CONSULTATION DOCUMENT

CUSC Amendment Proposal CAP046
Mandatory Frequency Response
(Calculation of Volumes)

Amendment Ref	CAP046
Issue	1.1
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Prepared by	National Grid

DOCUMENT CONTROL

Version	Date	Author	Change Reference
0.1	24/02/03	National Grid	Initial Draft for internal comment
1.0	28/02/03	National Grid	Formal version for release
1.1	3/03/03	National Grid	Version in pdf format corrected to enable the equations to be viewed fully in the legal text

DOCUMENT LOCATION

National Grid website:

http://www.nationalgridinfo.co.uk/cusc/mn_consultation_index.html

DISTRIBUTION

Name	Organisation
CUSC Parties	Various
Panel Members	Various
Interested Parties	Various
National Grid Industry Information Website	

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1.0 SUMMARY

The Amendment Proposal

1.1 CUSC Amendment Proposal CAP046 proposes to improve the mechanism for the approximation of calculating the response energy volume that occurs, as a result of the provision of mandatory frequency response.

1.2 CAP046 was proposed by National Grid with the recommendation that it be treated as an Urgent Amendment Proposal and submitted to the Amendments Panel for consideration at their meeting on 21st February 2003. The Amendments Panel determined that CAP046 was a valid Amendment Proposal and should be given Urgent status, subject to approval by the Authority, which was gained on 25th February 2003. The Panel agreed that CAP046 should proceed directly to an expedited period of wider industry consultation by National Grid in accordance with the CUSC.

1.3 This document initiates this wider industry consultation exercise and invites views on CUSC Amendment Proposal CAP046. The consultation closing date is **14th March 2003**.

2.0 INTRODUCTION

2.1 This is a consultation document issued by National Grid under the rules and procedures specified in the Connection and Use of System Code (CUSC) as designated by the Secretary of State. It addresses issues associated with the Mandatory Frequency Response provisions set out in Section 4 of the CUSC.

2.2 Further to the submission of Amendment Proposal CAP046 (see Annex 1), this document seeks views from Industry members relating to the Amendment Proposal. Such an amendment would result in changes to Section 4 and Schedule 2 – Exhibit 4 of the CUSC (as detailed in Annex 2 and 3).

2.3 This document outlines the nature of the CUSC changes that are proposed and also incorporates National Grid's and the Amendments Panel's views on the way forward concerning this Amendment. Representations received in response to this consultation document will be included in National Grid's Amendment Report that will be furnished to the Authority for its Direction.

2.4 This consultation document has been prepared in accordance with the terms of the CUSC. An electronic copy can be found on the National Grid website, at http://www.nationalgridinfo.co.uk/cusc.

3.0 BACKGROUND

3.1 National Grid believes that the CAP046 Amendment Proposal better facilitates achievement of the Applicable CUSC Objectives as against the existing CUSC. This "background" section is intended to provide some context as to the circumstances in which CAP046 was raised, and should be read as such. It in no way detracts from the fact that the Proposer of CAP046 (National Grid) believes that CAP046 better facilitates achievement of the Applicable CUSC Objectives.

3.2 All licensed generators are required to provide the ancillary service of mandatory frequency response as set out in CC.8.1 of the Grid Code. The payments associated with this service are described in Section 4 of the CUSC. Prior to the introduction of NETA it was recognised that generators would incur imbalance charges under the BSC when providing mandatory frequency response. A mechanism was introduced at NETA Go-live that was intended to compensate generators for this imbalance exposure. This mechanism was implemented via the NETA Implementation Scheme in the Mandatory Services Agreements (MSA) and subsequently codified into the CUSC.

3.3 Following the introduction of NETA, a number of providers raised concerns that the level of imbalance compensation, as calculated by the mechanism, did not adequately reflect the actual imbalance charges incurred as a result of providing mandatory frequency response. In order to address these concerns, the arrangements were reviewed by an informal pre-CUSC Working Group and resulted in the submission of CUSC Amendment Proposal CAP001 by National Grid. The Amendment proposed changes to the calculation methodology in order to provide a better approximation of the assumed energy imbalance volume used to calculate compensation payments. CAP001 followed the Urgent Amendment procedures and was approved by the Authority on 15th November 2001 with an effective implementation date of 21st September 2001.

