nationalgridESO

New Response Services

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1. Introduction

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1.1 These **Response Service Terms** describe the requirements for provision of **Response Services** procured by **NGESO** under **Auctions** and the basis upon which **NGESO** shall make payments in respect thereof, and shall apply to each **Service Provider** and **Response Unit** the subject of a **Response Contract** where, in accordance with the ~~**Response**~~ **Procurement Rules**, and for any **Service Period** and **Auction Product**, the **Service Provider's Sell Order** for that **Response Unit** is accepted by **NGESO**.

1.2 Each **Response Contract** so formed shall create a legally binding obligation on the **Service Provider** to provide from the relevant **Response Unit**, and for **NGESO** to pay for, the relevant **Auction Product,** to be delivered during the relevant **Contracted Service Period** upon the terms of these **Response Service Terms**. For the avoidance of doubt, neither a **Service Provider** nor **NGESO** shall be under any obligation or commitment to provide or pay for an **Auction Product** except pursuant to **Response Contracts**.

1.3 A **Response Contract** shall relate to a single **Response Unit** and shall apply only to a single **Service Period** and **Auction Product**.

1.4 Neither **Party** may terminate a **Response Contract** once formed except as provided or referred to in paragraph 14 or by agreement in writing between the **Parties**.

1.5 These **Response Service Terms** should be read alongside the **Response Procurement Documentation** of which they form a part.

2. Changes to these Response Service Terms

2.1 Subject always to paragraph 2.2, **NGESO** may update these **Response Service Terms** from time to time by publication of an updated version on its website, and each such updated version shall be effective from the date shown on its front cover provided always that any updated version shall not apply to any **Response Contract** extant at the date of publication except with the consent in writing of the relevant **Service Provider**.

2.2 To the extent required by the **Electricity Balancing Regulation** (and by reference to those provisions of the **Response Procurement Documentation** constituting terms and conditions approved by the **Authority** as the terms and conditions related to balancing pursuant to Article 18 of the **Electricity Balancing Regulation**), any variation to these **Response Service Terms** will be proposed and implemented in accordance with the applicable requirements in the **Electricity Balancing Regulation**.

3. Defined Terms

3.1 Unless ~~defined in paragraph 3.2 below, or~~ the context otherwise requires, ~~any capitalised term~~terms used in these **Response Service Terms** shall have the ~~meaning~~meanings given to ~~it~~each (if any) in~~:~~

3.1.1 Part 1 of Schedule 1;

3.1.2 the prevailing **~~Response~~ Procurement Rules** ~~or~~;

3.1.3 from commencement of (and subject to) the **EAC Go-Live Date**, Part 2 of Schedule 1; and

~~3.1~~3.1.4 the prevailing **Balancing Services Glossary of General Terms and Rules of Interpretation** ~~(as the case may be).~~ .

~~**3.2** In these **Response Service Terms**:~~

~~3.2.1 **"Cancellation Notice"** shall have~~Where a term is defined in Schedule 1 (Part 1 or Part 2) and also in either or both of the documents referred to at paragraphs 3.1.2 and 3.1.4, the meaning given ~~to it in paragraph 21.1;~~

~~3.2.2 **"Disarming Instruction"** shall have the meaning given to it~~ in ~~paragraph 6.14;~~

~~3.2.3 **"Monthly Statement"** shall have the meaning given to it in paragraph 1 of Schedule 3;~~

~~3.2.4 **"Operational Data"** shall have~~Schedule 1 shall prevail unless the ~~meaning given to it in paragraph 15.1;~~

~~3.2.5 **"Performance Data"** shall have the meaning given to it in paragraph 15.4;~~

~~3.2.6 **"Primary Service Provider"** shall have the meaning given to it in paragraph 21.1;~~

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~~3.2.7 **"Re-Arming Instruction"** shall have the meaning given to it in paragraph 6.14;~~

~~3.2.8 **"Secondary Service Provider"** shall have the meaning given to it in paragraph 21.1;~~

~~3.2.9 **"Transfer Notice"** shall have the meaning given to it in paragraph 21.4;~~

~~3.2.10~~3.2 ~~"**Transfer Period**" shall mean the period described as such in a **Transfer Notice** as may be shortened upon the cancellation or withdrawal of that **Transfer Notice** or~~context otherwise ~~in accordance with paragraph 21~~requires.

3.3 For the purposes of paragraph 3.1, with respect to any **Response Contract**, "prevailing" shall mean the latest version of the applicable document which is in effect at the time of formation of that **Response Contract**.

4. Interpretation

4.1 The rules of interpretation set out in the **Balancing Services Glossary of General Terms and Rules of Interpretation** shall apply to these **Response Service Terms**.

5. Service Availability

5.1 The **Service Provider** (or, where applicable, the **Secondary Service Provider**, and references in this paragraph 5 to "**Service Provider**" shall be construed accordingly) will procure that, with respect to each **Response Contract**, the applicable **Auction Product** is made available from the **Response Unit** for delivery throughout each **Contracted Service Period** in the manner provided in paragraph 6. It is a requirement of each **Response Contract** that, unless prevented by an unplanned outage or other unforeseen technical circumstances, a **Response Unit** will be available to provide that **Auction Product** in accordance with these **Response Service Terms** continuously throughout the **Contracted Service Period**, regardless of its **State of Energy** where applicable.

5.2 The **Service Provider** shall notify **NGESO** (by way of submission pursuant to paragraph 15 of **Operational Data** or (only if directed by **NGESO**) ~~by way of submission of~~ **Performance Data**~~, pursuant to paragraph 15.1)~~) promptly upon becoming aware that any **Response Unit** (including any component **Eligible Asset**) has become unable (including, where it is **Energy Limited**, because of its **State of Energy**) to provide (in whole or part), and at any time during the relevant **Contracted Service Period**, ~~the~~any **Contracted Quantity** or **Contracted Response Energy Volume** or comply with a **Disarming Instruction** or **Re-Arming Instruction** or with any other requirement of the applicable **Auction Product** in accordance with these **Response Service Terms**.

5.3 The submission of **Operational Data** (or, where applicable, **Performance Data**) pursuant to paragraph 15.1 shall also be used by the **Service Provider** to notify **NGESO** promptly when it becomes aware that, following notification pursuant to paragraph 5.2, the ability of a **Response Unit** to meet the requirements of the applicable **Auction Product** in accordance with these **Response Service Terms** has been restored.

5.4 Upon request by **NGESO**, any notification pursuant to paragraph 5.2 or 5.3 shall be followed promptly by an explanation in sufficient (but not excessive) detail to enable **NGESO** to verify that the **Service Provider**'s notification related to unplanned outage or other unforeseen technical circumstances.

5.5 Except as provided in paragraphs 5.6 and 5.8, with effect from the start of the **Settlement Period** in which the **Response Unit** becomes unable to meet the requirements of the relevant **Auction Product** (in whole or part, and whether or not notified by the **Service Provider** pursuant to paragraph 5.2) and until expiry of the **Settlement Period** in which the ability of a **Response Unit** to meet the requirements of such **Auction Product** is restored (or, if later, the time when the **Service Provider** notifies **NGESO** that it has been restored), the **Response Unit** shall, for the purposes of paragraph 7, be deemed to be unavailable to deliver the **Auction Product**.

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5.6 A **Response Unit** which would otherwise be considered unavailable due to its **State of Energy** will be deemed available if the **Service Provider** has complied with the **State of Energy** management rules in accordance with paragraph 6.11 and no further such management is possible.

5.7 Where either:-

i. in the absence of notification from the **Service Provider** pursuant to paragraph 5.2, **NGESO** nonetheless has reasonable grounds for believing that a **Response Unit** is unable to meet the requirements of the **Response Contract** in all or any part of a **Contracted Service Period**; or

ii. **NGESO** has reasonable grounds for believing that any notification from the **Service Provider** pursuant to paragraph 5.2 is for reasons other than related to an unplanned outage or other unforeseen technical circumstances and/or that the **Service Provider** has deliberately or recklessly failed to comply with the **State of Energy** management rules in accordance with paragraph 6.11,

then, notwithstanding paragraph 5.4 and for the purposes of paragraph 7, **NGESO** reserves the right to treat that **Response Unit** as deemed unavailable to deliver the applicable **Auction Product** for the entirety of the **Contracted Service Period** in question (including any part thereof prior to the commencement of unavailability).

5.8 A **Response Unit** shall not be considered unavailable by reason solely of its inability to comply with a **Disarming** (or **Re-Arming**) **Instruction**.

5.9 For the avoidance of doubt, with respect to any **Transfer Period** and for the purposes of this paragraph 5 and paragraph 7, all and any periods of unavailability of the applicable **Response Unit**(s) **Registered** to the **Secondary Service Provider** shall be treated as deemed unavailability of the **Response Unit**.

5.10 Further for the avoidance of doubt, the registration of **Eligible Assets** to a **Response Unit** may not be changed so as to be effective during the subsistence of a **Response Contract**.

6. Service Delivery

6.1 Throughout each **Contracted Service Period**, and except to the extent the **Response Unit** is deemed to be unavailable to deliver the relevant **Auction Product(s)** pursuant to paragraph 5 or is required to comply with a **Disarming Instruction**, the **Service Provider** (or, where applicable, the **Secondary Service Provider**, and references in this paragraph 6 to "**Service Provider**" shall be construed accordingly) shall procure the delivery of **Response** in accordance with this paragraph 6.

Operational Baselines

6.2 In relation to each **Settlement Period** falling in each **Contracted Service Period**, the **Service Provider** shall notify **NGESO** of an intended operating profile (being a level (which may be zero) of **Output** or **Demand**) for the **Response Unit** (which, where applicable, shall be an aggregate operating profile across all **Eligible Assets**) (the "**Operational Baseline**"), together with confirmation of the associated technical and commercial parameters ~~comprising each **Response Contract**~~, in accordance with either paragraph 6.3 or 6.4 (as applicable), and in relation thereto:-

i. each **Operational Baseline** shall be prepared by the **Service Provider** in accordance with **Good Industry Practice** so as to reflect for the relevant **Response Unit** the **Service Provider**'s best estimate of the operating profile of the **Response Unit** in the relevant **Settlement Period**;

ii. each **Operational Baseline** may be either an integer or a value with up to four (4) decimal places; and

iii. where the **Response Unit** is **Energy Limited** the **Service Provider** shall comply with the **State of Energy** management rules in paragraph 6.11.

6.3 Where the **Response Unit** is **BM Participating**, the **Service Provider** shall confirm its **Operational Baseline** to **NGESO** by submission of a **Physical Notification** in accordance with the **Grid Code** (where applicable, rounding up or down to the nearest integer), and shall maintain that **Physical Notification** as at **Gate Closure** (with any subsequent **Bid-Offer Acceptance** adjusting the **Operational Baseline** accordingly), and the **Service Provider** shall further maintain appropriate

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Dynamic Parameters throughout each relevant **Contracted Service Period** to create sufficient headroom and/or footroom for delivery of ~~the~~each **Contracted Quantity**~~.~~**(ies).**

6.4 ~~**NGESO** shall notify **Registered Response Participants** in writing of the date when it is able to receive **Operational Baselines** in respect of **Response Units** which are not **BM Participating**, and with effect from such date and in~~In relation to each ~~such~~ **Response Unit**~~,~~ **which is not BM Participating**, the **Service Provider** shall confirm its **Operational Baseline** to **NGESO** by submission, no later than sixty (60) minutes prior to the start of each relevant **Settlement Period**, of a **Non-BM Data Submission** (in such format as **NGESO** shall specify in writing from time to time) comprising, for that **Settlement Period**:-

i. the **Response Unit** ID;

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ii. confirmation of its **Operational Baseline;**

iii. a maximum export level or minimum import level which equals the **Operational Baseline** plus the **Total LF Contracted Quantity**; and

iv. a minimum export level or maximum import level which equals the **Operational Baseline** minus the **Total HF Contracted Quantity**,

which shall be submitted by the **Service Provider** by way of **Operational Data** or (only if directed by **NGESO**) by way of **Performance Data**, pursuant to paragraph 15.1.

6.5 Where, in respect of any **Settlement Period** in a **Contracted Service Period**, the **Service Provider** has failed to prepare and submit an **Operational Baseline** for the relevant **Response Unit** in accordance with paragraph 6.2 and (as applicable) paragraphs 6.3 or 6.4, then for the purposes of paragraphs 5 and 7 that **Response Unit** shall be deemed to be unavailable to deliver the applicable **Auction Product(s)** for the entirety of that **Settlement Period**.

