with the Terms of the CUSC. An electronic copy can be found on the National Grid Website <http://www.nationalgrid.com/uk/Electricity/Codes/systemcode/workingstandinggroups/bssg/index.htm>

¹ Assuming normal interconnector operation and barring any difference between losses over the interconnector and the estimated losses allocated to the users

3.0 RECOMMENDATIONS

CUSC Recommendation

- 3.1 The BSSG, sitting as the IFRWG, met on 5 separate occasions to consider the existing commercial framework around the provision of mandatory frequency response from interconnectors. Following deliberation, the BSSG, sitting as the IFRWG, is recommending that an Amendment Proposal to address the CUSC facilitation of interconnector frequency response should be raised. The group identified that the CUSC contained numerous references to the apparatus providing the service, but that those references are not applicable to interconnectors. Hence the IFRWG recommends that an Amendment Proposal should seek to include relevant references to interconnectors within CUSC section 4 and the Mandatory Service Agreement in order to ensure that contractual arrangements with interconnector providers can be agreed.

BSC Recommendation

- 3.2 The BSSG, sitting as the IFRWG, also considered how interconnector providers could be treated equitably within the settlement systems. The group identified that along with the multiple user BMUs associated with interconnectors, as illustrated in 2.6, there is also an interconnector error administrator (IEA) BMU. The IEA BMU under the BSC is allocated any difference between the aggregate of the user nominations² and the metered volume across the interconnector. Any volume accrued in the IEA account is in effect imbalance volume and would be subject to the imbalance price. Therefore, were a frequency response service called, as the BSC stands, the IEA account would automatically accrue the imbalance volume resulting from the provision of frequency response. For the avoidance of doubt interconnector Users, by the existence of IEA account, are held neutral.
- 3.3 For generators providing frequency response, the provider can choose³ the allocation of expected frequency response energy volumes that represent the contracted position. This aims to match with the physical delivered volumes for the service, holding the provider neutral to imbalance caused by matching their physical output to the contracted position. The group therefore believes that interconnector providers should also be able to choose to be allocated such expected frequency response volumes. However, in order to hold the provider neutral, it must be known whether the volume should be allocated to the providers Production or Consumption account. In the case of generators, the volume is always allocated to the Production account⁴. For IEA however, it is far less certain and can only be determined post event, as the BMU only accounts for imbalance between the summated user's contracts and the metered interconnector position, which could be either a production or consumption value.
- 3.4 To resolve this, the group recommends that National Grid raises a BSC modification to allow the Settlement Administration Agent (SAA) to automatically determine and subsequently allocate the frequency response volume to the correct BMU.

² The amount of energy the user states will flow (up to their bought capacity)

³ The provider chooses whether to be allocated frequency response volumes in accordance with the Applicable Balancing Service Volume Data (ABSVD) methodology statement

⁴ The polarity of the metered volume determines whether the volume should be production or consumption, e.g. +100MWh would go to the production account.

Frequency Response Calculation

It should also be noted that National Grid will be required to modify the information systems that provide the expected frequency response volumes in order to provide volumes for an interconnector provider. These required changes will not impact upon any other parties systems.

4.0 SUMMARY OF DISCUSSIONS

4.1 The IFRWG considered a number of issues in relation to the provision of frequency response from interconnectors, the following section summarises the main issues discussed and the key points from each issue.

Owner / User model

4.2 In consideration of the differences between interconnectors and existing providers of frequency response as highlighted in 2.6, the group considered two separate models. In the first model, the contractual relationship is with the interconnector owner, this is known as the owner model. In the second model, contractual relations would be with the interconnector users; this is known as the user model.

4.3 The owner model is based on the premise that National Grid will contract for the service with the party responsible for providing the technical frequency response capability, the owner. This model also holds any and all interconnector users neutral to any provision of the service, i.e. users nominations would not be effected.

4.4 The benefits of the owner model can be summarised as;

- Ensures the link between the Grid Code obligations and the contracted service
- Consistent with the existing setup for other mandatory providers (generators)
- Ensure National Grid is contracting with the party capable of effecting delivery and performance
- Minimises the contractual complexity

4.5 The group considered an alternative way in which the frequency response obligations could be delivered, by the interconnector users. This user model would require National Grid to have a contractual relationship with the interconnector users which in turn would mean these users would take responsibility for the energy delivered (through the settlement processes). For the avoidance of doubt, this model was considered based on the existing Grid Code obligations, i.e. the technical obligations are on the interconnector.

4.6 In further considering the user model, it became apparent that there would be a number of difficulties with implementing this model. For example, what would the contractual relationship look like? The interconnector users are both numerous and variable in their use of the capacity. The group did not consider it practical for National Grid to contract with so many parties for what is a single service, that is the interconnector is either providing frequency response, or not. Some of the other difficulties identified included;

- How would pricing work? Would each party be able to individually price?
- What happens if some users don't want to be involved in providing the service? Parties that are purely interested in energy trading for example
- What happens when there is under or over delivery? The users arguably have limited ability to effect performance

- How would users be apportioned expected frequency response volumes through settlement?

4.7 Due to the points outlined above, the group agreed to focus attention on the development of the owner model (rather than the user model).

CUSC changes

4.8 The group discussed the changes required to the CUSC in order for National Grid to contract with interconnectors. It was identified that changes were required to Section 4 of the CUSC and to Schedule 2 - Exhibit 4, the Mandatory Service Agreement. In principle the changes required are all based on ensuring the CUSC terminology used is applicable to interconnector as well as generators. For example these parts of the CUSC would often describe providers in terms such as "Generating Unit" and "Genset" which is not applicable to interconnectors. To resolve this issue, the term "DC Converter" was agreed by the group for inclusion as a new CUSC defined term. The group also agreed that the definition of "De-load" as contained within the CUSC also required modifying.

4.9 The defined De-Load parameters in relation to interconnectors was discussed. De-load under the CUSC is defined as the difference between the Maximum Export Limit (MEL) and the Final Physical Notification (FPN) Data. However it was identified that interconnectors do not presently provide either Grid Code parameter. The group discussed whether interconnectors should be required to provide these parameters; ultimately the group agreed that this would not be required as there are equivalent parameters supplied by interconnectors which meet the needs.

4.10 The group also accepted that due to the unique FPN equivalent for each interconnector, the exact De-Load definition would be specified within the MSA rather than Section 4 of the CUSC. However, it was agreed that the principle of De-load being calculated from the capability and the physical flow should be included within Section 4 of the CUSC.

Settlement Systems treatment of volumes and information provision

4.11 Under the BSC, frequency response providers have their expected frequency response imbalance volumes removed from their overall imbalance volumes by the allocation of Applicable Balancing Service Volume Data (ABSVD) to the BMU which has provided the service.

4.12 In the case of interconnectors where there are many BMUs associated with the apparatus, a separate BMU, the interconnector error administrator (IEA), takes account of any difference between the contractual volumes and the metered volumes. Like all other providers BMUs, the IEA has both a Production and Consumption account associated with it. However, whereas for other providers of mandatory frequency response, the volumes will always be allocated to the Production unit as the BMU is generating energy onto the transmission system, for the IEA this is not the case. The only volume associated with the IEA account is the difference between contracted and metered volume which can be either a production or consumption volume depending on whether the imbalance is positive or negative. This is not dependent on the direction of the interconnector flow.

4.13 On behalf of the group Elexon considered how the expected frequency response volume could be allocated to the right account. Elexon discussed two options with the group. In summary two options were identified. Under Option 1, National Grid would assign the volume to their chosen IEA BMU (e.g. either the production or consumption BMU) with any inaccurate submission requiring a resubmission of

ABSVD data to the correct account. Under Option 2, National Grid would submit the volumes and the Settlement Administration Agent (SAA) would assign these volumes to the correct unit. The group's preference was for Option 2 for the following reasons;

- Automatic solution of Option 2 is more robust than a manual solution, i.e. the automatic solution will be more accurate as the SAA has all the required data to calculate the correct account.
- National Grid would be unable to accurately submit the expected frequency response volumes to the correct unit as National Grid does not have access to the correct data within the required timescales
- Option 1 would place a requirement on the IEA to check submissions

- 4.14 The group agreed that National Grid should raise a BSC modification to develop this preferred solution further.
- 4.15 The IFRWG also considered the issue of information provision specifically around the ability of the market to view the interconnector physical position and the available capacity in the same location as generators have this information published.
- 4.16 The group preferred option is to modify the Balancing Mechanism Reporting System (BMRS) to provide this information and accordingly National Grid should raise a BSC modification. However National Grid will consider alternate arrangements for the publication of this information should the preferred option not be implemented.