3.4 Prior to Authority approval of CAP001, First Hydro Company submitted CUSC Amendment Proposal CAP009 that proposed further changes to the methodology used for calculating imbalance volume. The Amendment was proposed by First Hydro as they believed that neither the mechanism put in place at NETA go-live nor that proposed in CAP001 accurately reflected the actual volume of mandatory frequency response delivered.

3.5 The frequency response tables contained in Mandatory Services Agreements contain tested values of response capability relative to a ramped change in frequency. First Hydro suggested that for certain types of plant (whose output continues to increase after the 10 second cut-off in Primary and High frequency response tables) the Primary, Secondary and High frequency table approach was inappropriate for calculating the volume of energy delivery over a period a time. The amendment therefore proposed to include an additional set of tables in the Mandatory Services Agreement that describes the response delivery for generators during normal 'frequency following'. This data would then be used in the calculation of delivered frequency response volume.

3.6 At their meeting on 9th November 2001, the Amendments Panel actioned the Balancing Services Standing Group (BSSG) to act as a Working Group (in accordance with Paragraph 8.17.1 of the CUSC) to consider CAP009. Terms of Reference were agreed for the BSSG (in respect of CAP009) and further to three meetings and associated debate and correspondence, it was the combined view of the BSSG that the mechanism for frequency response imbalance compensation should be modified as follows:

(i) The response energy calculations set out in the CUSC should refer to a new set of Power Delivery Data Tables to be included in the Mandatory Services Agreements (MSAs);

(ii) When used in the imbalance compensation calculations, the values in the new Power Delivery Data Tables should aim to mimic response energy delivered by the generator; and

(iii) It should be possible for service providers to default to the extant methodology. Therefore the initial values in the Power Delivery Data Tables should be derived from the existing frequency response tables. Subsequently changes to these values can be requested, by either party, in line with existing arrangements.

3.7 The Amendments Panel endorsed the findings of the CAP009 Working Group on 22nd February 2002 as set out in Working Group Report and determined that the proposal proceed to industry consultation. Following closure of the consultation and in accordance with the provisions of the CUSC, the CAP009 Amendment Report was submitted to the Authority on 10th May 2002. The Amendment Report contained a recommendation to approve the implementation of CAP009, and it was National Grid's recommendation that the proposal should be implemented co-incident to BSC Modification P34/P36 or similar (e.g. P71). This was on the grounds that such a BSC Modification would provide the correct incentives on service providers to submit accurate values in their Power Delivery Data Tables.

3.8 On 22nd November 2002 the Authority directed that BSC Modification P71 (and separately, CAP011) should be implemented with effect from 25th February 2003 (the implementation of P71 and CAP011 has subsequently been delayed until 11th March 2003). It was indicated in the P71 decision letter that the Authority was minded to approve CAP009 with an effective implementation date on or after 25th February 2003.

3.9 Following the "minded to approve" indication for CAP009, it became apparent to National Grid that the baseline CUSC, upon which the legal text in the CAP009 Amendment Report had been drafted, had been changed by the implementation of CAP016 and furthermore would be changed again on 11th March 2003 by the implementation of CAP011. Due to interactions between CAP009, CAP011 and CAP016, the legal drafting for CAP009 was no longer compatible with the new CUSC baseline.

3.10 After consideration of the effects of these interactions, it was the opinion of National Grid that the legal drafting to give effect to CAP009 inadvertently prevented the intent of CAP009 from being realised and therefore CAP009 did not better facilitate achievement of the Applicable CUSC Objectives. Ofgem subsequently rejected CAP009. National Grid have now raised a new Amendment Proposal (CAP046) as an Urgent Amendment Proposal as provided for by CUSC. The intention was to implement the true *intentions* behind CAP009 as soon as possible after implementation of BSC Modification P71, and also to ensure that the *intentions* of CAP011 and CAP016 were preserved consistently in Section 4 of the CUSC going forward. It was believed (and accepted by the CUSC Panel) that because the effect of CAP046 was different from that of the flawed CAP009 legal text, it was accepted that CAP046 was a valid Amendment Proposal.