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6.6 Unless otherwise instructed by **NGESO**, for the duration of each **Contracted Service Period**, the **Service Provider** shall operate the **Response Unit** (where applicable at the **Operational Baseline** and with a **State of Energy**) so as to provide, for any **Frequency** deviation, at least the amount of **Response** shown in the ~~applicable capability data tables at Schedule 1 (being expressed as a percentage of the **Contracted Quantity**) and for a continuous period not less than the **Delivery Duration**~~relevant table in Schedule 2.

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6.7 For the purposes of paragraph 6.6:-

~~i. **Response** is not required for **Frequency** deviations of up to but not including + 0.015 Hz (in the case of the HF **Auction Products**) or up to but not including – 0.015 Hz (in the case of the LF **Auction Products**) in each case from **Target Frequency**, and from the edge of that dead band up to and including + 0.1 Hz (in the case of HF **Auction Products**) or up to and including – 0.1 Hz (in the case of the LF **Auction Products**) the required level of **Response** shall be either:-~~

~~1. in the case of the **DM-H,** a linear increase to a maximum of five percent (5%) of **Contracted Quantity** at + 0.1 Hz, and from that point the required level of **Response** shall be a linear increase to one hundred percent (100%) of **Contracted Quantity** at + 0.2 Hz;~~

~~2. in the case of the **DM-L,** a linear increase to a maximum of five percent (5%) of **Contracted Quantity** at – 0.1 Hz, and from that point the required level of **Response** shall be a linear increase to one hundred percent (100%) of **Contracted Quantity** at – 0.2 Hz;~~

~~3. in the case of the **DR-H**, the required level of **Response** shall be a linear increase to one hundred percent (100%) of **Contracted Quantity** at + 0.2 Hz;~~

~~4. in the case of the **DR-L**, the required level of **Response** shall be a linear increase to one hundred percent (100%) of **Contracted Quantity** at - 0.2 Hz;~~

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~~5. the case of the **DC-H**, the required level of **Response** shall be a linear increase to five percent (5%) of **Contracted Quantity** at + 0.2 Hz; and~~

~~6. the case of the **DC-L**, the required level of **Response** shall be a linear increase to five percent (5%) of **Contracted Quantity** at + 0.2 Hz.~~

~~ii. the required levels of **Response** in the tables are shown as a percentage of the **Contracted Quantity**;~~

i. **Response** shall be delivered for a continuous period not less than the **Delivery Duration**;

~~iii.~~ii. for a **Frequency** deviation at a given time differing from the figures shown in ~~the tables~~Table 3 of Schedule 2, the required levels of **Response** shall be calculated by linear interpolation from the values derived from ~~the table~~that Table;

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~~iv.~~iii. for any **Frequency** deviation greater than the greatest **Frequency** deviation given in ~~the tables~~Table 3 of Schedule 2 (whether positive or negative), the required levels of **Response** shall be calculated by reference to the greatest **frequency** deviation shown (whether positive or negative); and

~~v. required levels of **Response** for **Frequency** deviations lower than those specified in the tables shall be determined by deeming the tables to specify a level of zero (0) MW for a **Frequency** deviation of zero (0) Hz.~~

iv. **Response** must not be delivered within the **Deadband** except to the extent that a **Response Unit** which is not **Energy Limited** and which is contracted for **Dynamic Regulation** only is providing equivalent **Mode A Frequency Response** up to the **Contracted Quantity**.

Response Units** which are **Energy Limited

6.8 Throughout each **Contracted Service Period** and additionally during each **Settlement Period** falling immediately prior to and after that **Contracted Service Period**, for any **Response Unit** which is **Energy Limited** the **Service Provider** shall procure that its **Operational Baselines** at all times observe the **Maximum Ramp Rate**. Any failure to do so in relation to any **Settlement Period** will deem the **Response Unit** to be unavailable to deliver the applicable **Auction Product** for the entirety of that **Settlement Period** for the purposes of paragraphs 5 and 7.

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6.9 For the purposes of paragraph 6.8:-

i. the **Maximum Ramp Rate** shall be calculated by reference to whether the **Response Unit** is providing either or both of the LF or HF **Auction Products** ~~of the same **Response Service**~~, and whether its **Operational Baseline** is showing either an increase or reduction in level of **Active Power Output** or an increase or reduction in level of **Demand**;

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ii. where there are two adjacent **Contracted Service Periods** with different total **Contracted Quantities**, for two (2) adjacent **Settlement Periods** on the boundary of a change in **Contracted Quantity**, the relevant **Maximum Ramp Rate** will be that which incorporates the lowest maximum rate; and

iii. for the avoidance of doubt, where a **Response Unit** is **BM Participating** its **Operational Baseline** shall be adjusted by a **Bid-Offer Acceptance**, and accordingly to the extent complying with any such **Bid-Offer Acceptance** the **Response Unit** shall be deemed to be observing the **Maximum Ramp Rate**.

***Energy Limited** – **State of Energy** management rules*

6.10 It shall be the responsibility of each **Service Provider** to manage the **State of Energy** of any **Response Unit** which is **Energy Limited** (and constituent **Eligible Assets** if any) in order to ensure it can meet the requirements of the applicable **Auction Product(s)** and its obligations hereunder.

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6.11 Without limiting paragraph 6.10, the **Service Provider** shall manage **State of Energy** so as to deliver from the **Response Unit** the **Contracted Response Energy Volume(s)** following any activation at any point during the **Contracted Service Period**, and with respect thereto:

i. at the start of each **Settlement Period** within a **Contracted Service Period**, the **Service Provider** must assess (in accordance with **Good Industry Practice**) if the **State of Energy** is sufficient to deliver the **Contracted Response Energy Volume** as described above, and where **State of Energy** is assessed to be insufficient the **Service Provider** shall, before the end of that **Settlement Period**, calculate and submit a new **Operational Baseline** for either charging or discharging such that the **State of Energy** will become sufficient;

ii. the **Response Unit** should always be capable of recovering at least the volume of **Energy Recovery** in any single **Settlement Period**, through the recalculation and resubmission (where possible) of **Operational Baselines**;

iii. by way of explanation, in the case ~~of~~where, with respect to a **Response Unit** ~~providing both~~, the **Total LF** ~~and HF **Auction Products** of the same **Response Service** with an asymmetric~~ **Contracted Quantity**~~,~~ is not equal to the **Total HF Contracted Quantity**, then the **State of Energy** requirement will also be asymmetrical;

iv. if stored energy moves outside of this range (for example in response to a **Frequency** event), the **Service Provider** must submit at the first opportunity a revised **Operational Baseline** that will recover the stored energy back to the acceptable range;

v. at its discretion (acting reasonably), **NGESO** may determine that the **Service Provider** should not be treated as having failed to manage **State of Energy** where **System Frequency** is affected by:-

1. extended periods of high or low **System Frequency** deviation beyond 0.1 Hz above or below 50Hz; or

2. multiple concurrent frequency events; and

vi. ~~for **Dynamic Regulation**,~~ a **Response Unit**~~,~~ shall not deviate from its **Operational Baseline** (whether in order to manage **State of Energy** or otherwise) whilst **System Frequency** is within the ~~50Hz +/- 0.015Hz "deadband"~~**Deadband** except as provided in paragraph 6.7iv (but for the avoidance of doubt a **Response Unit** providing **Dynamic Regulation** which is not **Energy Limited** may deviate from its **Operational Baseline** whilst **System Frequency** is within ~~such "deadband"~~the **Deadband** to the extent it is providing equivalent **Mode A Frequency Response** up to the **Contracted Quantity**).

6.12 If in the reasonable opinion of **NGESO** a **Response Unit** is operating during a **Contracted Service Period** with a **State of Energy** which indicates that the **Service Provider** is not complying with the **State of Energy** management rules in paragraph 6.11, then **NGESO** reserves the right to treat that **Response Unit** as deemed unavailable to deliver the applicable **Auction Product** for the purposes of paragraphs 5 and 7 until such time as **NGESO** is satisfied (acting reasonably) that the **Service Provider** is in compliance once more.

6.13 **State of Energy** may only be managed by way of the submission of, and adherence to, **Operational Baselines** in accordance with this paragraph 6 (and not, for example, through deliberate imbalance, "spilling" and over/under delivery).

Disarming (and Re-Arming) Instructions

6.14 At any time during a **Contracted Service Period**, **NGESO** may issue an instruction to the **Service Provider** to cease provision of[any one or more of the applicable **Auction Product** ("**Disarming Instruction**"), and such **Disarming Instruction** shall remain in place for the remainder of that **Contracted Service Period** and all and any subsequent **Contracted Service Periods** until **NGESO** instructs the **Service Provider** that provision of that **Auction Product(s)** can resume from that **Response Unit** ("**Re-Arming Instruction**").

6.15 All **Disarming Instructions** and **Re-Arming Instructions** shall be given by **NGESO** by electronic means, which shall be acknowledged by the **Service Provider** also by electronic means within two (2) minutes of receipt, and for such purpose 'disarming codes' and 're-arming codes' shall be published by **NGESO** from time to time.

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6.16 No later than two (2) minutes following receipt of a **Disarming Instruction**, the **Service Provider** shall procure that the **Response Unit** (and its constituent **Eligible Asset**(s)) is disarmed such that no **Response** is provided and the **Response Unit** resumes operation in accordance with its then prevailing **Operational Baseline**.

6.17 No later than two (2) minutes following receipt of a **Re-Arming Instruction** (if given during a **Contracted EFA Period**), the **Service Provider** shall procure that the **Response Unit** (and its constituent **Eligible Asset**(s)) is re-armed such that provision of the applicable **Auction Product** is resumed in accordance with this paragraph 6.

6.18 For the purpose of paragraphs 5 and 7 the issue of a **Disarming Instruction** shall not affect payment of the **Availability Payment** during the relevant **Contracted Service Period(s)**, save that operation of the **Response Unit** shall be monitored by **NGESO** during the remainder of the **Contracted Service Period** and **NGESO** shall be entitled to treat the **Response Unit** as armed and continuing to deliver the applicable **Auction Product** until such time as **NGESO** is satisfied (acting reasonably) that the **Service Provider** has complied with the **Disarming Instruction**.in accordance with paragraph 6.16.

7. Availability Payments

7.1 In respect of each **Response Contract**, ~~**NGESO** shall,~~and in accordance with paragraph 8, **NGESO** shall pay to the **Service Provider**, or, (as the case may be), the **Service Provider** shall pay to **NGESO**, an **Availability Payment** calculated in accordance with the formulae in Schedule ~~2~~3.

7.2 No **Availability Payment** shall be made by **NGESO** to the **Service Provider** pursuant to this paragraph 7 in respect of any period or periods of deemed unavailability pursuant to paragraphs 5 or 6.

7.3 Without prejudice to its other rights and remedies, **NGESO** reserves the right to withhold payment of any **Availability Payment** where the **Service Provider** has failed to provide relevant **Operational Data** and/or **Performance Data** pursuant to paragraph 15.

7.4 With respect to any **Transfer Period**, and for the avoidance of doubt:-

i. for the purposes of this paragraph 7, the availability and provision of **Response** pursuant to the relevant **Response Contract** shall be assessed by reference to the **Response Units**(s) **Registered** to the **Secondary Service Provider** and not to the **Primary Service Provider's Response Unit**; and

ii. all and any **Availability Payments** accruing due pursuant to this paragraph 7 shall be payable to the **Primary Service Provider** and nothing in these **Response Service Terms** shall create any liability or obligation on the part of **NGESO** to make any such payments to the **Secondary Service Provider**.

8. Payment Procedure

8.1 In respect of each calendar month during which the **Service Provider** has been party to one or more **Response Contracts**, **NGESO** shall send to the **Service Provider** a **Monthly Statement** setting out, in respect of each such **Response Contract**, its calculation of:-

i. the **Availability Payments** payable to or from the **Service Provider** pursuant to paragraph 7;

ii. any adjustments made to previous **Monthly Statements**; and

iii. the resulting net amount due to (or from, as the case may be) the **Service Provider**,

and in respect thereof the provisions of Schedule ~~3~~4 shall apply.