Appropriateness of the CUSC Mandatory Frequency Response payments mechanisms

- 4.17 The group debated whether the current frequency response mechanisms where providers submit monthly holding prices payable when the provider is in frequency sensitive mode and also receives compensation for the expected energy delivered at an administered price for all providers, was appropriate for interconnector providers.
- 4.18 The basis of the debate centred on the potentially different cost base for the provision of frequency response energy that interconnector providers are exposed to and whether this is sufficiently divorced from the intentions of the frequency response energy payment mechanisms to warrant a different mechanism. The BritNed interconnector (due to go live later in 2010) being the first interconnector to be exposed to the Grid Code obligations was used as an example for this debate. BritNed's cost base when providing frequency response energy is likely to be the Dutch imbalance price, rather than fuel cost. The Dutch imbalance price can be seen to be volatile. Data taken in June 2008 sees the imbalance price⁵ reaching as high as £967/MWh and low as £1/MWh. Conversely, data from the end of May 2008 saw the imbalance price go negative to the approximate value of -£160/MWh.
- 4.19 However, the group believes that interconnectors are not unique in this area, and that other classes of providers face similar issues. For example, the group considered wind farms as another example of providers that arguably may not fit within the intentions of the frequency response payment mechanism. Wind farms, rather than a fuel cost have a lost opportunity cost in the form of the loss of Renewable Obligation Certificates when not generating to the maximum environmental conditions, which may well not be covered by the response energy payment.
- 4.20 The group concluded that while the frequency response mechanism may not be ideal for interconnectors, there are many other examples of providers that arguably are in

⁵ An approximate conversion factor was used to convert the €/MWh price to £/MWh

a similar position. Therefore if the payment mechanism is to be examined, it should be in the context of all providers and not just one set of providers, namely interconnectors.

Reciprocal mandatory frequency response obligations

- 4.21 The IFRWG also considered an interconnectors position where the two interconnected transmission systems have reciprocal mandatory frequency response obligations, and specifically whether this could potentially lead to any non-compliance with the Grid Code as a result.
- 4.22 The only issue found to be of potential concern in this area is the modes of operation. All applicable generators and DC converters must be in either Frequency Sensitive Mode or Limited Frequency Sensitive Mode at all times, however neither mode would allow an interconnector to provide a frequency response service to the other System Operator. Hence potentially an interconnector could be subject to conflicting obligations. For the avoidance of doubt BritNed is not subject to a mandatory frequency response requirement in the Netherlands.
- 4.23 The IFRWG recommends that this topic should be further examined under the Grid Code governance to ascertain the extent to any changes needed, if any.

Grid Code Obligation, export and import?

- 4.24 The IFRWG questioned whether the Grid Code frequency response obligation on interconnectors also included the situation where the interconnector was exporting from Great Britain. Examination of the Grid Code suggests that the obligation is only when the interconnector is importing to GB. However, the Grid Code can be considered contradictory in parts.
- 4.25 Further to this National Grid believes that the industry would benefit from debating whether the mandatory frequency response obligation should include exporting interconnectors. However, this should be within the context of mandatory frequency response obligations on all demand providers.
- 4.26 The group also noted that the Grid Code could be further clarified to reflect frequency response being delivered from interconnectors. For example Grid Code CC8.1 Part1(b) assumes that frequency response will be provided by generators.

European 3rd Package

- 4.27 Ofgem outlined the potential impact from the implementation of the European 3rd package. The group acknowledged that potentially interconnector owners may be certified as Transmission System Operators (TSO) and that this might have implications for the obligations on interconnectors including the provision of mandatory frequency response. Ofgem highlighted the development of industry consultations that will outline the potential implications of the implementation of the European 3rd package. However, at this stage the outcomes of the 3rd package implementation are uncertain, as are any associated ramifications; consequently the group agreed that consideration of any code changes can only be undertaken on the basis of the current industry codes and would therefore proceed with the modifications as proposed.

ANNEX 1 –TERMS OF REFERENCE

BSSG Interconnector Frequency Response Working Group Terms of Reference

It was agreed at October 2009 CUSC Panel to establish a BSSG (Balancing Service Standing Group) Working Group. The Working Group would be tasked with reviewing the commercial mechanisms applicable to the provision of frequency response by future interconnectors, given the anticipated increase in the use of such technology.

Objectives

The Working Group will:

- i. examine the appropriateness and effectiveness of the existing CUSC obligations and commercial mechanism for frequency response for future interconnectors;
- ii. ensure that the transparency of any commercial mechanisms proposed are appropriate, in relation to the corporate ownership of the Interconnector Owner and the National Electricity Transmission System Operator;
- iii. consider and undertake the appropriate mechanisms by which to gain full industry engagement, including the potential use of consultations or workshops;
- iv. identify feasible options that will facilitate the provision of frequency response from future interconnectors, whilst ensuring that undue discrimination does not exist as compared to other providers of frequency response services.
- v. identify and quantify the advantages and disadvantages of each option;
- vi. identify all the impacts of each option on the CUSC, BSC, Licence Methodologies and any other associated documents within the framework;
- vii. agree and recommend a preferred option;
- viii. draft any text modifications necessary to implement the recommendation; and
- ix. monitor the progress of the joint Grid Code/ BSSG Frequency Response Working Group and take into account any impacts arising from its recommendations.

Governance

The Working Group has been convened and will operate and be managed under the remit of the Balance Services Standing Group governance framework. The Working Group will be seeking approval from the BSSG to consequently submit its finding to the CUSC Panel. The CUSC Panel will be asked to approve the initiation of any code Amendment Proposals recommended.

Membership

The membership of the Working Group will be drawn from the BSSG, Elexon, the Authority and any relevant, potential interconnector developers.

Deliverables

The Working Group will produce a report outlining its analysis, findings and recommendations which will be submitted to the BSSG and CUSC Amendments Panel.

Timescales

The Working Group will aim to present its findings and recommendations to the May CUSC Panel and the equivalent meeting of the BSSG (held as and when appropriate).

The first of the future interconnectors, BritNed, is due to start commercial operations during the first financial quarter of 2011.

ANNEX 2 –ATTENDANCE REGISTER

Name	Company	15/12/09	03/02/10	03/03/10	12/04/10	12/05/10
Garth Graham	SSE	Yes	No	Yes*	No	No
Raoul Thulin	RWE	Yes	Yes	Yes	Yes	Yes
Claire Maxim	Eon	Yes	Yes	Yes	No	Yes
Simon Lord	First Hydro	Yes*	Yes*	Yes*	Yes	Yes
Paul McGuickin	Mutual Energy	Yes	Yes*	Yes*	Yes*	No
Rob Smith	BritNed	No	Yes*	Yes	Yes*	No
Simon Tweed	EirGrid	No	Yes*	Yes*	No	No
Mark Lane	EirGrid	No	Yes*	No	No	No
Rodney Doyle	EirGrid	No	Yes*	No	No	No
John Lucas	Elexon	Yes	Yes	Yes*	Yes	No
Camilla McCorkell	EDF	No	No	Yes	No	No
Chris Proudfoot	Centrica	No	No	No	Yes	Yes
Louise Schmitz	EDF	No	No	No	Yes	No
Shafqat Ali	National Grid	No	No	No	Yes	No
Rheka Patel	Waters Wye	No	No	No	Yes	No
Lisa Waters	Waters Wye	No	No	No	No	Yes*
Jenny Sinclair	Scottish Power	No	No	No	Yes*	No
Ewan Stott	Scottish Power	No	No	No	No	Yes
John Morris	British Energy	No	No	No	No	Yes
Olaf Islei	Ofgem	No	No	No	No	Yes*-
Charlotte Ramsay	Ofgem	No	No	No	No	Yes*-
Emmanouela Angelidaki	Ofgem	No	No	No	No	Yes*-
Craig Dyke	National Grid	No	No	No	Yes*	Yes
Mark Peace	National Grid	Yes*	No	Yes*	No	No
Hannah Morgan	National Grid	Yes	Yes	No	No	No
Emma Clark	National Grid	No	No	No	Yes	Yes
Thomas Derry	National Grid	No	No	Yes	Yes	No
Bushra Akhtar	National Grid	Yes	Yes	Yes	No	No
David Smith	National Grid	Yes	Yes	Yes	Yes	Yes
Neil Rowley	National Grid	Yes	Yes	Yes	Yes	Yes

* by teleconference
- Part Meeting

ANNEX 3 –DRAFT LEGAL TEXT FOR POTENTIAL CUSC AMENDMENT PROPOSAL

For the avoidance of doubt this legal text has been developed by the IFRWG and is for illustration purposes only.

CUSC - SECTION 4 BALANCING SERVICES

4.1.3 Frequency Response

Introduction

4.1.3.1 Each applicable **User** is obliged to provide (for the avoidance of doubt, as determined by any direction in force from time to time and issued by the **Authority** relieving that **User** from the obligation under its **Licence** to comply with such part or parts of the **Grid Code** or any **Distribution Code** or, in the case of **The Company**, the **Transmission Licence**, as may be specified in such direction) the **Mandatory Ancillary Service of Frequency Response** referred to in **Grid Code CC 8.1** by means of **Frequency sensitive generation** ([including for the avoidance of doubt by automatic changes in Interconnector flows](#)) in accordance with the terms of this Paragraph 4.1.3 and a **Mandatory Services Agreement** but subject always to and in accordance with the relevant part or parts of the **Grid Code** applicable thereto.