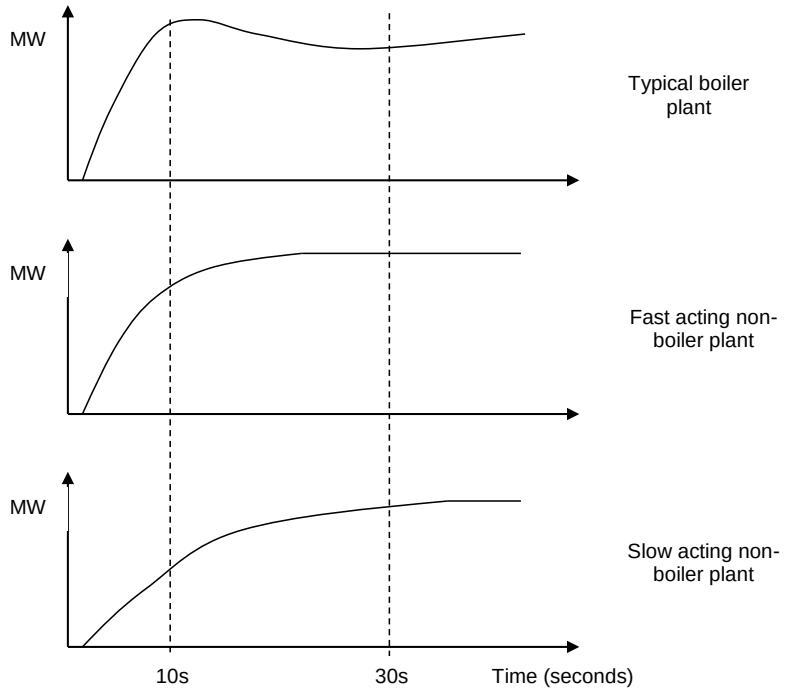
4.0 DESCRIPTION OF THE AMENDMENT PROPOSAL

4.1 The current methodology for calculating the actual volume of energy delivered by a generator when it is providing mandatory frequency response is based

on the Primary, Secondary and High frequency matrix values contained in the Mandatory Services Agreements (MSAs). The matrix values are determined by 'Compliance' testing, witnessed by National Grid in accordance with the Grid Code. These values are based on the response capability of generating units at a period of 10 seconds and 30 seconds after a low frequency incident (referred to as Primary and Secondary Response) and 10 seconds after a high frequency incident (referred to simply as High Frequency Response).

4.2 The compliance tests and resultant matrix tables included in the MSAs were devised to enable National Grid to determine the total quantity of frequency response that was needed on the system at any one time. This enables National Grid to instruct enough frequency response to cater for the instantaneous loss of the largest in-feed of generation or demand i.e. to contain and recover large frequency deviations.

4.3 It is a Grid Code requirement that all licensed generation is capable of operating in frequency sensitive mode. However, the output characteristics from different types of generating plant can vary quite significantly according to its primary fuel type and control system design. Typically, conventional 'boiler-plant' has a capability for storing significant quantities of energy that can be delivered in a short duration (i.e. primary response from coal or oil fired generating plant). However, in contrast, delivery from Hydro and CCGT generating plant is dependent on the rate of increase of primary fuel flow, meaning that for 'non-boiler-plant', any response energy is typically delivered in a more gradual manner. These typical response delivery characteristics are shown graphically below:



4.4 The use of primary and secondary response values to calculate the response energy delivered over a period of time can therefore be inappropriate for certain plant types. From the graphs above it can be seen that the Primary response value can be significantly lower than the steady state response output for slow acting non-boiler plant.

4.5 The matrix tables were not designed for the purpose of accurately calculating the volume of response energy produced by a generator over a period of time when it is operating in frequency sensitive mode and responding continuously to minor frequency fluctuations. To overcome this issue it is proposed that an additional set of Power Delivery Data Tables are contained in the MSA and used in the response energy payment calculation. The values in these tables should aim to mimic the energy delivered by the generating unit when following frequency deviations. The mechanism will continue to use the per-minute, dual linear interpolation methodology as introduced by CAP001.

4.6 It is intended that this proposal will establish Power Delivery Data Tables, which will initially contain values derived from the existing low frequency and high frequency response tables. For the avoidance of doubt this proposal will separate the power delivery data for low frequency into two tables – one for Primary Response and one for Primary and Secondary Response. The power delivery data for high frequency will be contained within a third table for High Frequency Response (Annex 3 illustrates the new Power Delivery Data Tables).