8.2 The **Monthly Statement** may include in addition to the calculation referred to in paragraph 8.1 details with respect to the settlement of other **Balancing Services** provided by the **Service Provider** during the relevant calendar month.

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9. Grid Code and Distribution Code

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9.1 The provision by the **Service Provider** of an **Auction Product** shall not relieve it of any of its obligations or affect such obligations (where applicable) set out in the **Grid Code** (including its obligations (if any) to provide **Mode A Frequency Response** when instructed by **NGESO** pursuant to the **CUSC** and/or the **Grid Code**) or to provide **Demand** control when instructed by **NGESO** pursuant to **Grid Code** OC6) or in the **Distribution Code** of its host **Public Distribution System Operator**.

9.2 Without limiting paragraph 9.1, each **Service Provider** that is or becomes a **DRSC Liable User** shall, for the duration of each **Contracted Service Period**, comply in all respects with the **Demand Response Services Code** as it refers to **Demand Response Active Power Control**.

10. Maintenance of Eligible Assets

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The **Service Provider** shall maintain each **Eligible Asset** to such a standard that the **Service Provider** can meet its obligations to provide the applicable **Auction Product** in accordance with each **Response Contract** and these **Response Service Terms**.

11. Third Party Claims

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11.1 The **Service Provider** undertakes to **NGESO** that the availability and delivery of the applicable **Auction Product** from any **Response Unit** pursuant to and in accordance with each **Response Contract** and these **Response Service Terms** (including during any **Transfer Period**) will not at any time during any **Contracted Service Period** cause the **Service Provider** to be in breach of or to otherwise be non-compliant with any **Connection Agreement** and/or any agreement for the supply of electricity or related services to or from any constituent **Eligible Asset** or any **Plant** and **Apparatus** associated with it.

11.2 Notwithstanding paragraph 11.1, in the event that the **Service Provider** (or, during any **Transfer Period**. any **Secondary Service Provider**) delivers the applicable **Auction Product** in accordance with these **Response Service Terms** in consequence of which **NGESO** suffers or incurs any loss in respect of a claim brought by any third party related to any actual or alleged breach or non-compliance by the **Service Provider** as described in paragraph 11.1, then the **Service Provider** shall indemnify **NGESO** against all and any losses, liabilities, claims, expenses and demands suffered or incurred by **NGESO** in connection therewith. Such indemnity shall include any legal costs and expenses reasonably incurred in the contesting of such claims including the court costs and reasonable attorney's fees and other professional advisors' fees. The **Parties** agree and accept that, for the purposes of paragraph 18 all such legal costs and expenses expressed to be the subject of such indemnity shall be treated as direct losses.

11.3 In the event of any such claim referred to in paragraph 11.2 being made against **NGESO**, **NGESO** shall as soon as reasonably practicable give notice of the claim together with all relevant supporting documentation to the **Service Provider**. The **Service Provider** shall be entitled, upon written notice to **NGESO** and subject to **NGESO** receiving from the **Service Provider** such reasonable undertakings as **NGESO** shall reasonably require to protect **NGESO** against damage to its name and reputation, to assume at its own expense the sole conduct of all proceedings relating to such claim including the right to contest such claim in the name of **NGESO**. **NGESO** shall supply the **Service Provider** with all information, assistance and particulars reasonably required by the **Service Provider** in connection therewith. **NGESO** shall not accept, settle, pay or compromise any such claim without the prior written approval of the **Service Provider** (not to be unreasonably withheld or delayed). The **Service Provider** shall reimburse to **NGESO** all of its reasonable expenses incurred in connection with the provision of any such information, assistance or particulars in the contesting of any such claim.

12. Provision of Other Services

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12.1 The **Service Provider** undertakes to **NGESO** that the availability and delivery of the applicable **Auction Product** from any **Response Unit** pursuant to and in accordance with a **Response Contract** and these **Response Service Terms** will not at any time during any **Contracted Service Period** (including during any **Transfer Period**) be impaired or otherwise prejudiced by the **Service Provider's** (or, during any **Transfer Period**, any **Secondary Service Provider's**) performance of

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any agreement with a third party (including another **Service Provider**) relating to any **Eligible Asset** or any associated **Plant** and **Apparatus**, including the making available and/or delivery of services to that third party by the **Service Provider** (whether by way of increases or reductions in **Generation** or **Demand** or stipulated running profiles, participation in any other services (including where part of a trial service) or otherwise, and whether to assist in the management, operation or protection of a **User System** or pursuant to the **Capacity Market Rules** or otherwise).

12.2 Notwithstanding paragraph 12.1, and without prejudice to paragraph 12.6, in the event that the **Service Provider** (or, during any **Transfer Period**, any **Secondary Service Provider**) is unable to provide the applicable **Auction Product** (to any extent) in all or any part of any **Contracted Service Period** for any reason described in paragraph 12.1, then the **Service Provider** shall (or shall procure that the **Secondary Service Provider** shall) give a full explanation to **NGESO** in its notification of unavailability pursuant to paragraph 5.2, and **NGESO** may in its absolute discretion (except where paragraph 12.5 applies) terminate the **Response Contract** in question pursuant to paragraph 14).

12.3 Subject always to paragraph 12.4, and irrespective of whether or not **NGESO** elects to terminate the **Response Contract**, the **Service Provider** hereby agrees to reimburse to **NGESO** all and any additional costs and expenses incurred by it as a result of such inability including **NGESO**'s additional costs of alternative or replacement service provision.

12.4 The amount or amounts for which the **Service Provider** may be liable to reimburse **NGESO** pursuant to paragraph 12.3 in respect of any single **Response Contract** shall not exceed in aggregate the greater of (1) two hundred and fifty thousand pounds sterling (£250,000), and (2) an amount equal to the aggregate **Availability Payments** in respect of that **Response Contract** calculated by reference to all **Settlement Periods** in the relevant **Contracted Service Period** (ignoring any periods of unavailability and whether or not declared by the **Service Provider**).

12.5 Where, during any one or more **Settlement Periods** in a **Contracted Service Period**, a **Service Provider** is required under the terms of any agreement with **NGESO** to provide from any **Eligible Asset** any other **Balancing Service** (except with respect to **Reactive Power**~~))~~, the **Parties** agree and acknowledge that to the extent that such service provision is inconsistent or in conflict with the delivery of the applicable **Auction Product** (as determined by **NGESO** acting reasonably) then the applicable **Auction Product** cannot be provided simultaneously with such other **Balancing Service**. Accordingly, unless pursuant to the terms for provision of and payment for such other **Balancing Services** the relevant **Response Unit** is deemed unavailable to provide the applicable **Auction Product** or except as may otherwise be specified by **NGESO**, the relevant **Response Unit** shall be deemed unavailable to provide such other **Balancing Service**, and availability of the **Response Unit** to provide the applicable **Auction Product** pursuant to these **Response Service Terms** shall prevail.

12.6 For the avoidance of doubt, paragraph 12.5 shall not affect~~:~~-

~~**12.6**~~i. the submission by a **Service Provider** of bids and offers (and the issue of **Bid-Offer Acceptances**) under the **Balancing Mechanism** where not made pursuant to terms agreed with **NGESO** for provision of any other **Balancing Service**~~, and furthermore unless otherwise indicated in writing by **NGESO** from time to time, the **Auction Products** of the same **Response Service** shall be capable of being provided by a **Response Unit** simultaneously. Further information regarding simultaneous provision of the **Response Services** is contained in the **Stacking Guidance** as published by **NGESO** from time to time.~~; and

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ii. the simultaneous performance from a single **Response Unit** of multiple **Contracts** (including where formed from the same **Sell Order**) insofar as permitted by the **Procurement Rules**.

Further information regarding paragraph 12.6i is contained in the **Stacking Guidance**.

12.7 Where, during any one or more **Settlement Periods** in a **Contracted Service Period**, a **Service Provider** (or, during any **Transfer Period**, any **Secondary Service Provider**) is making available and/or delivering services to a third party in breach of paragraph 12.1, then the relevant **Response Unit** shall be deemed unavailable for the purposes of paragraph 7.

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12.8 For the purposes of this paragraph 12 and for the avoidance of doubt, where a **Response Contract** is formed with respect to a **Response Unit** which is not registered as a **BM Unit** and with a **Contracted ~~Capacity~~Quantity** which is less than the aggregate **Registered Quantity** of each component **Eligible Asset**, then the making available and/or delivery of services by the **Service**

Provider to **NGESO** or a third party from such **Eligible Assets** or any of them with respect to any or all of that excess capacity shall be deemed to impair, and be inconsistent or in conflict with, the delivery of the applicable **Auction Product** pursuant to such **Response Contract** unless such excess capacity is demonstrated to **NGESO**'s reasonable satisfaction to be separately metered so as to enable the production of **Operational Data** and **Performance Data** pursuant to paragraph 15.

13. Communications

13.1 Any communications required by these **Response Service Terms** to be given in writing shall unless otherwise provided in this paragraph 13 be made and deemed to have been received in accordance with paragraph 26 (*Notices*) save as may be otherwise agreed by the **Parties**.

13.2 The **Parties** consent to the recording of all telephone conversations between them relating in whole or in part to these **Response Service Terms**, and each **Party** agrees to notify its employees of that consent and obtain their consent to that recording if required by **Law**.

13.3 All notifications to be made by the **Service Provider** with respect to any unavailability (and restoration of availability) of a **Response Unit** to provide the applicable **Auction Product(s)** pursuant to paragraph 5 shall be made as part of **Operational Data** using a **Data Concentrator** (unless otherwise provided in paragraph 15).

13.4 All **Operational Baselines** prepared by a **Service Provider** pursuant to paragraph 6.2 shall be submitted by the **Service Provider** to **NGESO** in accordance with paragraphs 6.3 or 6.4 (as applicable), which for **Response Units** which are **BM Participating** shall be via **BM Unit Data** submissions and for **Response Units** which are not **BM Participating** shall be submitted using such means as **NGESO** may direct or (for such period and upon such conditions as **NGESO** may specify) electronic transfer as part of **Performance Data**.

14. Termination of Response Contracts

14.1 Either **Party** shall have the right to terminate a **Response Contract** in the circumstances set out in paragraph 8.1 of the prevailing **Common Flexibility Service Terms and Conditions** as if paragraphs 8.1 and 8.2 were set out in full herein.

14.2 Without prejudice to paragraph 14.1, and in addition to any other rights of termination available under the **Response Procurement Documentation**, **NGESO** may in its absolute discretion terminate a **Response Contract** in respect of a **Response Unit** with immediate effect by notice in writing to the **Service Provider** in the following circumstances:-

i. where the **Service Provider** is in material breach of a warranty or declaration given as part of the **Registration and ~~Prequalification~~Pre-Qualification Procedure** or under any of the **Response Procurement Documentation**;

ii. where **NGESO** (acting reasonably) determines that the **Response Unit**, and/or one or more **Eligible Assets** comprising the **Response Unit**, is not ready for commercial operation and/or delivery of the applicable **Auction Product**; or

iii. where the **Service Provider** fails to comply in any material respect with its obligations under the **Testing Rules** including where **NGESO** determines (acting reasonably) that the **Service Provider's Independent Technical Expert** is failing to meet the required technical standard and/or is not sufficiently independent (each as defined in the **Testing Rules**).

14.3 Paragraphs 8.4 to 8.6 inclusive of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

15. Monitoring and Metering Data

Operational data

15.1 To enable **NGESO** to verify the **Operational Baseline** and facilitate calculation of **Availability Payments** in accordance with paragraph 7 and Schedule ~~2~~3, and unless and to the extent otherwise directed by **NGESO**, the **Service Provider** shall procure and submit to **NGESO**, on a continuous

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basis and with a maximum delay of five (5) seconds, the following data ("**Operational Data**") for each **Response Unit**, all at a granularity of one (1) measurement per second (1 Hz):-

i. date/time stamp;

ii. whether or not the **Response Unit** is available for the applicable **Auction Product(s)** pursuant to paragraph 5**;**

iii. whether or not the **Response Unit** is the subject of a **Disarming Instruction**;

iv. **Metered Active Power Output** or **Demand** (as the case may be); and

v. where the **Response Unit** is **Energy Limited**, its **State of Energy** in MWh (**Active Power Output** and **Demand**).