Definitions

4.1.3.2 For the purposes of this Paragraph 4.1.3:

- (i) “**Frequency Response Service**” means the **Mandatory Ancillary Service of Frequency Response** and any **Commercial Ancillary Service of Frequency Response** as may be agreed to be provided by a **User** from time to time;
- (ii) the **Mandatory Ancillary Service of Frequency Response** shall constitute operation of a **BM Unit** [or \(subject to \(vi\) below\) a DC Converter](#) in accordance with **Grid Code CC 6.3.7** and **BC 3.5** (with the exception of **BC 3.5.2**), including, without limitation, under normal operating conditions with the speed governor [or Frequency control device](#) set so that it operates with an overall speed droop of between 3% and 5% so as to provide the applicable levels of **Response** referred to in Paragraph 4.1.3.7;
- (iii) the term "instruction" means a communication whether by telephone or automatic logging device or facsimile from **The Company** to the **User** instructing a **User** in accordance with **Grid Code BC 2.8** and this Paragraph

4.1.3 to provide any **Frequency Response Service**, and derivations of the term shall be construed accordingly;

- (iv) the amendment of an existing instruction shall be deemed to be a new instruction;
- (v) an instruction will prevail until either it is countermanded by **The Company** or until the **BM Unit** to which the instruction relates is **De-synchronised** or (as the case may be) until the direction of Interconnector flow via the DC Converter to which the instruction relates ceases to be from the External System to the National Electricity Transmission System (whichever is first to occur);
- (vi) the Mandatory Ancillary Service of Frequency Response shall only be provided from a DC Converter when operating at a time when the direction of Interconnector flow is from the External System to the National Electricity Transmission System;
- (vii) all references to a User with respect to a DC Converter shall be to the relevant Interconnector Owner.

The Company's Instructions to provide Mode A Frequency Response

4.1.3.3 For the purposes of instructions and calculation of payments, the **Mandatory Ancillary Service of Frequency Response** as described in this Paragraph 4.1.3 shall be referred to as "**Mode A Frequency Response**".

4.1.3.4 **The Company** may at any time instruct a **User** to operate any one or more **BM Unit(s)** or DC Converter(s) so as to provide the following components of **Mode A Frequency Response**:-

- (a) **Primary Response**;
- (b) **Secondary Response**;
- (c) **High Frequency Response**,

in any of the permissible combinations set out in the relevant table in the **Mandatory Services Agreement**.

4.1.3.5 **The Company** shall not instruct a **User** to provide **Mode A Frequency Response** and any **Commercial Ancillary Service of Frequency Response** simultaneously.

4.1.3.6 In the event that any instruction to provide **Frequency Response** does not state whether the instruction is to provide **Mode A Frequency Response** or any **Commercial Ancillary Service of Frequency Response**, such instruction shall be

deemed to be an instruction to provide **Mode A Frequency Response**.

User's Obligation to Provide Response

4.1.3.7 When a **User** is instructed in accordance with Paragraphs 4.1.3.4 and/or 4.1.3.6 to operate a **BM Unit** or DC Converter so as to provide any component(s) of **Mode A Frequency Response**, that **User** shall operate that **BM Unit** or DC Converter so as to provide, for any **Frequency Deviation** and at any level of **De-Load**, at least the amount of **Primary Response** and/or **Secondary Response** and/or **High Frequency Response** set out respectively in the relevant **Frequency Response Capability Data** tables in the **Mandatory Services Agreement** (as such tables are to be interpreted in accordance with Paragraph 4.1.3.11).

4.1.3.7A For the avoidance of doubt a **User** shall ensure that the **Transmission Entry Capacity**, and if relevant the **STTEC** and/or **LDTEC** and/or any **Temporary Received TEC** less any **Temporary Donated TEC**, for the relevant **Connection Site** shall be sufficient to enable it to comply with its obligations under Paragraph 4.1.3.7 above at all times and in respect of all **BM Units** and/or DC Converters.

Calculation of Payments

4.1.3.8 The payments to be made by **The Company** to a **User** hereunder in respect of the provision of any **Mode A Frequency Response** from a **BM Unit** or DC Converter shall be comprised of **Holding Payments** and **Response Energy Payments** and shall be determined in accordance with the formulae in, respectively, Paragraphs 4.1.3.9 and 4.1.3.9A and in accordance with Paragraphs 4.1.3.10 to 4.1.3.12 inclusive.

Payment Formulae - Holding Payments

4.1.3.9 The **Holding Payments** for a **BM Unit** or DC Converter to be made by **The Company** to a **User** referred to in Paragraph 4.1.3.8 shall be calculated in accordance with the following formula:-

$$HP_M = P_M + H_M + S_M$$

Where:

HP_M is the **Holding Payment** to be made to the **User** calculated in £ per minute.

P_M is the payment per minute to be made by **The Company** to the **User** for the **Ancillary Service** of **Primary Response** provided by the **User** from the **BM Unit** or DC Converter

concerned pursuant to an instruction from **The Company** to provide **Mode A Frequency Response**, and is calculated as follows:-

$$P_M = (P_{PR} \times P_{MW} (1 - SF_P)) \times K_T \times K_{GRC} \times \left[\frac{1}{60} \right]$$

H_M is the payment per minute to be made by **The Company** to the **User** for the **Ancillary Service** of **High Frequency Response** provided by the **User** from the **BM Unit or DC Converter** concerned pursuant to an instruction from **The Company** to provide **Mode A Frequency Response**, and is calculated as follows:-

$$H_M = (H_{PR} \times H_{MW} (1 - SF_H)) \times K_T \times K_{GRC} \times \left[\frac{1}{60} \right]$$

S_M is the payment per minute to be made by **The Company** to the **User** for the **Ancillary Service** of **Secondary Response** provided by the **User** from the **BM Unit or DC Converter** concerned pursuant to an instruction from **The Company** to provide **Mode A Frequency Response**, and is calculated as follows:-

$$S_M = (S_{PR} \times S_{MW} (1 - SF_S)) \times K_T \times K_{GRC} \times \left[\frac{1}{60} \right]$$

In this Paragraph 4.1.3.9, the following terms shall have the following meanings:-

- P_{PR} = the appropriate payment rate for **Primary Response** determined in accordance with Paragraph 4.1.3.13;
- P_{MW} = the **Primary Response** capability (expressed in MW) for the level of **De-Load** of the **BM Unit or DC Converter** concerned at the end of the minute in which the service is provided;
- H_{PR} = the appropriate payment rate for **High Frequency Response** determined in accordance with Paragraph 4.1.3.13;
- H_{MW} = the **High Frequency Response** capability (expressed in MW) for the level of **De-Load** of the **BM Unit or DC Converter** concerned at the end of the minute in which the service is provided;
- S_{PR} = the appropriate payment rate for **Secondary Response** determined in accordance with Paragraph 4.1.3.13;
- S_{MW} = the **Secondary Response** capability (expressed in MW) for the level of **De-Load** of the **BM Unit or DC Converter** concerned at the end of the minute in which the service is provided;
- K_T = the ambient temperature adjustment factor. **The Company** and each **User** acknowledge and agree,

as between **The Company** and that **User**, that K_T shall be deemed to be 1 for the purposes of calculating payments until such time as they agree upon an appropriate formula and a suitable method of measuring the ambient temperature on a minute by minute basis which shall be set out in the **Mandatory Services Agreement**. In the event that any agreed method of measuring the ambient temperature on a minute by minute basis should fail following its implementation, then **The Company** and each **User** acknowledge and agree, as between **The Company** and that **User**, that K_T shall be deemed to be 1 until the method of measuring the ambient temperature on a minute by minute basis is restored;

$K_{GRC} =$ where the **BM Unit** is a **CCGT Module**, the plant configuration adjustment factor set out in the relevant table in the **Mandatory Services Agreement** for the configuration of the **BM Unit** concerned at the time at which the capability to provide the service is carried, otherwise 1;

$SF_P =$ 0, subject to Paragraph 4.1.3.21 (e);

$SF_S =$ 0, subject to Paragraph 4.1.3.21 (e);

$SF_H =$ 0, subject to Paragraph 4.1.3.21 (e).

Payment Formulae – Response Energy Payment

4.1.3.9A (a) The **Response Energy Payments** for **BM Unit or DC Converter** i in **Settlement Period** j to be made by **The Company** to a **User** referred to in Paragraph 4.1.3.8 shall be calculated in accordance with the following formulae:-

$$REP_{ij} = RE_{ij} \times \text{Reference Price}$$

But so that where REP_{ij} is negative such amount shall be paid by the **User** to **The Company**.

Where:

REP_{ij} is the **Response Energy Payment** to be made to or, as the case may be, by the **User**; and

RE_{ij} is the expected response energy for **BM Unit or DC Converter** i in **Settlement Period** j calculated as follows:-

$$RE_{ij} = \int_0^{SPD} \left[\max(FR_{ij}(t), 0) \times (1 - SF_{LF}) + \min(FR_{ij}(t), 0) \times (1 - SF_H) \right] \times K_T \times K_{GRC} dt$$

Where:

$\int_0^{SPD} dt$ is the integral at times t , over the **Settlement Period** duration.

SF_{LF} is equal to SF_P in the case of a **BM Unit or DC Converter** being instructed to deliver **Primary Response** without **Secondary Response** or the mean of SF_P and SF_S in the case of a **BM Unit or DC Converter** being instructed to deliver **Primary Response** and **Secondary Response**.

SF_P , SF_S , SF_H , K_T and K_{GRC} have the meanings ascribed to them in Paragraph 4.1.3.9.

$FR_{ij}(t)$ is the expected change in **Active Power** output for **BM Unit or DC Converter** i , at time t (resolved to the nearest integer minute), expressed in MW derived from the relevant **Frequency Response Power Delivery Data** table in the **Mandatory Services Agreement** (as such table is interpreted in accordance with Paragraph 4.1.3.11) by reference to the level of **De-Load** of the **BM Unit or DC Converter** concerned at the end of the minute and the mean **Frequency Deviation** over that minute when that **BM Unit or DC Converter** is providing **Mode A Frequency Response** and zero at all other times.