4.7 Initially the default values in the Power Delivery Data Tables will be derived as follows:

- The Primary Response Power Delivery Data Table shall initially be populated with Primary Response data values (for corresponding frequency deviation and generator de-load) from the existing Low Frequency Response table;
- The Primary & Secondary Response Power Delivery Data Table shall initially be populated with the average of the Primary and corresponding Secondary Response data values (for corresponding frequency deviation and generator de-load) from the existing Low Frequency Response table; and
- The High Frequency Power Delivery Data Table shall initially be populated with the High Frequency Response data values (for corresponding frequency deviation and generator de-load) from the existing High Frequency Response table.

Thus after implementation there will be no change to the response volume as calculated by the existing process. The methodology allows for the service provider or National Grid to propose revisions to the values in the Power Delivery Data Tables, in light of experience, in accordance with the existing amendment provisions set out in the CUSC.

5.0 SUMMARY OF VIEWS

Initial View of National Grid

5.1 National Grid believes that Amendment Proposal CAP046 better facilitates the achievement of the Applicable CUSC Objectives and should therefore be

implemented as soon as is practicable after the implementation of BSC Modification P71 (and CAP011).

Initial View of the Amendments Panel

5.2 The initial view of the Amendments Panel at their meeting on 21st February 2003 was that the legal drafting contained within Annex 2 and 3 of this consultation document should be reviewed by a body of industry experts to ensure that the intentions behind the proposal are correctly drafted. This will be undertaken by the BSSG during the consultation period. Should it be necessary, an Alternative Amendment Proposal will be developed by the BSSG.

6.0 VIEWS INVITED

6.1 National Grid is seeking the views of interested parties relating to CUSC Amendment Proposal CAP046. In particular views are invited on:

- Whether CAP046 does provide an improved and more accurate mechanism for approximating the assumed Frequency Response delivery of a generator and thereby better facilitating achievement of the Applicable CUSC Objectives;
- Whether CAP046 should be implemented as soon as is practicable after BSC Modification P71 (and CAP011) as recommended by National Grid.

6.2 Responses should be sent to National Grid by no later than close of business on **Friday 14th March 2003**.

6.3 Please address all comments to the email address below entitled "CAP046 Consultation Response".

emma.groves@uk.ngrid.com

Alternatively, comments may be addressed to:

Emma Groves
Commercial
National Grid Company plc
National Grid House
Kirby Corner Road
Coventry
CV4 8JY

Fax: 024 76423298

ANNEX 1 – AMENDMENT PROPOSAL FORM

CUSC Amendment Proposal Form	CAP046

Title of Amendment Proposal:

Mandatory Frequency Response (Calculation of Volumes)

Description of the Proposed Amendment *(mandatory by proposer)*:

The current mechanism for calculating the response energy volume that occurs, as a result of the provision of mandatory frequency response can be inaccurate. This amendment proposal seeks to improve the mechanism for the approximation of this volume.

Two methods could be used to determine the volume:

(1) The characteristic curve of the BMU could be used that tracks output with changing frequency.
(2) An approximation for (1) could be used that produces, for each BMU, a new pair of tables (Power Delivery Data Tables, one for High Frequency Volume and one for Low Frequency Volume) based on the format of the High Frequency Response table. These would initially contain the same data as the current Primary and High Frequency Response tables.

Method 1, although more accurate, is considered impractical. Therefore Method 2 is suggested for implementation. The Power Delivery Data Tables would be populated with data based on the stable output that is achieved by the BMU following a change in frequency. The effect of this would be to move the 10 second cut off for Primary and High Frequency Response to a different time, based on the time to achieve stable output.

Note:
This proposed amendment seeks to implement the intention behind CUSC Amendment Proposal CAP009 as described in the CAP009 Amendment Report and acts as a direct replacement for it. This is explained further below.

Description of Issue or Defect that Proposed Amendment seeks to Address *(mandatory by proposer)*:

The current mechanism for reflecting response energy volume that occurs as a result of the provision of Mandatory Frequency Response, can be inaccurate.

For certain types of plant the output of the plant continues to increase after the 10 second cut off in the current Primary and High Frequency Response tables. This proposal seeks to cut the link between the Primary and High Frequency Response Tables and the payment volume. A new set of tables would be produced that would more accurately reflect the energy produced when providing mandatory frequency response.