15.2 All **Operational Data** shall be submitted using such means as **NGESO** may specify, and shall cover the entirety of each **Contracted Service Period** together also with each **Settlement Period** which falls immediately before and after. Insofar as **NGESO** is unable to receive **State of Energy** of a **Response Unit** as **Operational Data**, then it shall so notify in writing **Registered Response Participants**, whereupon relevant **Service Providers** shall only be required to submit **State of Energy** from **Energy Limited Response Units** as part of **Operational Data** from the date 30 days after subsequent notice in writing from **NGESO** to **Registered Response Participants** that it is able to receive such submissions, and paragraph 15.1 shall be read and construed accordingly.

Performance data

15.3 In addition, and without limiting paragraph 15.1, to enable **NGESO** to monitor the delivery of **Response** pursuant to a **Response Contract** and to facilitate calculation of **Availability Payments** in accordance with paragraph 7 and Schedule ~~2~~3, the **Service Provider** shall procure and retain (for a period of not less than three (3) months) the data specified or referred to in paragraph 15.4 ("**Performance Data**") and shall submit the **Performance Data** to **NGESO** by electronic transfer on an hourly basis using a **Data Concentrator** throughout the **Contracted Service Period**.

15.4 Unless otherwise specified by **NGESO** in writing from time to time, whether or not the **Response Unit** is the subject of a **Disarming Instruction**, the **Performance Data** shall comprise (at a granularity of twenty (20) measurements per second (20 Hz) or alternatively in the case of **Dynamic Regulation** (but only where not **Stacked** with another **Auction Product**, two (2) measurements per second (~~2Hz~~2 Hz)), for each **Response Unit**:-

i. date/time stamp;

ii. **Input Frequency** (for one of the relevant **Eligible Assets**);

iii. whether or not the **Response Unit** is available for the applicable **Auction Product(s)** pursuant to paragraph 5**;**

iv. **Metered Active Power Output** or **Demand** (as the case may be);

v. where the **Response Unit** is **Energy Limited**, its **State of Energy** in MWh (**Active Power Output** and **Demand**); ~~and~~

vi. the **Performance Baseline**, which shall update any **Operational Baseline**, and shall be either an integer or a value with up to four (4) decimal places~~.~~; and

~~vi.~~vii. the status of the **Response Unit** as either armed or disarmed.

15.5 All **Operational Data** and **Performance Data** to be provided by the **Service Provider** pursuant to this paragraph 15:-

i. shall be provided where applicable at an aggregate level for each **Response Unit**; and

ii. shall be to a margin of error of 0.001 Hz for **System Frequency** and one percent (1%) for **Metered Active Power Output** or **Demand**.

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Publication of data

15.6 For the purposes of paragraph 22 (*Confidentiality*) the **Service Provider** consents to **NGESO** publishing all **Operational Data** and **Performance Data** on its website in a non-anonymised format.

Delivery Failure Report

15.7 Where in relation to any one or more **Settlement Periods** in a **Contracted Service Period** the **Availability Payment** calculated for a **Service Provider** is affected by an active K factor (as more particularly described in Schedule ~~2~~3), then no later than five (5) **Business Days** following request from **NGESO** the **Service Provider** shall provide to **NGESO** a report in writing (in such form as **NGESO** may reasonably require) setting out in reasonable detail an explanation for the underlying performance of the relevant **Response Unit(**s) attributed to such K factor.

Measurement of frequency

15.8 For the purposes of this paragraph 15, the **Parties** agree that **System Frequency** shall be measured in accordance with the **Frequency Measurement Standard**.

16. ABSVD

For the purposes of the **ABSVD Methodology Statement**, the **Service Provider** hereby consents (where applicable for and on behalf of the **Lead Party** of all relevant **BM Units**) to all and any energy volumes associated with delivery of **Response** pursuant to ~~these~~a **Response** ~~**Service Terms**~~**Contract** not being included within the **Applicable Balancing Services Volume Data** save where the **Response Unit** is **BM Participating** (for the avoidance of doubt as a **Primary BM Unit**) in which case energy volumes associated with delivery of **Response** pursuant to each **Response Contract** will be included within the **Applicable Balancing Services Volume Data**~~.~~ (separately, where **Auction Products** are **Stacked**).

17. Force Majeure

17.1 Save for paragraphs 10.2.2 and 10.4 which shall not apply, paragraph 10 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

18. Liability, Indemnity and Insurance

18.1 Paragraph 11 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

19. Records and Audits

19.1 Paragraph 5 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

20. Assignment

20.1 Paragraph 12 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

21. Transfer of Response Contracts

21.1 At any time during the subsistence of a **Response Contract**, a **Service Provider** (the "**Primary Service Provider**") may nominate another **Registered Response Participant** (the "**Secondary Service Provider**") to discharge its obligations to **NGESO** with respect to the delivery of **Response** in the applicable **Contracted Service Period** pursuant to that **Response Contract**.

21.2 The effect of any such nomination once validated by **NGESO** pursuant to this paragraph 21 is to treat delivery of **Response** from one or more **Response Units** registered to the **Secondary Service Provider** as if delivered by the **Primary Service Provider** from its **Response Unit** for the purposes of these **Response Service Terms**.

21.3 No nomination shall be valid unless:-

i. both entitles are **Registered Response Participants**;

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ii. the **Secondary Service Provider** has **Eligible Assets** which are **Registered** to it and allocated to one or more **Response Units** pursuant to the ~~Response~~ **Procurement Rules** with sufficient aggregate **Registered Quantity** and proven capability to deliver the applicable **Auction Product** to enable the **Response Contract** to be discharged during the applicable **Contracted Service Period**;

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iii. the specified **Transfer Period** during which the nomination is to be effective is a period which comprises the entire **Contracted Service Period** created by a subsisting **Response Contract** to which the **Primary Service Provider** is a party; and

iv. the nomination is validly notified to **NGESO** pursuant to paragraphs 21.4, 21.5 and 21.6 and the **Transfer Notice** validated by **NGESO**.

Transfer Notices

21.4 Each nomination shall be notified to **NGESO** by the **Primary Service Provider** by no later than one (1) hour prior to commencement of the applicable **Contracted Service Period**, and each such nomination is referred to in these **Response Service Terms** as a "**Transfer Notice**".

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21.5 Unless otherwise specified in writing by **NGESO** from time, each **Transfer Notice** shall comprise the entirety of a **Contracted Service Period**, and shall specify:-

i. the identity of the **Primary Service Provider** and **Response Unit**; and

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ii. the identity of the **Secondary Service Provider** and its **Response Unit**(s) and **Eligible Assets**.

21.6 Each nomination shall comprise the entire **Contracted Quantity** associated with the **Response Contract** during the relevant **Transfer Period**, and for the avoidance of doubt the **Contracted Quantity** shall not be capable of being split amongst two or more **Secondary Service Providers**.

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21.7 In giving a **Transfer Notice**, the **Primary Service Provider** warrants that the **Secondary Service Provider** accepts the nomination.

21.8 **NGESO** shall notify the **Primary Service Provider** as soon as reasonably practicable following receipt of the **Transfer Notice** whether or not the **Transfer Notice** has been validated. In the absence of any notification by **NGESO** of validation of the **Transfer Notice** by commencement of the relevant **Contracted Service Period** the **Transfer Notice** shall be deemed not to have been validated.

21.9 Where in **NGESO**'s reasonable opinion the delivery of **Response** pursuant to the **Response Contract** during the **Transfer Period** by the **Secondary Service Provider**'s designated **Response Unit(s)** would or might endanger operational security within the meaning of the **Electricity Transmission System Operation Regulation**, then **NGESO** shall so notify both **Registered Response Participants** whereupon the **Transfer Notice** shall be deemed withdrawn.

21.10 A **Transfer Notice** shall be invalid if the **Secondary Service Provider'**s designated **Response Unit** or any **Eligible Asset** allocated to it is the subject of a **Response Contract** for the same **Contracted Service Period**, in which case **NGESO** shall so notify both whereupon the **Transfer Notice** shall be deemed withdrawn.

Cancellation Notice

21.11 A **Transfer Notice** may be cancelled by the **Primary Service Provider** (but not under any circumstances by the **Secondary Service Provider**) by notification to **NGESO** in writing ("**Cancellation Notice**") specifying the date and time form which the cancellation is to be effective.

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Effect of Transfer Notice

21.12 For the duration of each **Transfer Period** (or any earlier period where the **Transfer Period** comes to an end pursuant to the foregoing provisions), **NGESO** consents to the **Primary Service Provider**'s obligation to deliver **Response** pursuant to the relevant **Response Contract** being discharged on its behalf by the **Secondary Service Provider** from its **Response Unit(s)**.

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Form of notifications

21.13 All **Transfer Notices** and **Cancellation Notices** and other notifications related thereto between the **Parties** referred to in this paragraph 21 shall be made using the method of communication specified from time to time by **NGESO**.

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22. Confidentiality

22.1 The provisions of paragraph 12 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply to all and any information provided by **NGESO** or any **Registered Response Participant** to the other (whether orally or in writing) pursuant to or in connection with these **Response Service Terms** as if set out in full herein.

23. Intellectual Property Rights

23.1 The provisions of paragraph 14 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply to all **Intellectual Property Rights** owned by or licensed to either **Party** as if set out in full herein.

24. Data Protection

24.1 The provisions of paragraph 15 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

25. Modern Slavery, Anti-bribery and Living Wage

25.1 The provisions of paragraph 16 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein, and without limitation as at the date of formation of each **Response Contract** the **Service Provider** warrants, represents and undertakes to **NGESO** in the manner set out in paragraph 16.1 thereof and indemnifies **NGESO** as provided in paragraphs 16.2 and 16.7 thereof.

25.2 Any breach of this paragraph 25 by the **Service Provider** shall be deemed a material breach of all and any relevant **Response Contracts** for the purposes of paragraph 14.1.

26. Notices

26.1 Save to the extent the manner of communication between the **Parties** is otherwise stipulated in these **Response Service Terms**, paragraph 17 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply to any notice required to be submitted under these **Response Service Terms** by either **NGESO** or the **Registered Response Participant** to the other as if set out in full herein.

26.2 For the purposes of paragraph 26.1, the relevant contact details and addresses of each **Party** shall be those notified from time to time by that **Party** to the other pursuant to the **Registration and Pre-Qualification Procedure.**

27. Dispute Resolution

27.1 The provisions of paragraph 18 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply in relation to any dispute or difference of whatever nature however arising under, out of, or in connection with these **Response Service Terms** as if set out in full herein, save that:-

i. no **Party** shall have any right to refer any dispute to an **Expert** for determination except where the dispute is stated in these **Response Service Terms** to be referable to an **Expert** for determination or otherwise agreed in writing by the **Parties** to be so referable;

ii. nothing in this paragraph 27.1 shall prevent the **Parties** from agreeing to resolve any dispute or difference through the courts in which case paragraph 28.2 shall apply; and

iii. where any dispute is referred to arbitration, the rules of the Electricity Arbitration Association shall apply unless otherwise agreed in writing by the **Parties** (and paragraph 18 of the prevailing **Common Flexibility Service Terms and Conditions** shall be read and construed accordingly).

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28. Governing Law and Jurisdiction

28.1 Any claim, dispute or matter (whether contractual or non-contractual) arising under or in connection with these **Response Service Terms** or their enforceability shall be governed by and construed in accordance with the laws of England and Wales.

28.2 Subject always to paragraph 27.1, **NGESO** and each **Registered Response Participant** submits to the exclusive jurisdiction of the courts of England and Wales over any claim, dispute or matter arising under or in connection with these **Response Service Terms** or their enforceability and waives any objection to proceedings being brought in such courts or on the grounds that proceedings have been brought in an inconvenient forum.

29. Severance

29.1 The provisions of paragraph 19 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

30. Third Party Rights

30.1 The provisions of paragraph 20 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein with the exception of the words "other than the Distribution and Transmission Licensees (the Company) who shall be entitled to independently enforce all of the terms of the Contract".

31. No Agency or Partnership

31.1 The provisions of paragraph 21 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

32. Waiver

32.1 The provisions of paragraph 22 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

33. Entire Agreement

33.1 The provisions of paragraph 23 of the prevailing **Common Flexibility Service Terms and Conditions** shall apply as if set out in full herein.