For this purpose:-

- (i) for a positive **Frequency Deviation** the expected change in **Active Power** output of **BM Unit or DC Converter** i shall be derived from the table entitled “**High Frequency Response Power Delivery – Mode A**” set out in the **Mandatory Services Agreement** and shall be signed negative; and
- (ii) for a negative **Frequency Deviation**, the expected change in **Active Power** output of **BM Unit or DC Converter** i shall be derived from:
 - A) the table entitled “**Primary Response Power Delivery – Mode A**” in the case of a **BM Unit or DC Converter** being instructed to deliver **Primary Response** without **Secondary Response**; or
 - B) the table entitled “**Primary and Secondary Response Power Delivery – Mode A**” in the case of a **BM Unit or DC Converter** being instructed to deliver **Primary Response** and **Secondary Response**,

in each case set out in the **Mandatory Services Agreement** and shall be signed positive.

Where: RE_{ij} is positive then:

$$\text{Reference Price} = \max \left(\frac{\sum_s \{ \mathbf{PXP}_{sj} \times \mathbf{QXP}_{sj} \}}{\sum_s \{ \mathbf{QXP}_{sj} \}} \times 1.25, 0 \right)$$

where \sum_s represents the sum over all **Market Index Data Providers**.

Where RE_{ij} is negative then:

$$\text{Reference Price} = \max \left(\frac{\sum_s \{ \mathbf{PXP}_{sj} \times \mathbf{QXP}_{sj} \}}{\sum_s \{ \mathbf{QXP}_{sj} \}} \times 0.75, 0 \right)$$

where \sum_s represents the sum over all **Market Index Data Providers**

- (b) In this Paragraph 4.1.3.9A, the following terms shall have the meanings ascribed to them in the **Balancing and Settlement Code**:-

“ \mathbf{PXP}_{sj} ”

“ \mathbf{QXP}_{sj} ”

“**SPD**”

“**Market Index Data Provider**”

- 4.1.3.10 **The Company** and each **User** acknowledge and agree, as between **The Company** and that **User**, that no **Holding Payment** or **Response Energy Payment** shall be payable except in relation to periods in respect of which instructions have been issued by **The Company** pursuant to this Paragraph 4.1.3.

- 4.1.3.11 *Interpretation of Tables – Levels of Response*
The figures for **Response** set out in the Frequency Response Capability Data tables and Frequency Response Power Delivery Data tables in the **Mandatory Services Agreements** shall be given in relation to specific **Frequency Deviations** and to specific levels of **De-Load** for a **BM Unit or DC Converter**. Such tables shall, for the purposes of Paragraphs 4.1.3.7 and 4.1.3.9A(a), be construed in accordance with this Paragraph 4.1.3.11. Subject to Paragraphs 4.1.3.11(d) and (e):-

- (a) for a **Frequency Deviation** at a given time differing from the figures given in a table, the level of **Response** shall be calculated by linear interpolation from the

figures specified in the table in respect of **Frequency Deviations**;

(b) for a level of **De-Load** at a given time differing from the figures given in a table, the level of **Response** shall be calculated by linear interpolation from the figures specified in the table in respect of levels of **De-Load**. For the avoidance of doubt, **Frequency Sensitive Mode** shall not be instructed for any **De-Load** greater than the maximum level of **De-Load** given in the relevant Frequency Response Capability Data table;

(c) in respect of any time in relation to which both Paragraphs 4.1.3.11(a) and (b) apply, the level of **Response** shall be calculated by dual linear interpolation from the figures specified in the table in respect of **Frequency Deviations** and in respect of levels of **De-Load**;

and

(d) for any **Frequency Deviation** greater than the greatest **Frequency Deviation** given in a table (whether positive or negative), the level of **Response** shall be calculated by reference to the greatest **Frequency Deviation** (positive or negative, as the case may be) given in that table; and

(e) for the purposes of calculating levels of **Response** in respect of **Frequency Deviations** lower than those specified in a table, the relevant table(s) shall be deemed to specify a level of zero **Response** for a **Frequency Deviation** of zero.

Interpretation of Tables – Levels of Holding Payment

4.1.3.12 The Frequency Response Summary Data table in the **Mandatory Services Agreement** shall set out figures in respect of given levels of **De-Load** for the purposes of calculating payment in accordance with the formulae in Paragraph 4.1.3.9. Where the level of **De-Load** of the **BM Unit or DC Converter** is other than one of the levels given in such table, then, the figure for P_{MW} , S_{MW} or H_{MW} as the case may be, shall be calculated by linear interpolation from the figures in such table in respect of levels of **De-Load**.

User's submission of Holding Payment Rates

4.1.3.13 The following terms shall apply to determine the payment rates for **Primary Response**, **High Frequency Response** and **Secondary Response** used in the calculation of **Holding Payments** in accordance with Paragraph 4.1.3.9 which shall apply in respect of the provision of **Mode A Frequency Response** by the **User** to **The Company** from one or more **BM Units or DC Converters** in a calendar month (and, for the purposes thereof, all dates specified in this Paragraph 4.1.3.13

unless stated otherwise refer to the immediately preceding calendar month):-

- (a) By the fifth **Business Day** of the calendar month, **The Company** shall publish on its web-site information relating to **The Company's** requirement for **Mode A Frequency Response** (in MW) in the next following calendar month.
- (b) By the fifteenth **Business Day** of the calendar month, the **User** may in relation to any of its **BM Units or DC Converters** identified in a **Mandatory Services Agreement** to which the **User** is a party submit a single notification to **The Company** (in a form and by such method as shall be prescribed by **The Company** from time to time) specifying in respect of that **BM Unit or DC Converter** the payment rates to apply in determining the **Holding Payments** for the provision of **Mode A Frequency Response** during the next following calendar month, each such notification to specify:-
 - (i) the **BM Unit or DC Converter** in question;
 - (ii) the payment rate for **Primary Response**;
 - (iii) the payment rate for **High Frequency Response**; and
 - (iv) the payment rate for **Secondary Response**.
- (c) Payment rates submitted by the **User** in accordance with Paragraph 4.1.3.13(b) must be:-
 - (i) quoted in pounds sterling to the nearest penny;
 - (ii) quoted in units of £/MW/h; and
 - (iii) no greater than £[9999.99].
- (d) Upon receipt of a notification from the **User** made in accordance with Paragraph 4.1.3.13(b), **The Company** shall publish details of such notification in a report issued in accordance with Paragraph 4.1.3.13(A)(a) and, subject always to rectification (if any) of payment rates pursuant to Paragraph 4.1.3.13(e), **The Company** shall apply published payment rates for **Primary Response**, **High Frequency Response** and **Secondary Response** in calculating the **Holding Payments** for the relevant **BM Unit or DC Converter** in the next following calendar month.
- (e) The **User** shall have the right, to be exercised within one **Business Day** of the publication of payment rates in respect of a **BM Unit or DC Converter** in accordance with Paragraph 4.1.3.13(d), to notify **The Company** (in a

form and by such method as shall be prescribed by **The Company** from time to time) of any discrepancy between those payment rates and the actual payment rates submitted by the **User** in respect of that **BM Unit or DC Converter** in accordance with Paragraph 4.1.3.13(b). Upon receipt of any such notification, **The Company** shall rectify the report issued in accordance with Paragraph 4.1.3.13A(a) and shall publish the rectified report in accordance with Paragraph 4.1.3.13A(b).

- (f) In the absence of a notification from a **User** in accordance with Paragraph 4.1.3.13(b) in respect of the provision by a **BM Unit or DC Converter** of **Mode A Frequency Response** in the next following calendar month, then the payment rates for **Primary Response**, **High Frequency Response** and **Secondary Response** to apply in determining the **Holding Payments** for that **BM Unit or DC Converter** in respect of that calendar month shall be determined as follows:-
- (i) where the **User** has never in respect of any previous calendar month submitted a notification in accordance with Paragraph 4.1.3.13(b) in respect of the provision by that **BM Unit or DC Converter** of **Mode A Frequency Response**, the payment rate to apply to the provision of each of **Primary Response**, **High Frequency Response** and **Secondary Response** from that **BM Unit or DC Converter** in that calendar month shall be deemed to be either:-
- (aa) the payment rates for **Primary Response**, **High Frequency Response** and **Secondary Response** prevailing immediately prior to the date of implementation of **Amendment Proposal CAP047**; or
- (bb) where no payment rates as referred to in paragraph (aa) above subsisted at the date of implementation of **Amendment Proposal CAP047**, £00.00/MW/h; or
- (ii) in all other cases, the payment rates for **Primary Response**, **High Frequency Response** and **Secondary Response** which shall apply in respect of the provision by that **BM Unit or DC Converter** of **Mode A Frequency Response** in that calendar month shall be the payment rates most recently published in accordance with Paragraph 4.1.3.13A(a) or (b) (as the case may be) for that **BM Unit or DC Converter** in respect of a previous calendar month;

- (g) Paragraph 4.4.2.2 shall not apply to the payment rates for **Primary Response, High Frequency Response** and **Secondary Response** determined in accordance with this Paragraph 4.1.3.13.