Note:
National Grid recommends that this proposal is treated as an Urgent Amendment Proposal in order to ensure that the intentions of CAP009, CAP011 and CAP016 are implemented together, as described below.

CUSC Amendment proposal CAP009 sought to improve the estimation of response energy volume delivered during the provision of Mandatory Frequency Response. After due debate, consultation and consideration the proposal was unanimously supported by the industry.

However, due to other modifications (CAP016, CAP011) changing the CUSC, the drafting of the proposed CUSC text in the CAP009 Amendment Report is no longer compatible with the new baseline CUSC. National Grid has therefore had to recommend to the Authority that CAP009 be rejected, and has subsequently raised this new proposed amendment as a direct replacement.

In summary this proposal seeks to ensure that the intentions behind CAP009, CAP011 and CAP016, which have already been debated within the industry and consulted upon, are implemented consistently through CUSC Section 4. This proposal is not intended to introduce material changes or new thinking beyond that described in the original Amendment Reports for CAP009, CAP011 and CAP016.

Impact on the CUSC *(this should be given where possible)*:

Section 4.1.3 – Calculation of Volumes formulae. Amendment is required to reflect the revised tables that will be used for calculating the volumes for delivery of response energy as outlined above, and to re-instate Configuration Factors in the calculation of response energy.

Modification of the CUSC Mandatory Services Agreement to reflect the inclusion of Power Delivery Data Tables (one for High Frequency Volume and one for Low Frequency Volume) for each BMU.

Impact on Core Industry Documentation *(this should be given where possible)*:

None.

Impact on Computer Systems and Processes used by CUSC Parties *(this should be given where possible)*:

The proposed amendment will require modification to the payment calculation system (GENRES) used by National Grid to calculate the Frequency Response payments, preparations for which have already been made.

Details of any Related Modifications to Other Industry Codes *(where known)*:

CAP009, CAP011, CAP016, BSC P71

Justification for Proposed Amendment with Reference to Applicable CUSC Objectives *(mandatory by proposer)*:**

The Transmission Licence obligates National Grid to purchase ancillary services from the most economical sources available to it having regard to the quantity an nature of the ancillary services.

The proposed amendment would better facilitate the efficient discharge of this licence obligation by aligning more accurately payments made with costs incurred, as the volume would be more accurately calculated.

This in turn will ensure that the most economic sources of Mandatory Frequency Response continue to make their full capacity available for despatch by National Grid.

Details of Proposer: Organisation's Name	National Grid Company plc
Capacity in which the Amendment is being proposed: (i.e. CUSC Party, BSC Party or "energywatch")	CUSC Party
Details of Proposer's Representative:	
Name:	Mark Brackley
Organisation:	National Grid Company plc
Telephone Number:	0118 9363364
Email Address:	**mark.brackley@uk.ngrid.com**
Details of Representative's Alternate:	
Name:	John Greasley
Organisation:	National Grid Company plc
Telephone Number:	024 76423190
Email Address:	**john.greasley@uk.ngrid.com**

Attachments (~~Yes~~/No):
If Yes, Title and No. of pages of each Attachment:

Notes:

1. Those wishing to propose an Amendment to the CUSC should do so by filling in this "Amendment Proposal Form" that is based on the provisions contained in Section 8.15 of the CUSC. The form seeks to ascertain details about the Amendment Proposal so that the Amendments Panel can determine more clearly whether the proposal should be considered by a Working Group or go straight to wider National Grid Consultation.

2. The Panel Secretary will check that the form has been completed, in accordance with the requirements of the CUSC, prior to submitting it to the Panel. If the Panel Secretary accepts the Amendment Proposal form as complete, then he will write back to the Proposer informing him of the reference number for the Amendment Proposal and the date on which the Proposal will be considered by the Panel. If, in the opinion of the Panel Secretary, the form fails to provide the information required in the CUSC, then he may reject the Proposal. The Panel Secretary will inform the Proposer of the rejection and report the matter to the Panel at their next meeting. The Panel can reverse the Panel Secretary's decision and if this happens the Panel Secretary will inform the Proposer.