34. EMR

34.1 Notwithstanding any confidentiality obligations and any restriction on the use or disclosure of information set out in the **Response Procurement Documentation**, the **Services Provider** consents to **NGESO** and each of its subsidiaries using all and any information or data supplied to or acquired by it in any year under or in connection with any **Balancing Services Contract** for the purpose of carrying out its **EMR Functions**.

34.2 For the purposes of this paragraph 34 only:-

i. **"AF Rules"** has the meaning given to "allocation framework" in section 13(2) of the Energy Act 2013;

ii. **"Capacity Market Rules"** means the rules created pursuant to section 34 of the Energy Act 2013 as modified from time to time in accordance with The Electricity Capacity Regulations 2014;

iii. **"EMR Functions"** has the meaning given to "EMR functions" in Chapter 5 of Part 2 of the Energy Act 2013; and

iv. **"EMR Document"** means The Energy Act 2013, The Electricity Capacity Regulations 2014, the Capacity Market Rules, The Contracts for Difference (Allocation) Regulations 2014, The Contracts for Difference (Electricity Supplier Obligation) Regulations 2014, The Contracts

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for Difference (Definition of Eligible Generator) Regulations 2014, The Electricity Market Reform (General) Regulations 2014, the AF Rules and any other regulations or instruments made under Chapter 2 (contracts for difference), Chapter 3 (capacity market) or Chapter 4 (investment contracts) of Part 2 of the Energy Act 2013 which are in force from time to time.

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SCHEDULE 1 – DEFINED TERMS

Part 1

"Availability Payment"	the **Settlement Value** for an **Auction Product** calculated in accordance with Schedule 3;
"Cancellation Notice"	shall have the meaning given to it in paragraph 21.1;
"Contracted Service"	a **Response Service** the subject of a **Response Contract**;
"Disarming Instruction"	shall have the meaning given to it in paragraph 6.14;
"Deadband"	**Frequency** deviations between but not including +0.015 Hz and -0.015 Hz in each case from the **Target Frequency**;
"**EAC Go-Live Date**"	shall have the meaning given to it in the **EAC Procurement Rules;**
"EAC Procurement Rules"	the document entitled "Reserve/Response Services Procurement Rules" published by **NGESO** on or prior to the **Effective Date**;
"Effective Date"	shall have the meaning given to it in the **EAC Procurement Rules**;
"Monthly Statement"	shall have the meaning given to it in paragraph 1 of Schedule 4;
"Operational Data"	shall have the meaning given to it in paragraph 15.1;
"Performance Data"	shall have the meaning given to it in paragraph 15.4;
"Primary Service Provider"	shall have the meaning given to it in paragraph 21.1;
"Procurement Rules"	either the **Response Procurement Rules** or, from and subject to the **EAC Go-Live Date**, the **EAC Procurement Rules**;

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"Re-Arming Instruction"	shall have the meaning given to it in paragraph 6.14;
"Response Service Window"	shall have the meaning given to it in the **EAC Procurement Rules**;
"Secondary Service Provider"	shall have the meaning given to it in paragraph 21.1;
"Stacking" or **"Stacked"**	with respect to any **Response Unit** and **Service Period**, that more than one **Balancing Service** is provided simultaneously (for the avoidance of doubt in the case of **Response Services**, each under a separate **Response Contract**);
"Total HF Contracted Quantity"	for any **Response Unit** and **Settlement Period**, the sum of the **Contracted Quantities** of each of DC-high, DM-high and DR-high (which may, for the avoidance of doubt, be zero);
"Total LF Contracted Quantity"	for any **Response Unit** and **Settlement Period**, the sum of the **Contracted Quantities** of each of DC-low, DM-low and DR-low (which may, for the avoidance of doubt, be zero);
"Transfer Notice"	shall have the meaning given to it in paragraph 21.4;
"**Transfer Period**"	shall mean the period described as such in a **Transfer Notice** as may be shortened upon the cancellation or withdrawal of that **Transfer Notice** or otherwise in accordance with paragraph 21.

Part 2

"Auction Product"	a **Response Product**;
"Contracted Quantity"	in respect of any **Response Unit**, **Auction Product** and **Contracted Service Period**, the amount of **Response** (MW) which a **Service Provider** has agreed to provide as an **Auction Product** in accordance with a **Response Contract**;

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"Contracted Response Energy Volume"	in relation to any **Response Unit** and **Contracted Service Period**, the volume of stored **Active Energy** (MWh) (or capability to store energy) that a **Response Unit** should be capable of delivering before becoming unavailable due to exhaustion (calculated as the sum of the **Contracted Quantity** multiplied by the **Delivery Duration** for each **Auction Product**);
"Contracted Service Period"	a **Response Service Window** the subject of a **Response Contract**;
"Data Concentrator"	a software platform utilised by **NGESO** for the receipt of **Operational Data**;
"Delivery Duration"	in relation to any **Response Unit** and **Contracted Service Period**, the time over which the **Contracted Quantity** must be capable of being delivered so as to derive the **Contracted Response Energy Volume;**
"Energy Limited"	a classification given in the **Registration and Pre-Qualification Procedure** to any **Auction Unit** comprised of one or more **Eligible Assets**:- (a) which creates its store of energy by using power ultimately drawn from the **National Electricity Transmission System**; and (b) whose **State of Energy** at the start of a relevant **Service Period** is insufficient to provide full delivery of the **Contracted Quantity** for the duration of that **Service Period**;
"Energy Recovery"	in relation to any **Response Unit** which is **Energy Limited** and to any **Contracted Service Period**, the minimum volume of **Active Energy** (MWh) capable of being recovered by way of **State of Energy** management in a single **Settlement Period**, calculated as twenty percent (20%) of **Contracted Response Energy Volume**;
"Frequency Deviation"	as defined in the **CUSC**;

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"Frequency Measurement Standard"	the prevailing document titled "Frequency Measurement Standard" published by or on behalf of **NGESO** from time to time;
"Grid Supply Point"	as defined in the **Grid Code**;
"Independent Technical Expert"	an experienced technical expert with expertise in the operation of demand side response (DSR) or generating units or electricity Interconnectors (as the case may be), independent of the prospective **Service Provider** and engaged by it at its expense to carry out a technical assessment and prepare a test certificate, all as more particularly described in the **Testing Rules**;
"Input Frequency"	the number of alternative current cycles per second (expressed in Hertz) as measured at the grid connection point of the relevant **Eligible Asset**;
"Maximum Ramp Rate"	in relation to any **Response Unit** which is **Energy Limited** and to any **Contracted Service Period**, the maximum ramp rate permitted at any point within an **Operational Baseline** and **Performance Baseline**, calculated as five percent (5%) of **Contracted Quantity**, as more particularly referred to in these **Response Service Terms**;
"Non-BM Data Submission"	a notification from a **Service Provider** to **NGESO** giving prevailing operational and other information with respect to a **Response Unit** as more particularly described in these **Response Service Terms**;
"Operational Baseline"	the **Service Provider**'s best estimate of **Active Power Output** or **Demand** from or attributable to a **Response Unit** in any **Settlement Period**, as notified to **NGESO** in accordance with these **Response Service Terms**;
"Performance Baseline"	in relation to any **Response Unit**, the intended operating profile where applicable prior to the delivery of the applicable **Auction Product** (being a level (which may be zero) of **Output** or **Demand** and which, where applicable, shall be an aggregate operating profile across all **Eligible Assets**);

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"Proceedings"	as defined in paragraph 12 (*Governing law and jurisdiction*) of the **Balancing Services General Terms and Conditions**;
"Registered Quantity"	in relation to any **Eligible Asset** and **Auction Product**, its **Maximum Registered Product Capacity** as validated by **NGESO**;
"Registered Response Participant"	a **Registered Service Provider** who has registered with **NGESO** pursuant to the **Registration and Pre-Qualification Procedure** as eligible to participate in the procurement of an **Auction Product**, which shall include acceding to the **Response Procurement Documentation**;
"Registered Service Provider"	an entity who has submitted the relevant registration documents and to whom **NGESO** has confirmed is subsequently registered as such in each case pursuant to the **Registration and Pre-Qualification Procedure**;
"Registration and Pre-Qualification Procedure"	the procedure and processes described in Schedule 2 of the **Procurement Rules**;
"Response Procurement Documentation"	these **Response Service Terms** together also with the **Procurement Rules**, the **Balancing Services General Terms and Rules of Interpretation**, the **Common Flexibility Service Terms and Conditions** (to the extent that any of its provisions are incorporated by any of the other **Response Procurement Documentation** into such document(s)) and such other document(s) as **NGESO** any designate from time to time as comprising a part of the **Response Procurement Documentation**;
"Response Service(s)"	the **Auction Products** or any of them;
"Response Service Terms"	this document as published by **NGESO** from time to time;
"Response Unit"	an **Auction Unit** the subject of a **Response Contract**;
"Service Period"	a **Response Service Window**;
"Service Provider"	with respect to any **Response Contract**, the applicable **Registered Response Participant**;

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"Stacking Guidance"	the prevailing document titled "Unlocking Stacking of BOAs with Frequency Response Services" published by or on behalf of **NGESO** from time to time setting out the rules for **Stacking** of **Response Services** with offers and bids in the **Balancing Mechanism**;
"State of Energy"	the prevailing state of charge of a battery representing its available **Active Power Output** and **Demand**;
"Testing Rules"	the rules for testing **Eligible Assets** forming part of the **Registration and Pre-Qualification Procedure** as described in Schedule 5 of these **Response Service Terms**.

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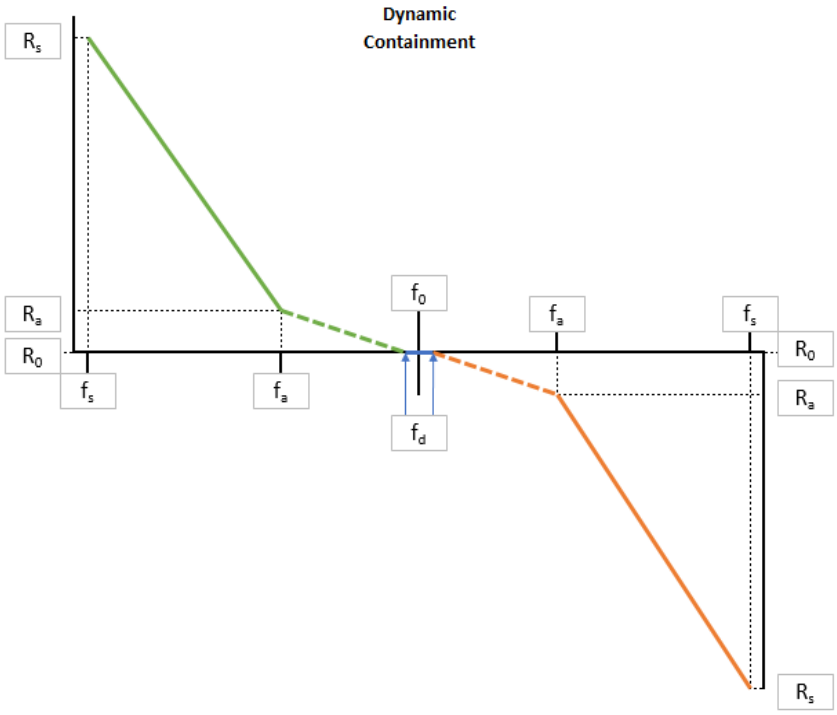
SCHEDULE 2 - CAPABILITY DATA TABLES