*Publication of **Holding Payment Rates** and other information*

- 4.1.3.13A (a) **The Company** shall use reasonable endeavours to publish on its web-site by the 16th **Business Day** of each calendar month, a report containing the following information in respect of each applicable **User's BM Unit(s) and/or DC Converter(s)** to apply in respect of the next following calendar month:-
- (i) the payment rates for **Primary Response, High Frequency Response** and **Secondary Response** to apply in determining the **Holding Payments** for the next following calendar month as determined in accordance with Paragraph 4.1.3.13;
 - (ii) the available **Response** volume (in such form and manner as shall be prescribed by **The Company** from time to time).
- (b) Where any payment rates published in a report issued in accordance with Paragraph 4.1.3.13A(a) are rectified by **The Company** in accordance with Paragraph 4.1.3.13(e), **The Company** shall as soon as reasonably practicable thereafter publish the rectified report on its web-site.
- (c) In respect of each day in a calendar month, **The Company** shall use reasonable endeavours to publish on its web-site by the third **Business Day** of the calendar month following that calendar month, provisional data in respect of all **BM Units and DC Converters** details of instructions issued by **The Company** in accordance with Paragraph 4.1.3.4 for each of **Primary Response, High Frequency Response** and **Secondary Response** (in such form and manner as shall be prescribed by **The Company** from time to time). The **Users** recognise that the provisional data may differ from the data to be provided under Paragraph 4.1.3.13A (d) and therefore any reliance upon this provisional data is entirely at the **User's** risk.
- (d) In respect of each day in a calendar month, **The Company** shall, by the ninth **Business Day** of the calendar month following that calendar month, publish on its web-site in respect of all **BM Units and DC Converters** details of instructions issued by **The Company** in accordance with Paragraph 4.1.3.4 for each of **Primary Response, High Frequency**

Response and **Secondary Response** (in such form and manner as shall be prescribed by **The Company** from time to time).

- (e) Each **User** consents to the disclosure by **The Company** of the information referred to in Paragraphs 4.1.3.13A(a) and (b) in so far as it relates the provision of **Mode A Frequency Response** from its **BM Unit(s) and/or DC Converter(s)**, provided always that **The Company** shall not be bound to comply with the provisions of Paragraphs 4.1.3.13A(a) and (b) with regard to the provision of information to the extent that to do so would be likely to restrict, distort or prevent competition in the provision of **Mode A Frequency Response**.

Requests to Amend Levels of Response

- 4.1.3.14 Where either the **User** or **The Company** reasonably considers in light of operating experience that the levels of **Response** set out in the Frequency Response Capability Data tables and / or the Frequency Power Delivery Data tables in the **Mandatory Services Agreement** do not represent the true operating capabilities of a **BM Unit(s) or DC Converter(s)**, the **User** or **The Company** (as the case may be) shall have the right not more than once every two months (or otherwise at any time with the specific agreement of the other party to the **Mandatory Services Agreement**) to request (provided always that such request be accompanied by a reasonable justification therefor) that the levels of **Response** set out in the relevant response table(s) in the **Mandatory Services Agreement** be reviewed and, if appropriate, amended by agreement with such other party, such agreement not to be unreasonably withheld or delayed.

Procedure for Amendments to Levels of Response

- 4.1.3.15 Any amendments agreed by **The Company** and a **User** pursuant to Paragraph 4.1.3.14 or determined by an arbitrator or panel of arbitrators under the **Dispute Resolution Procedure** in the circumstances referred to in Paragraph 4.1.3.16 shall not become effective until (in the case of agreed amendments) a date at least five **Business Days** after an amending agreement is entered into between **The Company** and the **User** in accordance with the **Mandatory Services Agreement** or, in the case of determined amendments, such other date as may be determined by an arbitrator or panel of arbitrators under the **Dispute Resolution Procedure** subject always to Paragraphs 4.1.3.17 and 4.1.3.18.

Failure to Agree Amendments

- 4.1.3.16 If **The Company** and a **User** are unable to agree any amendments requested pursuant to Paragraph 4.1.3.14 within 28 days of either of them serving on the other notice of its intention to invoke the **Dispute Resolution Procedure** then either party may initiate the procedure for resolution of the issue as an **Other Dispute** in accordance with Paragraph 7.4.

Dispute Resolution Procedure

- 4.1.3.17 **The Company** and each **User** acknowledge and agree, as between **The Company** and that **User**, that rule 12.1(p) of the **Electricity Arbitration Association** shall apply to any arbitration proceedings initiated pursuant to Paragraph 7.4 in the circumstances referred to in Paragraph 4.1.3.16, but that the changes determined by any arbitrator or panel of arbitrators shall not apply in respect of any period prior to the date on which the **Dispute Resolution Procedure** is invoked.

Implementation of Determinations

- 4.1.3.18 Any amendments to levels of **Response** determined by an arbitrator or panel of arbitrators under the **Dispute Resolution Procedure** in the circumstances referred to in Paragraph 4.1.3.16 shall take effect from the date five **Business Days** following the relevant determination.

Implementation of Continuous Monitoring System

- 4.1.3.19 To the extent the same shall be acceptable to **The Company** and a **User** on the basis of a cost benefit analysis, **The Company** and a **User** agree, as between **The Company** and that **User**, to the implementation of a continuous monitoring system as soon as is reasonably practicable. The continuous monitoring system shall be in accordance with the relevant principles set out in Paragraph 4.1.3.21 for the purposes of confirming performance of the **BM Units** or DC Converters and adjusting payments pursuant to this Paragraph 4.1.3.

Incident Based Monitoring System

- 4.1.3.20 Pending implementation of the continuous monitoring system, **The Company** and each **User** agree, as between **The Company** and that **User**, to implement an incident based monitoring scheme for the purpose of confirming the performance of the **BM Units** or DC Converters pursuant to this Paragraph 4.1.3. Such incident based monitoring scheme shall be in accordance with the relevant principles set out in Paragraph 4.1.3.21. Neither **The Company** nor the **User** shall unreasonably withhold or delay such agreement and/or implementation.

Genset and DC Converter Response Monitoring

Introduction

- 4.1.3.21 (a) This Paragraph 4.1.3.21 sets out the principles relating to:
- (i) the proposed continuous monitoring system to be implemented pursuant to Paragraph 4.1.3.19; and
 - (ii) the incident based monitoring system to apply until such time as implementation of the continuous monitoring system takes place.

Some elements of the continuous monitoring system are currently undergoing testing and development and it is accepted that if final testing of these elements proves unsatisfactory alternatives will need to be developed. Further, implementation of the continuous monitoring system shall be subject to its acceptability to **The Company** and **Users** on the basis of a cost benefit analysis.

Wherever possible the technical specification of both the incident based monitoring system and the continuous monitoring system will be designed so as to enable future development or enhancement.

Aims of Project

- (b) The aim of the monitoring project (which includes, without limitation, the development of the incident based monitoring system and the continuous monitoring system) is to develop a response monitoring system which will measure the response performance of generators against the levels of **Frequency Response** required to be provided under **Mandatory Services Agreements**.

Incident Based Monitoring Scheme

- (c) Details of the incident based monitoring scheme (including without limitation the definitions of Shortfall Period and Incident, the calculation of service delivery and the determination of Incident start and end times) will be more particularly set out in a document entitled "Procedure for Incident Based Response Monitoring" ("the PIRM Document") to be produced by **The Company** and agreed by all relevant **Users** (such agreement not to be unreasonably withheld or delayed).

For the avoidance of doubt during the period during which the incident based monitoring scheme applies, and prior to the implementation of the continuous monitoring system, for the purposes of the formulae in Paragraphs 4.1.3.9 and 4.1.3.9A, the values of SF_P , SF_S and SF_H shall be zero, such that no payment reduction shall apply during such period in respect of shortfall.

Continuous Based Monitoring Scheme – Confirmation of Response Delivery

- (d) The main objective of the continuous monitoring scheme is to provide a quantitative measure of **Frequency Response** delivery against which payment can be justifiably made and to reduce payments if delivery does not comply with the **CUSC** and the **Mandatory Services Agreement**. As the capability of a **BM Unit** or DC Converter to provide the level of

Response required pursuant to this Paragraph 4.1.3 for any change in **System Frequency** occurring during the period of delivery of Response pursuant to a prior change in **System Frequency** will be affected by the level of **Response** then being delivered, relevant fluctuations in **System Frequency** should to this extent be taken into account by the continuous monitoring scheme for the purpose of calculating payment levels.

Determination of Response Shortfall

(e) For the purposes of the continuous monitoring system, the **Response** shortfall may take three forms:-

- (i) average **Primary Response** under-delivery;
- (ii) average **Secondary Response** under-delivery;
- (iii) average **High Frequency Response** under-delivery,

in each case over a Shortfall Period (such term to be defined prior to implementation of the continuous monitoring system).

Upon the implementation of the continuous monitoring system, for the purposes of determining any such average under-delivery, SF_P , SF_S and SF_H shall be the average under-delivery of **Primary Response**, **Secondary Response** and **High Frequency Response** respectively during the Shortfall Period in which the **Ancillary Service** was, or should have been, provided. For the purposes of the formulae in Paragraphs 4.1.3.9 and 4.1.3.9A, such average under-delivery will be determined using a continuous plant response assessment algorithm which is under development and which will be agreed with the **User** prior to its implementation and expressed in terms of $0 \leq SF \leq 1$.

Measurement of System Variables

(f) In relation to the continuous monitoring system measurement of **System Frequency** and generator output power will be required local to the **BM Unit or DC Converter**. **Synchronised** time tagging of both power and **Frequency** will be required.

Frequency is required as the fundamental driving variable of the contract model software. Access to a voltage source to enable **Frequency** to be measured is not expected to cause any difficulty. The measurement of generator output power will also be required every

second. Cost effective access to this measurement is, however, less straight forward. Covered below are two options describing how this will be achieved. It is expected that normally the FMS interface unit will be the method used; however, where the **BM Unit or DC Converter** concerned has derogations from FMS, method two may be used.