   The completed form should be returned to:

   Richard Dunn
   Panel Secretary
   Commercial Development
   National Grid Company plc
   National Grid House
   Kirby Corner Road
   Coventry, CV4 8JY

   Or via e-mail to: CUSC.Team@uk.ngrid.com

   (Participants submitting this form by email will need to send a statement to the effect that the Proposer acknowledges that on acceptance of the proposal for consideration by the Amendments Panel, a Proposer which is not a CUSC Party shall grant a licence in accordance with Paragraph 8.15.7 of the CUSC. A Proposer that is a CUSC Party shall be deemed to have granted this Licence).

3. Applicable CUSC Objectives** - These are defined within the National Grid Company Transmission Licence under Section C7F, paragraph 15. Reference should be made to this section when considering a proposed amendment.

Annex 2 – Proposed Changes to Section 4 of the CUSC (Balancing Services)

For the avoidance of doubt, the proposed changes are indicated with coloured text only. Coloured underlined text will be inserted, and coloured strikethrough text will be deleted.

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 **NGC**, 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 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** 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 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 **NGC** 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 **NGC** or until the **BM Unit** to which the instruction relates is **De-synchronised** (whichever is first to occur).

NGC'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 **NGC** may at any time instruct a **User** to operate any one or more **BM Unit(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 **NGC** 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** so as to provide any component(s) of **Mode A Frequency Response**, that **User** shall operate that **BM Unit** 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).

Calculation of Payments

4.1.3.8 The payments to be made by **NGC** to a **User** hereunder in respect of the provision of any **Mode A Frequency Response** from a **BM Unit** 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__ to be made by __NGC__ 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 **NGC** to the **User** for the **Ancillary Service** of **Primary Response** provided by the **User** from the **BM Unit** concerned pursuant to an instruction from **NGC** 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 **NGC** to the **User** for the **Ancillary Service** of **High Frequency Response** provided by the **User** from the **BM Unit** concerned pursuant to an instruction from **NGC** 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 **NGC** to the **User** for the **Ancillary Service** of **Secondary Response** provided by the **User** from the **BM Unit** concerned pursuant to an instruction from **NGC** 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** set out in the **Mandatory Services Agreement**;

P_{MW} = the **Primary Response** capability (expressed in MW) for the level of **De-Load** of the **BM Unit** concerned at the end of the minute in which the service is provided;

H_{PR} = the appropriate payment rate for **High Frequency Response** set out in the **Mandatory Services Agreement**;

H_{MW} = the **High Frequency Response** capability (expressed in MW) for the level of **De-Load** of the **BM Unit** concerned at the end of the minute in which the service is provided;

S_{PR} = the appropriate payment rate for **Secondary Response** set out in the **Mandatory Services Agreement**;

S_{MW} = the **Secondary Response** capability (expressed in MW) for the level of **De-Load** of the **BM Unit** concerned at the

end of the minute in which the service is provided;

K_T = the ambient temperature adjustment factor. **NGC** and each **User** acknowledge and agree, as between **NGC** 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 **NGC** and each **User** acknowledge and agree, as between **NGC** 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 4.1.3.25 (e);

SF_S = 0, subject to Paragraph 4.1.3.25 (e);

SF_H = 0, subject to Paragraph 4.1.3.25 (e).

*Payment Formulae - **Response Energy Payment***

4.1.3.9A (a) The **Response Energy Payments** for **BM Unit** i in **Settlement Period** j to be made by **NGC** 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 **NGC**.

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** i in **Settlement Period** j calculated as follows:-

~~$$RE_{ij} = \int_0^{SPD} FR_{ij}(t)dt$$~~

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

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** 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** 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.

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$FR_{ij}(t)$ is the expected change in **Active Power** output for **BM Unit** i, at time t (resolved to the nearest integer minute), expressed in MW derived from the relevant Frequency Response Power Delivery Data table ~~set out~~ 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** concerned at the end of the minute and the mean **Frequency Deviation** over that minute when that **BM Unit** 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** i shall be derived from the ~~high frequency response~~ 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** i shall be derived from:

A) the table entitled "Primary Response Power Delivery - Mode A" ~~data~~ in the case of a **BM Unit** being instructed to deliver **Primary Response** without **Secondary Response**; or

B) the ~~mean of the **Primary Response** and~~ table entitled "Primary & Secondary Response Power Delivery - Mode A" ~~data~~ in the case of a **BM Unit** being instructed to deliver **Primary Response** and **Secondary Response**,

in each case ~~shown in the low frequency response tables~~ set out in the **Mandatory Services Agreement** and shall be signed positive.