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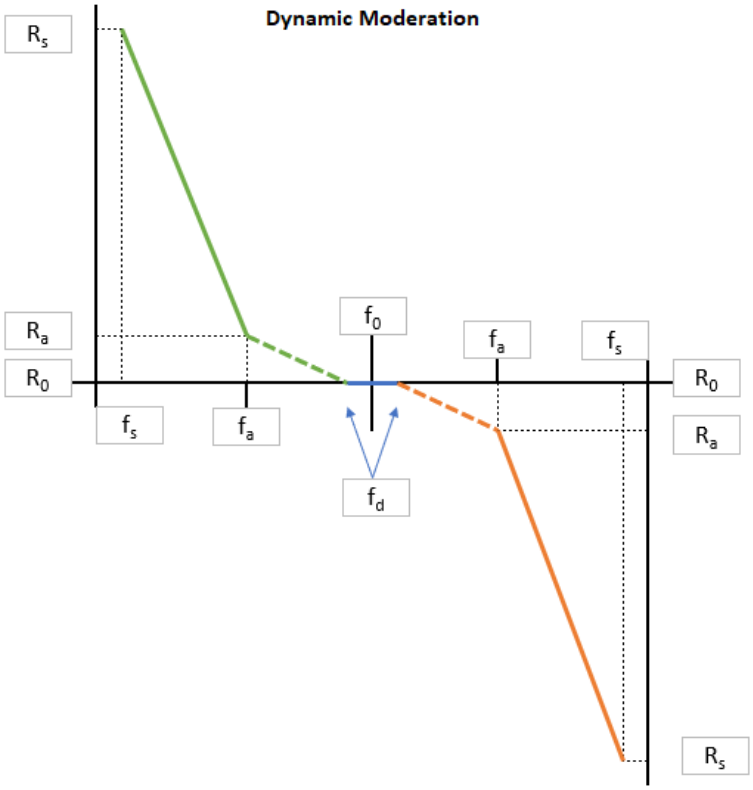

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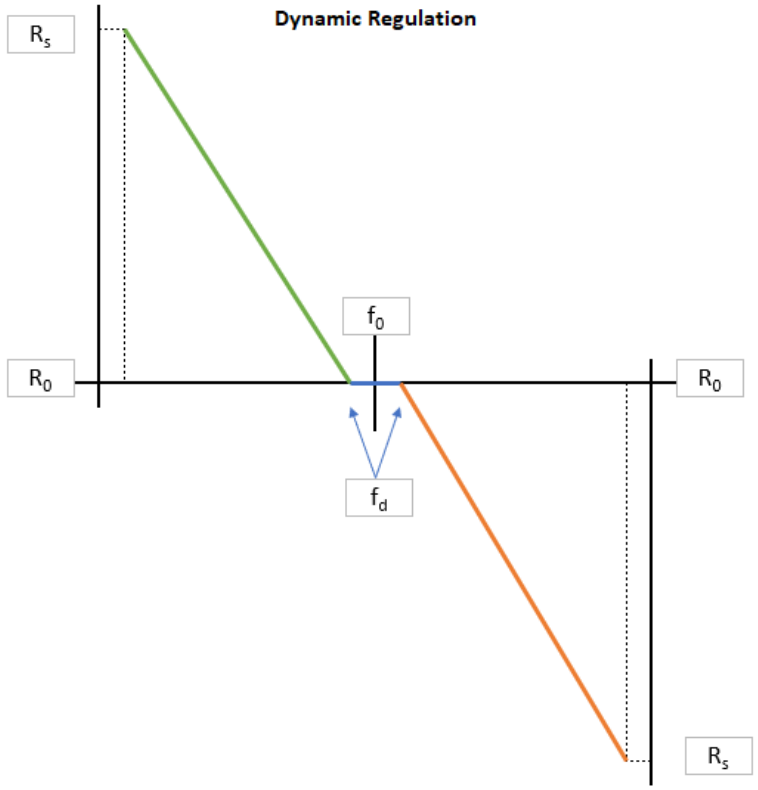

NOTE: the above assumes no deviation from **Operational Baseline** within the **Deadband** and should be read subject to paragraph 6.11vi.

Service parameters

The service parameters below are included solely for the interpretation and understanding of the above tables and the formulae in Schedule ~~2~~3. In the event of any conflict or inconsistency between these service parameters and terminology used or defined elsewhere in the **Response Procurement Documentation**, the former shall prevail.

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			Value (possible range)			
Parameter	Description	I.D	DC	DM	DR	Comment
Frequency & delivery quantity parameters						
Nominal frequency	Statutory system frequency for GB	f_n	50 Hz	50 Hz	50 Hz	
Target frequency	System frequency that **NGESO** aims to achieve	f_0	50 Hz	50 Hz	50 Hz	
Dead-band frequency range	Frequency range over which the service does not deliver	f_d	f_0 - 0.015Hz to f_0 + 0.015Hz	f_0 - 0.015Hz to f_0 + 0.015Hz	f_0 - 0.015Hz to f_0 + 0.015Hz	This has been specified to align with Article 154, Annex 5 of the **System Operator Guidelines** (as converted into **Retained EU Law**). Active power delivery will commence at f_d
Knee-point frequency	Frequency set point which defines the beginning of the delivery curve	f_a	f_n +/- 0.2 Hz	f_n +/- 0.1 Hz	not applicable	The knee point describes where delivery of the service begins.
Full delivery frequency (saturation)	Frequency set point at which the service must deliver full contracted quantity (Qcontract(h,l))	fs	f_n +/- 0.5 Hz	f_n +/- 0.2 Hz	f_n +/- 0.2 Hz	At this frequency set point the service must deliver the full contracted quantity.
Quantity at target and	The percentage amount of	R_0	0 %	0 %	0 %	

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			Value (possible range)			
Parameter	Description	I.D	DC	DM	DR	Comment
~~deadband~~Dead band	$Q_{contract}$ to be delivered at f_0 and f_d					
Quantity at knee-point	The percentage amount of $Q_{contract}$ to be delivered at f_a	R_a	5%	5%	not applicable	The delivery profile is linear between f_d and f_a
Quantity at saturation	The percentage amount of $Q_{contract}$ to be delivered at f_s	R_s	100 %	100 %	100 %	At the full delivery frequency the service must deliver 100 % of the contracted quantity.
Contract quantity parameters						
Contracted quantity	The amount of service that a provider is contracted to deliver. Can be either high or low frequency, or both.	$Q_{contract}$ (h,l)	Min 1MW	Min 1MW	Min 1MW	h refers to contracted quantity for high frequency service. l refers to contracted quantity for low service. This is the **Contracted Quantity**
Contracted LF quantity	The quantity of LF service that a provider is contracted to deliver	P	Min 1MW	Min 1MW	Min 1MW	Is equivalent to $Q_{contract}(l)$
Contracted HF quantity	The quantity of HF service that a provider is contracted to deliver	Q	Min 1MW	Min 1MW	Min 1MW	Is equivalent to $Q_{contract}(h)$
Energy limited parameters						

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			Value (possible range)			
Parameter	Description	I.D	DC	DM	DR	Comment
Delivery duration	Time that an energy limited provider must be capable of sustained delivery of $Q_{contract}(h,l)$	T_{sus}	15 minutes	30 minutes	60 minutes	
Contracted Response ~~energy volume~~Energy Volume	The volume of stored energy required to be delivered before State of Energy management is required to avoid unavailability	$V_{maxC(h,l)}$	= (T_{sus} / 60) x $Q_{contract}$ MWh	= (T_{sus} / 60) x $Q_{contract}$ MWh	= (T_{sus} / 60) x $Q_{contract}$ MWh	This is NOT the maximum energy volume that could be delivered over the duration of a **Contracted Service Period**.
Energy recovery	The minimum volume of energy recovery possible (by submission of Operational Baseline) in a single settlement period. As a percentage of $V_{maxC(h,l)}$	$V_{rec(h,l)}$	20%	20%	20%	Applicable only to energy limited providers. This equates to 3 minutes of energy when T_{sus} is 15 minutes.
Response delivery parameters						
Max initiation time	The maximum time between a change in frequency and change in the delivery of response	T_{iMAX}	0.5 s	0.5 s	~~2 s~~2 s (or 0.5 s when Stacked with DC and/or DM)	The provider must begin their response to a change in frequency between 0 s and T_{iMAX} after the deviation occurred.

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Parameter	Description	I.D	Value (possible range) DC	DM	DR	Comment
Max time to full delivery	The maximum time between frequency deviation occurring and delivery of the saturation quantity (R_s)	T_{dMAX}	1 s	1 s	~~10 s~~10 s (or 1s when stacked with DC and/or DM)	For a change in frequency that requires a change in response from 0 to R_s, this is the maximum time it should take.
Lag upper bound tolerance	Maximum initiation time tolerance		0.05 s	0.05 s	Not applicable	
Ramp time upper bound	The upper time bound of start of delivery to delivery of full contracted quantity	tr_{max}	0.5 s	0.5 s	8 s	Equivalent to $(T_{dMAX} - T_{iMAX})$. If the provider initiates response at latest possible time, this is the longest duration that a response unit can reach saturation quantity (R_s) output after initiation at the max initiation time.
Maximum ramp rate for Baselines	The maximum ramp rate per minute permitted at any point within a baseline submitted by an energy limited provider as a percentage of contracted	$RR_{bp(h,l)}$	5% per minute	5% per minute	5% per minute	The ramp rate limit can be calculated from the contracted quantity. There will be a different maximum ramp rate if the volumes of high/low response are different.

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			Value (possible range)			
Parameter	Description	I.D	DC	DM	DR	Comment
	quantity $Q_{contract}(h,l)$					
Error tolerance for full payment	The response error up to and including where no performance payment penalties are applied.	A	0.03	0.03	~~0.05~~0.05 (or 0.03 when Stacked with DC and/or DM)	For DC and DM, this is an error of 3% of contracted quantity. See Schedule ~~2~~3.
Error limit for zero payment	The response error at and above which performance payment penalties are 100%.	B	0.07	0.07	~~0.25~~0.25 (or 0.07 when Stacked with DC and/or DM)	For DC and DM, this is an error of 7% of contracted quantity (with linear interpolation of penalties between 3% and 7%) See Schedule ~~2~~3.
Grace Period for change between Response Contracts						
Grace period 1	After a response unit begins delivery, after a period of missing data, or after switching from unavailable to available		0.55 s	0.55 s	2 s (of 0.55 s when Stacked with DC and/or DM)	The upper and lower performance bounds wil be set to P and -Q respectively
Grace period ~~duration~~2	To allow time to change between Response Contracts		~~2s~~2 s	~~2s~~2 s	~~10s~~10 s (or 2 s when Stacked with DC and/or DM)	The performance bounds will be calculated for 2 seconds after the change using whichever of the

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			Value (possible range)			
Parameter	Description	I.D	DC	DM	DR	Comment
						contracts gives the lower bound, and the higher upper bound.
Error tolerance	Error tolerance for the scaled error		0.25	0.25	0.25	The performance will be assumed to be 100% during the grace period provided that the scaled error is below 25%.

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Rolling minimum window length	Time window length for the rolling minimum error	e_{win}	0.2 s	0.2 s	2 s (or 0.2 s when Stacked with DC and/or DM)

General dynamic service delivery curve

The service delivery curves for DC, DM and DR are generalised in **Error! Reference source not found.**.

Table 1: DC, DM and DR delivery curve values vs frequency.

f	DC	DM	DR
49.5	100.00%	100.00%	100.00%
49.8	5.00%	100.00%	100.00%
49.9	2.30%	5.00%	45.95%
49.985	0.00%	0.00%	0.00%
50.015	0.00%	0.00%	0.00%
50.1	-2.30%	-5.00%	-45.95%
50.2	-5.00%	-100.00%	-100.00%
50.5	-100.00%	-100.00%	-100.00%

Calculation of the general delivery curve is described in this section. The general delivery curve is the delivery profile of the **Contracted Service** or the allowed combination of **Contracted Services**.

The general delivery curve depends on the proportion of each volume of **Contracted Service** to be delivered. The derivation can be achieved by assigning a volume factor to each of the **Contracted Services** based on the total volume contracted. The **Contracted Quantity** for each **Contracted Service** is defined as:

$$DC\ Low\ volume = V_{DCL}$$

$$DC\ High\ volume = V_{DCH}$$

$$DM\ Low\ volume = V_{DML}$$

$$DM\ High\ volume = V_{DMH}$$

$$DR\ Low\ volume = V_{DRL}$$

$$DR\ High\ volume = V_{DRH}$$

Then for a **Contracted Service** which is **Stacked**, the total volume is:

$$Total\ Low\ volume = V_{DCL} + V_{DML} + V_{DRL} = TV_L$$

$$Total\ High\ volume = V_{DCH} + V_{DMH} + V_{DRH} = TV_H$$

Note that for **Response Services** which are not the subject of a **Response Contract**, the corresponding volumes should be set up to zero. To derive the general service curve, the factor of each service volume is calculated in relation to the total volume:

$$DC\ Low\ service\ volume\ factor = \frac{V_{DCL}}{TV_L} = VF_{DCL}$$

$$DC\ High\ service\ volume\ factor = \frac{V_{DCH}}{TV_H} = VF_{DCH}$$

$$DM\ Low\ service\ volume\ factor = \frac{V_{DML}}{TV_L} = VF_{DML}$$

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$$DM\ High\ service\ volume\ factor = \frac{V_{DMH}}{TV_H} = VF_{DMH}$$

$$DR\ Low\ service\ volume\ factor = \frac{V_{DRL}}{TV_L} = VF_{DRL}$$

$$DR\ High\ service\ volume\ factor = \frac{V_{DRH}}{TV_H} = VF_{DRH}$$

such that:

$$VF_{DCL} + VF_{DML} + VF_{DRL} = 1$$

$$VF_{DCH} + VF_{DMH} + VF_{DRH} = 1$$

representing the saturation level. Then based on **Error! Reference source not found.**, the general service delivery curve is derived in **Error! Reference source not found.** as a percentage of delivery.