FMS Interface Unit

- (g) The use of the Final Metering System (FMS) represents a logical method of measurement since it eliminates the high cost associated with running cables to access CTs and VTs.

The high accuracy integrated data from FMS will be used to re-generate a power profile and curve fitting techniques will be applied to improve accuracy. This instantaneous power curve will then be sampled every second to obtain the required values.

Direct Measurement

- (h) Where for the reasons detailed in Paragraph 4.1.3.21(f) it is not possible to use the FMS interface unit, the use of 'ISAT' type transducers will be employed to interface between the monitoring equipment and the measurement transformers' secondary circuit.

It is envisaged that generators seeking derogations from FMS will be supportive in establishing convenient VT and CT secondary connections for this purpose.

Contract Model

- (i) The contract model is the heart of the continuous monitoring system and it is crucial to the philosophy behind the system, namely that of modelling the **Mandatory Services Agreement** and not the **BM Unit or DC Converter** itself.

Given the difficulty in measuring **Frequency Response** directly on loaded plant, the need to compare changes in power delivery against expectation is evident. Comparison against this model output, which in turn is based on agreed and legally binding contracts, permits an identifiable quantity of non conformity to be measured and payments to be suitably reduced.

Therefore, since the **Mandatory Services Agreement** itself is the quantifying factor, there can be no redress due to assumptions regarding the technical attributes of the **BM Unit or DC Converter** other than those taken into account in setting the levels of **Response**.

Functional Objective

- (j) In relation to the continuous monitoring system, the model will comprise software which uses system and

instructed variables to access the contract look-up tables. The look-up tables used will precisely mimic the response tables set out in **Mandatory Services Agreements**. These variables in turn will be processed using an algorithm to determine the levels of **Response** expected at any instant in time.

It is intended that this process will be effective during both small and large **Frequency Deviations**. Indeed with regard to reduction in payment and estimated **Response** capability, response to small **Frequency Deviations** is extremely important.

Input Data

- (k) In relation to the continuous monitoring system, inputs to the contract model will include **Frequency**, all contract table data, target load, **Target Frequency**, the latest genset availability, the response instruction, LF setting (if electronically despatched) and any other information required which may be specified in the **Mandatory Services Agreement**.

Comparator

- (l) In relation to the continuous monitoring system, the comparator will determine the difference between the measured change in the level of **Output** from the **BM Unit or DC Converter** by way of **Frequency Response** and the change in **Output** level that is specified in the **Mandatory Services Agreement**.

- 4.1.3.22 If, at any time during the term of a **Mandatory Services Agreement**, there is a variation in the security standards with which **The Company** is obliged to comply and such variation would, in a **User's** reasonable opinion, materially affect the operation of the services to be provided under that **Mandatory Services Agreement**, **The Company** and that **User** shall negotiate in good faith with a view to agreeing and implementing appropriate amendments to any relevant **Mandatory Services Agreement**. If they are unable to reach agreement within 28 days of either of them serving on the other notice of its intention to invoke the **Dispute Resolution Procedure**, either of them may initiate the procedure for resolution of the issue as an **Other Dispute** in accordance with Paragraph 7.4.

CUSC - SECTION 11

INTERPRETATION AND DEFINITIONS

“De-Load” the difference (expressed in MW) between:

- (a) in the case of a **BM Unit**, the **Maximum Export Limit** and the **Final Physical Notification Data** as adjusted by the **Acceptance Volume** in respect of a **Bid-Offer Acceptance** (if any); or
- (b) in the case of a **DC Converter**, the prevailing transfer capacity of the relevant **Interconnector** and the prevailing **Interconnector** flow, in each case in the direction of flow from the **External System** to the **National Electricity Transmission System** and as more particularly specified in the **Mandatory Services Agreement**,

“**External System**” as defined in the **Grid Code**;

SCHEDULE 2 - EXHIBIT 4

DATED [] 200[]

NATIONAL GRID ELECTRICITY TRANSMISSION COMPANY PLC (1)

and

[] (2)

**THE CONNECTION AND USE OF SYSTEM CODE
MANDATORY SERVICES AGREEMENT
RELATING TO [] [POWER STATION][DC CONVERTER]**

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

THIS **MANDATORY SERVICES AGREEMENT** is made on the [] day of [] 200[]

BETWEEN

- (1) **National Grid Electricity Transmission plc** a company registered in England with number 2366977 whose registered office is at 1-3 Strand, London, WC2N 5EH ("**The Company**", which expression shall include its successors and/or permitted assigns); and
- (2) [] a company registered in [] with number [] whose registered office is at [] ("**User**", which expression shall include its successors and/or permitted assigns)

WHEREAS

- (A) Pursuant to the **Transmission Licence**, **The Company** is required to prepare a Connection and Use of System Code (**CUSC**) setting out the terms of the arrangements for connection to and use of the **National Electricity Transmission System** and the provision of certain **Balancing Services**.
- (B) As at the date hereof, **The Company** and the **User** are parties to the **CUSC Framework Agreement** (being an agreement by which the **CUSC** is made contractually binding between the parties).
- (C) This **Mandatory Services Agreement** is entered into pursuant to the terms of the **CUSC** and shall be read as being governed by it and, as between **The Company** and the **User**, has priority over the terms of the **CUSC** in accordance with (and subject to) Paragraph 11.2.2 of the **CUSC**.

NOW IT IS HEREBY AGREED as follows:

1. DEFINITIONS, INTERPRETATION AND CONSTRUCTION

Unless the subject matter or context otherwise requires or is inconsistent therewith, terms and expressions defined in Section 11 of the **CUSC** have the same meanings, interpretations or constructions in this **Mandatory Services Agreement**. Subject thereto, unless the subject matter or context otherwise requires or is inconsistent therewith, in this **Mandatory Services Agreement** the terms set out in Appendix 3 shall have the meanings set out respectively therein.

2. COMMENCEMENT

This **Mandatory Services Agreement** shall commence on [] ("**Commencement Date**").

3. OBLIGATORY REACTIVE POWER SERVICE - DEFAULT UTILISATION

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3.1 Schedule 3, Part I to the CUSC

The provisions of this Clause 3 implement the terms of Paragraph 2 of Schedule 3, Part I to the **CUSC** ("**CUSC Schedule**") with respect to the payments to be made by **The Company** to the **User** for the provision by the **User** from the **BM Units** of the **Obligatory Reactive Power Service**, and in accordance with Paragraph 2.1 thereof the **Parties** hereby agree to make all necessary amendments to this **Mandatory Services Agreement** so as to give effect to the provisions of the **CUSC Schedule** as amended or modified from time to time.

3.2 Term and Suspension

[3.2.1 The provisions of this Clause 3 shall be deemed to have applied in relation to each **BM Unit** with effect from 00.00 hours on the [date hereof] [**Commencement Date**] and, subject always to Sub-Clause 3.2.2, shall continue thereafter unless and until the earlier of termination of the **CUSC Schedule** and termination of this **Mandatory Services Agreement**. For the avoidance of doubt, in the event this **Mandatory Services Agreement** is terminated in relation to any individual **BM Unit**, the provisions of this Clause 3 shall terminate in relation to that **BM Unit** only.] *OR*

[3.2.1 The provisions of Sub-Clauses 3.3 to 3.6 inclusive shall apply with effect from 00.00 hours on the date on which it is demonstrated (having regard to industry practice) to the reasonable satisfaction of **The Company** that each of the [**CCGT**] [**BM**] **Units** complies with the provisions of **Grid Code CC** 6.3.2 and 6.3.4 (or the coming into force of a direction issued by the **Authority** relieving the **User** of the obligation under its **Licence** to comply therewith) or (where **The Company** in its sole discretion requires **Reactive Power** from the **BM Units** before then for the purposes of security of the **National Electricity Transmission System**) such earlier date as **The Company** may agree with the **User** and, subject always to Sub-Clause 3.2.3, shall continue thereafter unless and until the earlier of termination of the **CUSC Schedule** and termination of this **Mandatory Services Agreement**. For the avoidance of doubt, the issue by **The Company** in relation to the **BM Unit** of a **Reactive Despatch Instruction** to unity power factor or zero Mvar shall not imply demonstration to **The Company's** reasonable satisfaction of compliance as referred to above nor imply in relation to the **BM Unit** agreement by **The Company** of an earlier date as referred to herein.

3.2.2 No demonstration referred to in Sub-Clause 3.2.1 shall take place until the **User** shall have demonstrated to **The Company's** reasonable satisfaction (having regard to industry practice) that each [**CCGT**] [**BM**] **Unit's Excitation System**, and in particular the **Under-excitation Limiter**, has been

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successfully commissioned and complies with the provisions of **Grid Code CC 6.3.8.**]

3.2.2/3 In relation to any **BM Unit**, the provisions of this Clause 3 (except this Sub-Clause 3.2) shall be suspended and have no force and effect upon the coming into effect, and for the duration of, any agreement (referred to in the **CUSC Schedule** as a "**Market Agreement**" and being either a new **Ancillary Services Agreement** or an agreement incorporating provisions into this **Mandatory Services Agreement**) which may be entered into between the Parties pursuant to Paragraph 3 of the **CUSC Schedule** for the provision by the **User** in relation to that **BM Unit** of:-

- (a) the **Obligatory Reactive Power Service** but with alternative payment arrangements to those provided in this Clause 3; or

- (b) an **Enhanced Reactive Power Service**.