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$$\text{reference price} = \frac{\left(\overline{SBP_{month}} + \overline{SSP_{month}}\right)}{2}$$

Where:

$\overline{SBP_{month}}$ and $\overline{SSP_{month}}$ are the calculated time weighted average of SBP_j and SSP_j respectively for the preceding calendar month in which the service is provided.

(b) (not used)

(c) (not used)

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

"SSP_j"
"SBP_j"
"SPD"

4.1.3.10 **NGC** and each **User** acknowledge and agree, as between **NGC** 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 **NGC** pursuant to this Paragraph 4.1.3.

*Interpretation of Tables – Levels of **Response***

4.1.3.11 The figures for **Response** set out in the ~~response~~ 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**. Such tables shall, for the purposes of ~~Paragraph 4.1.3.7,~~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 ~~the relevant response tables in the **Mandatory Services** Agreement,~~ a table, the level of **Response** ~~required~~ shall be calculated by linear interpolation from the figures specified in the ~~relevant~~ table~~(s)~~ in respect of **Frequency Deviations**;

(b) for a level of **De-Load** at a given time differing from the figures given in ~~the relevant response tables in the **Mandatory Services Agreement**~~a table, the level of **Response** ~~required~~ shall be calculated by linear interpolation from the figures ~~in the relevant table(s)~~ 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 ~~response tables~~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** ~~required~~ shall be calculated by dual linear interpolation from the figures specified in the ~~relevant table(s)~~ 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 ~~the relevant response tables in the **Mandatory Services Agreement**~~ a table (whether positive or negative), the level of **Response** ~~required~~ shall be calculated by reference to the greatest **Frequency Deviation** (positive or negative, as the case may be) given in ~~the relevant table(s)~~that table; and

(e) for the purposes of calculating levels of **Response** ~~to be provided in response to~~ in respect of **Frequency Deviations** lower than those specified in ~~the response tables in the **Mandatory Services Agreement**~~a table, the relevant table(s) shall be deemed to specify ~~that~~ a level of zero **Response** ~~is to be provided~~ for a **Frequency Deviation** of zero.

Interpretation of Tables – Levels of Holding Payment

4.1.3.12 The ~~summary response~~ 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** is other than one of the levels given in such table, then ~~, for the purposes of the payment table in the **Mandatory Services Agreement**,~~ 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 *Request to Amend Levels of and/or Payment Rates for* ***Response***

4.1.3.13 Each **User** shall have the right, as between **NGC** and that **User**, not more than once every two months (or otherwise at any time with the specific agreement of **NGC**) to request in writing an amendment to the levels of **Response** set out in the ~~response~~ Frequency Response Capability Data tables and/or the Frequency Response Power Delivery Data tables in the **Mandatory Services Agreement** and/or, provided such request is made in accordance with the relevant charging principles set out in Paragraph 4.4, the payment rates referred to in the ~~payment~~ Payment Rates table(s) in the **Mandatory Services Agreement**. **NGC**'s agreement to such a request shall not be unreasonably withheld or delayed.

NGC's *Requests to Amend Levels of* ***Response***

4.1.3.14 Where **NGC** reasonably considers in light of operating experience that the levels of **Response** set out in the ~~response~~ Frequency Response Capability Data tables and/or the Frequency Response Power Delivery Data tables in the **Mandatory Services Agreement** do not represent the true operating capabilities of a **BM Unit(s), NGC** shall have the right not more than once every two months (or otherwise at any time with the specific agreement of the relevant **User**) 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 ~~tables~~ table(s) in the **Mandatory Services Agreement** be reviewed and, if appropriate, amended by agreement with such **User** such agreement not to be unreasonably withheld or delayed.

Procedure for Amendments to Levels of and/or Payment Rates for ***Response***

4.1.3.15 Any amendments agreed by **NGC** and a **User** pursuant to Paragraphs 4.1.3.13 or 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 **NGC** 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 4.1.3.19.