Table 2: General service delivery curve as percentage of delivery

f	DC	DM	DR	General Service
49.50	100%	100%	100%	$(100\% * VF_{DCL}) + (100\% * VF_{DML}) + (100\% * VF_{DRL})$
49.80	5%	100%	100%	$(5\% * VF_{DCL}) + (100\% * VF_{DML}) + (100\% * V_{DRL})$
49.90	2.30%	5%	45.95%	$(2.3\% * VF_{DCL}) + (5\% * VF_{DML}) + (45.95\% * VF_{DRL})$
49.985	0%	0%	0%	$(0\% * VF_{DCL}) + (0\% * VF_{DML}) + (0\% * VF_{DRL})$
50.015	0%	0%	0%	$-(0\% * VF_{DCH}) - (0\% * VF_{DMH}) - (0\% * VF_{DRH})$
50.10	-2.3%	-5%	-45.95%	$-(2.3\% * VF_{DCH}) - (5\% * VF_{DMH}) - (45.95\% * VF_{DRH})$
50.20	-5%	-100%	-100%	$-(5\% * VF_{DCH}) - (100\% * VF_{DMH}) - (100\% * V_{DRH})$
50.50	-100%	-100%	-100%	$-(100\% * VF_{DCH}) - (100\% * VF_{DMH}) - (100\% * VF_{DRH})$

Error! Reference source not found. shows the general delivery curve for DC,DM and DR **Stacked**. Note that this curve assumes equal contracted volume across the three **Response Services**.

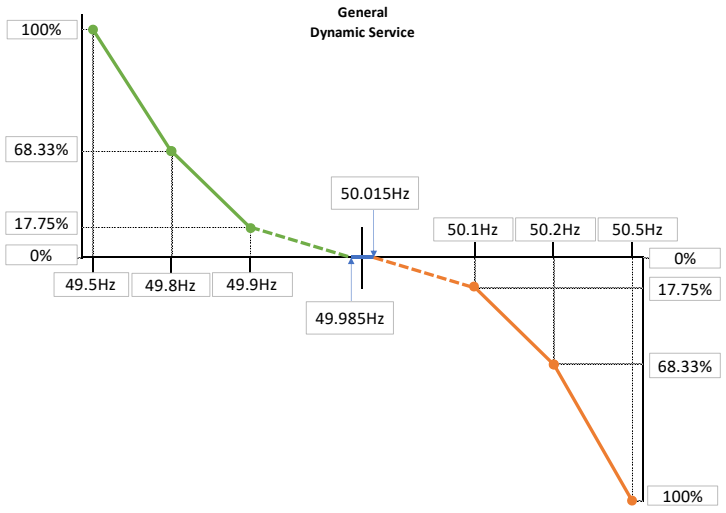

Figure 1: General delivery curve for DC, DM and DR stacked as percentage of delivery.

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Table 3: Stacked service curve as volume contracted.

f	General Service
49.50	$TV_L \times ((100\% \times VF_{DCL}) + (100\% \times VF_{DML}) + (100\% \times VF_{DRL}))$
49.80	$TV_L \times ((5\% \times VF_{DCL}) + (100\% \times VF_{DML}) + (100\% \times VF_{DRL}))$
49.90	$TV_L \times ((2.3\% \times VF_{DCL}) + (5\% \times VF_{DML}) + (45.95\% \times VF_{DRL}))$
49.985	0%
50.015	0%
50.10	$TV_H \times (-(2.3\% \times VF_{DCH}) - (5\% \times VF_{DMH}) - (45.95\% \times VF_{DRH}))$
50.20	$TV_H \times (-(5\% \times VF_{DCH}) - (100\% \times VF_{DMH}) - (100\% \times VF_{DRH}))$
50.50	$TV_H \times (-(100\% \times VF_{DCH}) - (100\% \times VF_{DMH}) - (100\% \times VF_{DRH}))$

SCHEDULE ~~2~~3 - AVAILABILITY PAYMENTS

Calculation of Settlement Value

A~~A~~With respect to each **Response Contract,** a settlement value shall be ~~established~~calculated for each ~~**Auction Product**~~**Settlement Period** in accordance with the following formula:

~~$Si_e = \left(\sum_{i}^{CEB} \text{Round}\left(Pij_e \times Vij_e \times 0.5, 2\right) \times Fij_e\right) \times K_e$~~

$$S_{aij} = Round\left(\left(\left(P_{aj} - \left(\left(1 - K_{aij}\right) \times PF_{aj}\right)\right) \times V_{aij} \times 0.5 \times F_{aij}\right), 2\right)$$

Where:

- ~~Si_e~~S_{aij} is the settlement value ~~for the relevant **Auction Product** e~~calculated in respect of Response Unit **i** for the ~~applicable **Contracted Service Period** e~~

- ~~$\sum_j$ is the summation over the~~relevant **Auction Product a** and Settlement Period **j** ~~in the relevant **Contracted Service Period** e~~;
- ~~P_{ije}~~P_{aj} is the applicable Market Clearing Price~~,~~ in ~~GBP/~~£/MW/h~~, attributable to **Settlement Period** j~~ for the relevant ~~**Contracted Service Period** e and~~ Auction Product **a** and **Settlement Period j**;
- ~~V_{ije}~~V_{aj} is the Contracted Quantity in ~~megawatts,~~MW in respect of Response Unit **i** for the relevant **Auction Product a** and Settlement Period **j**~~, for the relevant **Contracted Service Period** e~~;
- ~~F_{ije}~~F_{aij} is zero ~~where there is~~(0) if **Response Unit i** has any period or periods of unavailability for **Auction Product a** within Settlement Period **j** ~~during the relevant **Contracted Service Period** e,~~ and is one (1) otherwise ~~is 1~~;
- ~~K_e is defined~~ K_{aij} is the performance factor in respect of **Response Unit i** for ~~each~~the relevant Auction Product ~~in the remainder of~~ **a** and **Settlement Period j**, and is defined in this Schedule ~~2~~3 below~~.~~; and

PF_{aj} is the settlement adjustment price in £/MW/h applicable to **Auction Product a** and **Settlement Period j**, and is which is calculated as follows:

- The settlement adjustment price is equal to the **Market Clearing Price** if the **Market Clearing Price** is greater than or equal to [x2];
- The settlement adjustment price is equal to -1 (negative one) times the **Market Clearing Price** if the **Market Clearing Price** is less than or equal to [x1];
- The settlement adjustment price is equal to [X] if the **Market Clearing Price** is between [x1] and [x2].

The performance monitoring scheme for each Auction Product adjusts the value calculated for a ~~**Contracted Service**~~**Settlement** Period by a factor K based on the worst of the performance scores in ~~that~~the Contracted Service Period in which the **Settlement Period** falls. Performance scores are described below for each Auction Product, calculated using performance bounds to represent valid response delivery. Performance bounds are a pair of time series that enclose possible valid Auction Product delivery profiles – this accounts for different lag times and ramp rate between services.

NGESO may at its sole discretion (but shall not be obliged to) ignore a performance score when determining factor K in the calculation of the settlement value for any particular **Contracted Service Period**:-

(i) where the **Response Unit** in question is **Energy Limited,** and the performance monitoring error in question arose due to inadequate **State of Energy** in circumstances where the **Service Provider** was compliant in all respects with the **State of Energy** management rules in paragraph 6.11; or

(ii) where that **Contracted Service Period** falls in a 'grace period' to which **NGESO** has given its prior agreement in writing (which shall not exceed fourteen (14) consecutive days) to recognise on-boarding by the relevant **Service Provider** of control systems and other IS interfaces necessary for the delivery and monitoring of the applicable **Auction Product**.

Metered response is derived from **Operational Data** and **Performance Data** for the relevant **Response Unit** obtained by **NGESO** pursuant to paragraph 15 of these **Response Service Terms**.

~~**PART 1 -**~~

DETERMINATION OF K FACTOR~~: DYNAMIC MODERATION~~

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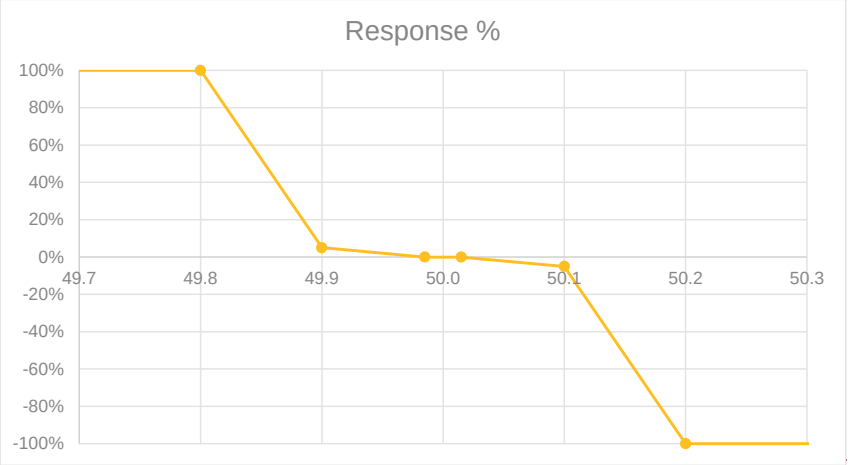
Response Curve

The **General Dynamic ~~Moderation~~Service** response curve is defined as the linear interpolation between ~~68~~ pairs of frequency and response % delivery.

Saturation	$f_{S\pm} = f_0 \pm 0.25$ Hz	$R_{S\pm} = \mp 100\%$
Operation	$f_{O\pm} = f_0 \pm 0.2$ Hz	$R_{O\pm}$
Activation	$f_{A\pm} = f_0 \pm 0.1$ Hz	$R_{A\pm} = \mp 5\%$
Delivery/deadband	$f_{D\pm} = f_0 \pm 0.015$ Hz	$R_{D\pm} = 0\%$



$$R_{sym}(f) = \begin{cases} R_{S-} & : f < f_{S-} \\ R_{A-} + \frac{R_{S-} - R_{A-}}{f_{S-} - f_{A-}} \times (f - f_{A-}) & : f_{S-} \le f < f_{A-} \\ \frac{R_{A-}}{f_{A-} - f_{D-}} \times (f - f_{D-}) & : f_{A-} \le f < f_{D-} \\ 0 & : f_{D-} \le f < f_{D+} \\ \frac{R_{A+}}{f_{A+} - f_{D+}} \times (f - f_{D+}) & : f_{D+} \le f < f_{A+} \\ R_{A+} + \frac{R_{S+} - R_{A+}}{f_{S+} - f_{A+}} \times (f - f_{A+}) & : f_{A+} \le f < f_{S+} \\ R_{S+} & : f_{S+} \le f \end{cases}$$

R_S, R_O, R_A and R_D are calculated using the column "General Service" of **Error! Reference source not found.**.

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The percentage will depend on the total volume contracted and each individual volume for each service. The general delivery curve is then defined in Figure 2 below.