For the avoidance of doubt, with effect from the expiry or termination of any **Market Agreement** such provisions shall in relation to that **BM Unit** cease to be suspended and shall resume full force and effect.

3.2.3/4 Termination or suspension of this Clause 3 shall not affect the rights and obligations of the **Parties** accrued as at the date of termination or suspension.

3.3 Capability Data

3.3.1 The **Parties** agree that, for the purposes of the Appendices to the **CUSC Schedule**:-

- [(a) the figures set out in Table B of Appendix 1, Section A, Part I represent for each **BM Unit** the **Reactive Power** capability at **Rated MW** which the **User** is obliged to provide under and in accordance with the **Connection Conditions** of the **Grid Code**, together with **Reactive Power** capability at other levels of **MW Output** as specified therein by reference to the **Generator Performance Chart** submitted in accordance with **Grid Code OC 2.4.2** and measured at the generator stator terminals; and

- (b) the figures set out in Table A of Appendix 1, Section A, Part I shall constitute for each of the **BM Units** the value of QC_{lead} and QC_{lag} referred to in Section 2 of Appendix 3 to the **CUSC Schedule** representing the **Reactive Power** capability at **Rated MW** shown at the **Commercial Boundary** (by application of the formulae set out in Appendix 8 to the **CUSC Schedule**).] *OR*

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[(a) the figures set out in Table B of Appendix 1, Section A, Part I represent for each relevant **CCGT Unit** the **Reactive Power** capability at **Rated MW** which the **User** is obliged to provide under and in accordance with the **Connection Conditions** of the **Grid Code**, together with **Reactive Power** capability at other levels of **MW Output** as specified therein by reference to the **Generator Performance Chart** submitted in accordance with **Grid Code OC 2.4.2** and measured at the generator stator terminals; and

- (b) the figures set out in summary Table C of Appendix 1, Section A, Part I represent for the **BM Unit** the **Reactive Power** capability of each relevant **CCGT Unit** at **Rated MW** (derived from Table B) but shown at the high voltage side of the **Generating Unit** step-up transformer by application of the formula set out in Appendix 8, Part 2 to the **CUSC Schedule**; and
- (c) the figures set out in Table A of Appendix 1, Section A, Part I shall constitute for the **BM Unit** the value of QC_{lead} and QC_{lag} referred to in Section 2 of Appendix 3 to the **CUSC Schedule** representing the **Reactive Power** capability of the **BM Unit** at **Rated MW** shown at the **Commercial Boundary** (derived by the summation of the **Reactive Power** capability of each relevant **CCGT Unit** at **Rated MW** extracted from summary Table C and by application of the formulae set out in Appendix 8, Part 2 to the **CUSC Schedule**.)

3.4 Payments to User

- 3.4.1 In respect of each **BM Unit**, and in consideration of the **User** providing the **Obligatory Reactive Power Service** from that **BM Unit**, **The Company** shall pay to the **User** in respect of each calendar month in accordance with Paragraph 4.3 of the **CUSC** the aggregate total payments calculated in accordance with Appendix 1 to the **CUSC Schedule** and referred to therein as "PT".
- 3.4.2 For the purposes of Sub-Clause 3.4.1:-
 - (a) the **Relevant Zone** in which the **BM Units** are situated is specified in Appendix 1, Section A, Part I;
 - (b) without prejudice to Paragraph 4.1.2.2 of the **CUSC**, **The Company** shall use the meters and aggregation principles specified and/or referred to in Appendix 1, Section A, Part II to ascertain the amount of **Leading** and **Lagging** Mvarh produced in each **Settlement Period** by the **BM Units**, and such amount of **Leading** or **Lagging** Mvarh shall constitute

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the respective values of U_{lead} and U_{lag} as referred to in paragraph 1 of Appendix 3 to the **CUSC Schedule**; and

- (c) the **Parties** acknowledge that all meters and metered data used for the purposes of this Clause 3 shall comply with the provisions of Appendix 4 to the **CUSC Schedule**.

4. FREQUENCY RESPONSE

4.1 Paragraph 4.1.3 of CUSC

The provisions of this Clause 4 give effect to the provisions of Paragraph 4.1.3 of the **CUSC** in respect of the provision by the **User** from the **[BM Units]-[DC Converter]** of the **Mandatory Ancillary Service of Frequency Response** and the payments to be made by **The Company** to the **User** in respect thereof.

4.2 Term

4.2.1 The provisions of this Clause 4 shall be deemed to have applied in relation to each **[BM Unit][DC Converter]** with effect from 00.00 hours on the [date hereof] **[Commencement Date]** and shall continue thereafter unless and until this **Mandatory Services Agreement** is terminated. For the avoidance of doubt, in the event this **Mandatory Services Agreement** is terminated in relation to any individual **[BM Unit][DC Converter]**, the provisions of this Clause 4 shall terminate in relation to that **[BM Unit][DC Converter]** only.

4.2.2 Termination of this Clause 4 shall not affect the rights and obligations of **The Company** and the **User** accrued as at the date of termination.

4.3 Provision of Frequency Response

4.3.1 The **Parties** agree that:-

- (a) [subject always to Sub-Clause 4.4,] for the purposes of Paragraph 4.1.3.7 of the **CUSC**, the figures set out in the response tables in Appendix 1, Section B, Part I represent the amount of **Primary Response, Secondary Response and High Frequency Response** referred to therein;
- (b) [subject always to Sub-Clause 4.4] for the purposes of Paragraph 4.1.3.9 of the **CUSC**, the figures set out in the summary response table in Appendix 1, Section B, Part II represent the capabilities in respect of **Primary Response, Secondary Response and High Frequency Response** at given levels of **De-Load** referred to therein;
- (c) for the purposes of Paragraph 4.1.3.4 of the **CUSC**, the table in Appendix 1, Section B, Part III shows the permissible combinations of **Primary Response, Secondary Response and High Frequency Response** referred to therein;

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- (d) for the purposes of Paragraph 4.1.3.9 of the **CUSC**, the figures (if any) set out in the plant configuration table in Appendix 1, Section B, Part II represent the plant configuration adjustment factors referred to therein to be applied where the **BM Unit** is a **CCGT Module**;
- (e) [subject always to Sub-Clause 4.4,] for the purposes of Paragraph 4.1.3.9A(a) of the **CUSC** in respect of calculation of the **Response Energy Payment**, the response values in Appendix 1, Section B, Part IV represent the **Frequency Response Power** that is deemed to be delivered in respect of **Primary Response**, **Secondary Response** and **High Frequency Response**.

4.3.2 For the purposes of this **Mandatory Services Agreement** and Section 4 of the **CUSC** "**De-Load**" shall mean [_____].²⁰

4.4 [Commissioning and Provisional Response Levels

Without prejudice to Paragraph 4.1.3.14 of the **CUSC**, the **User** acknowledges that the levels of **Response** set out in the response tables in Appendix 1, Section B, Parts I, II and IV are indicative figures only during the period in which the relevant [**Generating Unit(s)**][**DC Converter(s)**] is being commissioned and the **User** hereby undertakes to use its reasonable endeavours to forward to **The Company** levels of **Response** which represent the true operating characteristics of such **Generating Unit(s)** [**DC Converter(s)**] for inclusion in Appendix 1, Section B, Parts I, II and IV as soon as possible following completion of commissioning.]

5. RESTRICTIVE TRADE PRACTICES ACT

Any restriction or information provision (each of those terms having the same meaning in this Clause 5 as in the Restrictive Trade Practices Act 1976) contained in this **Mandatory Services Agreement** shall cease to have effect:-

- (i) if a copy of this **Mandatory Services Agreement** is not provided to the Department of Trade and Industry ("**DTI**") within 28 days of the date on which this **Mandatory Services Agreement** is made; or
- (ii) if, within 28 days of the provision of that copy to the **DTI**, the **DTI** gives notice of objection to the **Party** providing it.

6. GENERAL PROVISIONS

²⁰ To be included in the case of DC Converters only.

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IN WITNESS WHEREOF the hands of the duly authorised representatives of the parties hereto at the date first above written

SIGNED BY)
[name])
for and on behalf of)
NATIONAL GRID ELECTRICITY TRANSMISSION PLC)

SIGNED BY)
[name])
for and on behalf of)
[User])

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

APPENDIX 1 – DATA
SECTION A (REACTIVE POWER)

Part I
Capability Tables (Relevant Zone [])

BM Unit No.

REACTIVE POWER CAPABILITY AT COMMERCIAL BOUNDARY (at rated stator terminal and nominal system voltage)

TABLE A	LEAD (Mvar)	LAG (Mvar)
AT RATED MW		

REACTIVE POWER CAPABILITY AT GENERATOR STATOR TERMINAL (at rated terminal voltage)

TABLE B	MW	LEAD (Mvar)	LAG (Mvar)
AT RATED MW			
AT FULL OUTPUT (MW)			
AT MINIMUM OUTPUT (MW)			

BM Unit No.

REACTIVE POWER CAPABILITY AT COMMERCIAL BOUNDARY (at rated stator terminal and nominal system voltage)

TABLE A	LEAD (Mvar)	LAG (Mvar)
AT RATED MW		

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REACTIVE POWER CAPABILITY AT GENERATOR STATOR TERMINAL (at rated terminal voltage)

TABLE B	MW	LEAD (Mvar)	LAG (Mvar)
AT RATED MW			
AT FULL OUTPUT (MW)			
AT MINIMUM OUTPUT (MW)			

BM Unit No.