Failure to Agree Amendments

4.1.3.16 If **NGC** and a **User** are unable to agree any amendments requested pursuant to Paragraphs 4.1.3.13 or 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 **NGC** and each **User** acknowledge and agree, as between **NGC** 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 Subject to Paragraph 4.1.3.17, any changes to payment rates 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 apply with effect from the date specified in the determination and consequential adjustments shall be made in the next practicable **Provisional Monthly Statement** issued following the date of the determination. If any such changes are so determined to apply in respect of any period prior to the date of determination then in respect of such period until actual payment (or, as the case may be, repayment) **NGC** shall pay to the **User** (where such payment rates are determined to be greater than current payment rates) the excess together with interest thereon at the **Base Rate** and the **User** shall repay to **NGC** (where such payment rates are determined to be less than current payment rates) the amount by which **NGC** has

overpaid the **User** together with interest thereon at the **Base Rate**.

4.1.3.19 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.

Annex 3 – Proposed Changes to Schedule 2- Exhibit 4 of the CUSC (Mandatory Services Agreement)

For the avoidance of doubt, the proposed changes are indicated with coloured text only. Coloured underlined text will be inserted, and coloured strikethrough text will be deleted.

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** of the **Mandatory Ancillary Service** of **Frequency Response** and the payments to be made by **NGC** 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** 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**, the provisions of this Clause 4 shall terminate in relation to that **BM Unit** only.

4.2.2 Termination of this Clause 4 shall not affect the rights and obligations of **NGC** 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 4.6,] 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 4.6,] for the purposes of Paragraph ~~4.1.3.8(i)~~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;

(d) for the purposes of Paragraph ~~4.1.3.8(iv)~~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**; ~~and~~

(e) for the purposes of Paragraph ~~4.1.3.8(ii)~~4.1.3.9 of the **CUSC**, the payment rates in Appendix 2, Section B constitute the payment rates in respect of **Primary Response**, **Secondary Response** and **High Frequency Response** referred to ~~therein.~~therein; and

(f) [subject always to Sub-Clause 4.6,] 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**.

4.4 Indexation

The payment rates set out in Appendix 2, Section B are specified at April [ ] base, and shall from 1st April each year be indexed in accordance with Paragraph 4.5 of the **CUSC**.

4.5 Triennial Review

For the purposes of Paragraph 4.1.3.20 of the **CUSC**, the first **Triennial Review Date** shall be [ ].

4.6 [Commissioning and Provisional Response Levels

Without prejudice to Paragraphs 4.1.3.13 and 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, ~~Part I~~Parts I, II and IV are indicative figures only during the period in which the relevant **Generating Unit(s)** is being commissioned and the **User** hereby undertakes to use its reasonable endeavours to forward to **NGC**

levels of **Response** which represent the true operating characteristics of such **Generating Unit(s)** for inclusion in Appendix 1, Section B, ~~Part I~~Parts I, II and IV as soon as possible following completion of commissioning.]

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

Station:
BM Unit Nos.

Table 1	Low Frequency Response – Mode A						
Genset De-Load (MW)	δf_p (Hz)	Primary Response (MW)	Secondary Response (MW)				
			δf_s= - 0.1Hz	δf_s= - 0.2Hz	δf_s= - 0.3Hz	δf_s= - 0.4Hz	δf_s= - 0.5Hz
	-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						
	-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						

Station:
BM Unit Nos:

Table 2	High Frequency Response (MW) - Mode A				
Genset De-Load (MW)	Frequency Deviation from Target Frequency				
	δf_h = +0.1 Hz	δf_h = +0.2 Hz	δf_h = +0.3 Hz	δf_h = +0.4 Hz	δf_h = +0.5 Hz

[In relation to the levels of **Response** ~~required~~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** ~~required~~capability for a **Frequency Deviation** of 0.0 Hz shall be 0.0 MW.

Part II

Frequency Response Summary Data

Station:
BM Unit Nos:

Table 1	Frequency Response Capability Summary - Mode A		
Genset De-Load (MW)	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)

Part III
Frequency Response - Permissible Combinations

Station:
BM Unit Nos:

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

Part IV
Frequency Response Power Delivery Data

Station:
BM Unit Nos:

Primary Response Power Delivery – Mode A						
Frequency Deviation (Hz)	Genset De-load (MW)					
-0.1						
-0.2						
-0.3						
-0.4						
-0.5						

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

High Frequency Response Power Delivery – Mode A						
Frequency Deviation (Hz)	Genset De-load (MW)					
+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.