REACTIVE POWER CAPABILITY AT COMMERCIAL BOUNDARY (at rated stator terminal and nominal system voltage)

TABLE A	LEAD (Mvar)	LAG (Mvar)
AT RATED MW		

REACTIVE POWER CAPABILITY AT GENERATOR STATOR TERMINAL (at rated terminal voltage)

TABLE B	MW	LEAD (Mvar)	LAG (Mvar)
AT RATED MW			
AT FULL OUTPUT (MW)			
AT MINIMUM OUTPUT (MW)			

BM Unit No.

REACTIVE POWER CAPABILITY AT COMMERCIAL BOUNDARY (at rated stator terminal and nominal system voltage)

TABLE A	LEAD (Mvar)	LAG (Mvar)
AT RATED MW		

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

REACTIVE POWER CAPABILITY AT GENERATOR STATOR TERMINAL (at rated terminal voltage)

TABLE B	MW	LEAD (Mvar)	LAG (Mvar)
AT RATED MW			
AT FULL OUTPUT (MW)			
AT MINIMUM OUTPUT (MW)			

OR

REACTIVE POWER CAPABILITY AT COMMERCIAL BOUNDARY (at rated stator terminal and nominal system voltage)

TABLE A	MW	LEAD (Mvar)	LAG (Mvar)
AT RATED MW			

REACTIVE POWER CAPABILITY AT GENERATOR STATOR TERMINAL (at rated terminal voltage)

CCGT Unit No. []

TABLE B	MW	LEAD (Mvar)	LAG (Mvar)
AT RATED MW			
AT FULL OUTPUT (MW)			
AT MINIMUM OUTPUT (MW)			

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CCGT Unit No. []

TABLE B	MW	LEAD (Mvar)	LAG (Mvar)
AT RATED MW			
AT FULL OUTPUT (MW)			
AT MINIMUM OUTPUT (MW)			

CCGT Unit No. []

TABLE B	MW	LEAD (Mvar)	LAG (Mvar)
AT RATED MW			
AT FULL OUTPUT (MW)			
AT MINIMUM OUTPUT (MW)			

REACTIVE POWER CAPABILITY AT HV SIDE OF STEP-UP TRANSFORMER (at rated terminal and nominal system voltage)

SUMMARY TABLE C	RATED MW	LEAD (Mvar)	LAG (Mvar)
CCGT UNIT			

]

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

Part II
Meters and Aggregation Principles

[BM Unit No.]

[BM] or [CCGT] Unit No	Meter Identification No.	Meter Code	Location	Loss Factor	Adjustment

Aggregation Methodology

[N/A]

or

[Category A/B/C aggregation principles as set out in the latest published version of the document entitled "Methodology Document for the Aggregation of Reactive Power Metering" shall apply]*

** Delete as applicable*

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

Part III
Calculation of Reactive Power Capability
at the Commercial Boundary

For the purposes of Appendix 8 to the **CUSC Schedule**, the following table shows the reactive load applicable to each of the relevant **BM Units**, constituting the respective value Q_{ts} referred to therein:-

Reactive Load	
BM Unit	Q_{ts}

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APPENDIX 1 – DATA (Cont.)
SECTION B (FREQUENCY RESPONSE)
Part I - Frequency Response Data

Station:

[BM Unit Nos.][DC Converter Station No.]

Table 1		Low Frequency Response – Mode A					
Genset Load (MW) or DC Converter De-load in a DC Converter Station	δf_p (Hz)	Primary Response (MW)	Secondary Response (MW)				
			$\delta f_s = - 0.1\text{Hz}$	$\delta f_s = - 0.2\text{Hz}$	$\delta f_s = - 0.3\text{Hz}$	$\delta f_s = - 0.4\text{Hz}$	$\delta f_s = - 0.5\text{Hz}$
	-0.1						
	-0.2						
	-0.3						
	-0.4						
	-0.5						
	-0.6						
	-0.7						
	-0.8						
	-0.1						
	-0.2						
	-0.3						
	-0.4						
	-0.5						
	-0.6						
	-0.7						
	-0.8						
	-0.1						
	-0.2						
	-0.3						
	-0.4						
	-0.5						
	-0.6						
	-0.7						
	-0.8						
	-0.1						
	-0.2						
	-0.3						
	-0.4						
	-0.5						
	-0.6						
	-0.7						
	-0.8						
	-0.1						
	-0.2						

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-0.3						
-0.4						
-0.5						
-0.6						
-0.7						
-0.8						

Station:

[BM Unit Nos:][DC Converter Station No :]

Table 2	High Frequency Response (MW) - Mode A				
Genset De-Load (MW) or DC Converter De-load in a DC Converter Station	Frequency Deviation from Target Frequency				
	$\delta f_h = +0.1$ Hz	$\delta f_h = +0.2$ Hz	$\delta f_h = +0.3$ Hz	$\delta f_h = +0.4$ Hz	$\delta f_h = +0.5$ Hz

[In relation to the levels of **Response** capability pursuant to Paragraph 4.1.3 of **CUSC** and Table 2 above it is agreed that for low operating outputs, the **High Frequency Response** capability will be limited such that the generation level will under normal operating conditions not be caused to drop below [] MW.]

For the purpose of Paragraph 4.1.3.11(a) of the **CUSC** the level of **Response** capability for a **Frequency Deviation** of 0.0 Hz shall be 0.0 MW.

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Part II

Frequency Response Summary Data

Station:

[BM Unit Nos: [[DC Converter Station No.]]]

Table 1	Frequency Response Capability Summary - Mode A		
Genset De-Load (MW) <u>or</u> DC Converter De-load in a DC Converter Station	Primary Response @-0.5Hz (MW)	Secondary Response @-0.2Hz (MW)	High Frequency Response @+0.5Hz (MW)
	P_{MW}	S_{MW}	H_{MW}

Table 2	Plant Configuration Adjustment Factor K_{GRC} – Mode A
1 Gas Turbine and 1 Steam Turbine	
1 Gas Turbine	

(or whatever configuration is appropriate)

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Part III
Frequency Response - Permissible Combinations

Station:

[BM Unit Nos:][DC Converter Station No :]

Table 1	Mode A Response	
Primary Response	✓	✓
Secondary Response		✓
High Frequency Response	✓	✓

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Part IV
Frequency Response Power Delivery Data

Station:
 BM Unit Nos:

Primary Response Power Delivery – Mode A						
Frequency Deviation (Hz)	Genset De-load (MW) or DC Converter De-load in a DC Converter Station					
-0.1						
-0.2						
-0.3						
-0.4						
-0.5						

Primary & Secondary Response Power Delivery – Mode A						
Frequency Deviation (Hz)	Genset De-load (MW) or DC Converter De-load in a DC Converter Station					
-0.1						
-0.2						
-0.3						
-0.4						
-0.5						

High Frequency Response Power Delivery – Mode A						
Frequency Deviation (Hz)	Genset De-load (MW) or DC Converter De-load in a DC Converter Station					
+0.1						
+0.2						
+0.3						
+0.4						
+0.5						

The figures for genset deload in the tables shall be taken from the figures for genset deload shown in the tables Frequency Response Capability Data tables in Part I.

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APPENDIX 2 - PRICES

SECTION A (REACTIVE POWER)

Not Used

APPENDIX 2

SECTION B (FREQUENCY RESPONSE)

Not Used

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APPENDIX 3 – FURTHER DEFINITIONS

["BM Units"]	<i>[identify]</i>
["DC Converter"]	<i>[identify]</i> ²¹
["De-Load"]	the meaning attributed to it in <u>Sub-Clause 4.3.2;</u> ²²
"Frequency Sensitive Mode"	a [Genset][DC Converter] operating mode which will result in the Active Power output changing, in response to a change in System Frequency , in a direction which assists in the recovery to Target Frequency by operating so as to provide Primary Response and/or Secondary Response and/or High Frequency Response ;
"Full Output"	the meaning attributed to it in Grid Code BC 2.A.3.1 ;
"Generator Performance Chart"	a diagram which shows the MW and Mvar capability limits within which a BM Unit will be expected to operate under steady state conditions;
"Minimum Output"	the meaning attributed to it in Grid Code BC 2.A.3.1 ;
"Mode A"	in relation to Primary, Secondary and/or High Frequency Response means the levels of Response set out in relation thereto in Table 1 and/or (as applicable) Table 2 of Appendix 1, Section B, Part I;
"Parties"	the parties to this Mandatory Services Agreement ;
"Reactive Power Zone"	means those separate areas of England and Wales identified as zones in the Seven Year Statement for 1997 for the purposes of specifying local

²¹ To be included for DC Converter only

²² To be included for DC Converter only

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	Reactive Power capability and need;
“Relevant Zone”	the Reactive Power Zone in which the BM Units are situated, which for convenience only shall be specified in Appendix 1, Section A, Part I;
	the meaning attributed to it in the Grid Code ;
“Under-excitation Limiter”	
δf_h	a Frequency Deviation from Target Frequency which is achieved 10 seconds from the time of the Frequency change and is sustained thereafter;
δf_p	a Frequency Deviation from Target Frequency which is achieved 10 seconds from the time of the Frequency change and is sustained for a further 20 seconds;
δf_s	a Frequency Deviation from Target Frequency which is achieved 30 seconds from the time of the Frequency change and is sustained for a further 30 minutes.