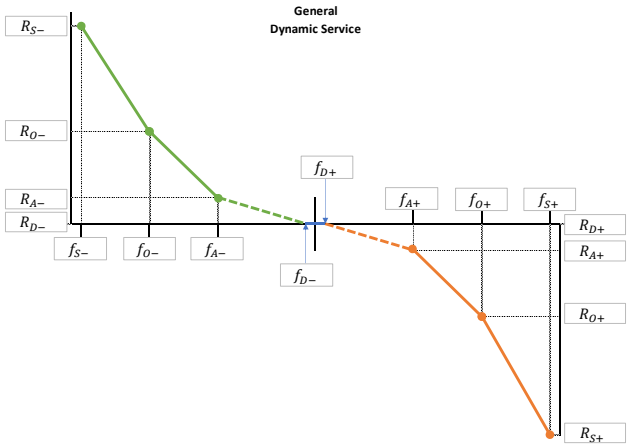

Figure 2: General dynamic service curve.

$$R_{sym}(f) = \begin{cases} R_{S-} & : f < f_{S-} \\ R_{O-} + \frac{R_{S-} - R_{O-}}{f_{S-} - f_{O-}} \times (f - f_{O-}) & : f_{S-} \le f < f_{O-} \\ R_{A-} + \frac{R_{O-} - R_{A-}}{f_{O-} - f_{A-}} \times (f - f_{A-}) & : f_{O-} \le f < f_{A-} \\ \frac{R_{A-}}{f_{A-} - f_{D-}} \times (f - f_{D-}) & : f_{A-} \le f < f_{D-} \\ 0 & : f_{D-} \le f < f_{D+} \\ \frac{R_{A+}}{f_{A+} - f_{D+}} \times (f - f_{D+}) & : f_{D+} \le f < f_{A+} \\ R_{A+} + \frac{R_{O+} - R_{A+}}{f_{O+} - f_{A+}} \times (f - f_{A+}) & : f_{A+} \le f < f_{O+} \\ R_{O+} + \frac{R_{S+} - R_{O+}}{f_{S+} - f_{O+}} \times (f - f_{O+}) & : f_{O+} \le f < f_{S+} \\ R_{S+} & : f_{S+} \le f \end{cases}$$

These are the equations for LF and HF only ~~moderation~~ response curves.

$$R_{LF}(f) = \begin{cases} R_{S-} & : f < f_{S-} \\ R_{A-} + \frac{R_{S-} - R_{A-}}{f_{S-} - f_{A-}} \times (f - f_{A-}) & : f_{S-} \le f < f_{A-} \\ \frac{R_{A-}}{f_{A-} - f_{D-}} \times (f - f_{D-}) & : f_{A-} \le f < f_{D-} \\ 0 & : f_{D-} \le f \end{cases}$$

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$$R_{HF}(f) = \begin{cases} 0 & : f < f_{D+} \\ \frac{R_{A+}}{f_{A+} - f_{D+}} \times (f - f_{D+}) & : f_{D+} \le f < f_{A+} \\ R_{A+} + \frac{R_{S+} - R_{A+}}{f_{S+} - f_{A+}} \times (f - f_{A+}) & : f_{A+} \le f < f_{S+} \\ R_{S+} & : f_{S+} \le f \end{cases}$$

$$R_{LF}(f) = \begin{cases} R_{S-} & : f < f_{S-} \\ R_{O-} + \frac{R_{S-} - R_{O-}}{f_{S-} - f_{O-}} \times (f - f_{O-}) & : f_{S-} \le f < f_{O-} \\ R_{A-} + \frac{R_{O-} - R_{A-}}{f_{O-} - f_{A-}} \times (f - f_{A-}) & : f_{O-} \le f < f_{A-} \\ \frac{R_{A-}}{f_{A-} - f_{D-}} \times (f - f_{D-}) & : f_{A-} \le f < f_{D-} \\ 0 & : f_{D-} \le f \end{cases}$$

$$R_{HF}(f) = \begin{cases} 0 & : f < f_{D+} \\ \frac{R_{A+}}{f_{A+} - f_{D+}} \times (f - f_{D+}) & : f_{D+} \le f < f_{A+} \\ R_{A+} + \frac{R_{O+} - R_{A+}}{f_{O+} - f_{A+}} \times (f - f_{A+}) & : f_{A+} \le f < f_{O+} \\ R_{O+} + \frac{R_{S+} - R_{O+}}{f_{S+} - f_{O+}} \times (f - f_{O+}) & : f_{O+} \le f < f_{S+} \\ R_{S+} & : f_{S+} \le f \end{cases}$$

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Lags and ramp limits

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~~Lag upper bound (maximum initiation time): $T_{iMAX} = 0.50\ s$~~

~~Lag upper bound tolerance: $tol_{iMAX} = 0.05\ s$~~

~~Ramp time upper bound: $tr_{max} = T_{dMAX} - T_{iMAX} = 0.50s$~~

~~Ramp rate (proportional) lower bound: $rr_{min} = \frac{1}{tr_{max}} = 2\ s^{-1}$~~The parameters for lags and ramp limits will be defined by the fastest service of the **Contracted Services**.

-	Stacked Service Parameters	Units
Max time to full delivery (T_{dMAX})	$\min(T_{dMAX\_service1}, T_{dMAX\_service2}, T_{dMAX\_service3})$	s
Lag upper bound (T_{iMAX})	$\min(T_{iMAX\_service1}, T_{iMAX\_service2}, T_{iMAX\_service3})$	s
Ramp time upper bound (tr_{max})	$\min(tr_{\max\_service1}, tr_{\max\_service2}, tr_{\max\_service3})$	s
Ramp rate (rr_{min})	$\max(rr_{\min\_service1}, rr_{\min\_service2}, rr_{\min\_service3})$	1/s

Performance bounds definition

Frequency bounds

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The frequency bounds are used in the definition of the performance bounds. The upper and lower frequency bounds describe the highest and lowest frequencies that can be found within the lag window.

Upper frequency band at time t:

$$F^{upper}(t) = \max_{0 \le t_{lag} \le \mathrm{T_{iMAX}} + tol_{iMAX}} f\left(t - t_{lag}\right)$$

Lower frequency band at time t:

$$F^{lower}(t) = \min_{0 \le t_{lag} \le \mathrm{T_{iMAX}} + tol_{iMAX}} f\left(t - t_{lag}\right)$$

Where $f(t)$ is the **Input Frequency** at time *t*.

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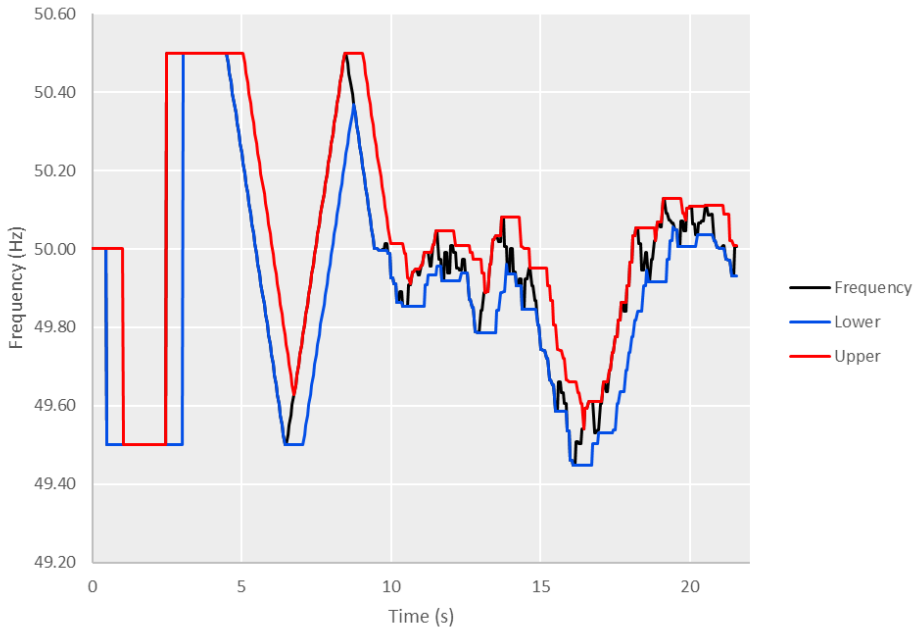

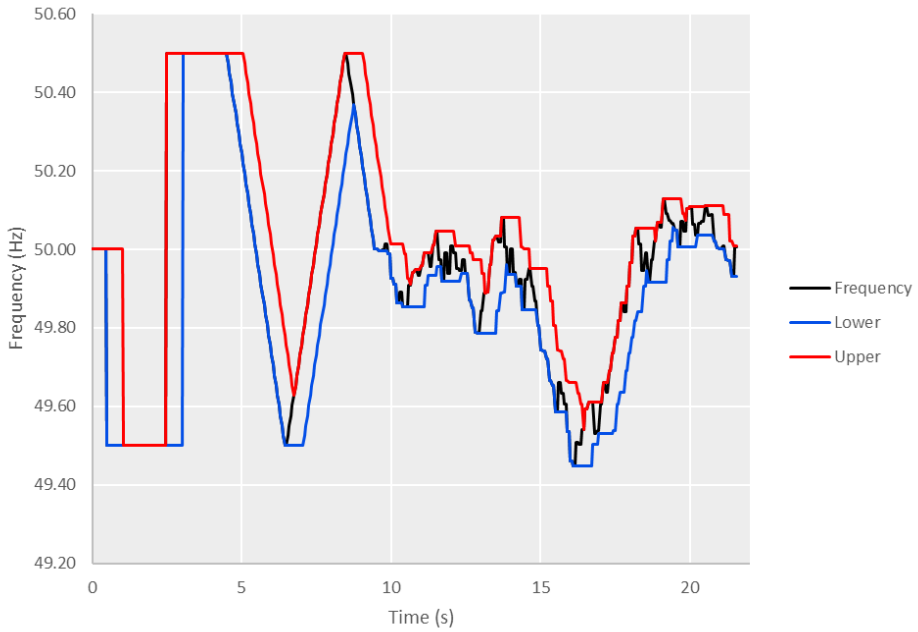

Figure 1: Example of frequency bounds calculation

Ramp limits

Ramp limits are applied to the response curves used in the calculation of the performance bounds. The ramp limits are defined as limits to the rate of change of response.

Upwards ramp limit for function $R(t)$ with ramp limit r:

$$RLU(R(t), r) = \begin{cases} RLU_{prev} + r \times \Delta t & R(t) > RLU_{prev} + r \times \Delta t \\ R(t) & \text{otherwise} \end{cases}$$

Where $RLU_{prev} = RLU(R(t - \Delta t), r)$

Downwards ramp limit for function $R(t)$ with ramp limit r:

$$RLD(R(t), r) = \begin{cases} RLD_{prev} - r \times \Delta t & R(t) < RLD_{prev} - r \times \Delta t \\ R(t) & \text{otherwise} \end{cases}$$

Where $RLD_{prev} = RLD(R(t - \Delta t), r)$.

Performance bounds

The upper bound $UB(t)$ is the response curve applied to the lower lagged frequency, with the ramp limit applied when decreasing.

The lower bound $LB(t)$ is the response curve applied to the upper lagged frequency, with the ramp limit applied when increasing.

~~For the first 0.55 seconds after~~After a ~~response unit~~**Response Unit** begins delivery, after a period of missing data, or after switching from unavailable to available the upper and lower performance bounds will be set to P and -Q respectively for the duration of **Grace period 1** of the corresponding service.

To allow time to change between ~~contracts~~**Response Contracts**, the performance bounds will be calculated for ~~**2 seconds**~~the duration of **Grace period 2** (of the corresponding **Contracted Service**) after the change using whichever of the ~~contracts~~**Response Contracts** gives the lower bound, and the higher upper bound. The performance will be assumed to be 100% during such grace period provided that the scaled error is below 25%.

Note that for **Stacked** services, the shortest grace period will apply.

Performance bounds for LF only

$$UB_{LF}(t) = RLD\left(R_{LF}\left(F^{lower}(t)\right), rr_{min}\right) \times ~~P~~TV_L$$

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$$LB_{LF}(t) = RLU\left(R_{LF}\left(F^{upper}(t)\right), rr_{min} \right) \times PTV_L$$

Performance bounds for HF only

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$$UB_{HF}(t) = RLD\left(R_{HF}\left(F^{lower}(t)\right), rr_{min} \right) \times QTV_H$$

$$LB_{HF}(t) = RLU\left(R_{HF}\left(F^{upper}(t)\right), rr_{min} \right) \times Q\left(R_{HF}\left(F^{upper}(t)\right), rr_{min} \right) \times TV_H$$

Performance bounds for LF and HF

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$$UB(t) = ub(t) \times \begin{cases} P & ub(t) \geq 0 \\ Q & ub(t) < 0 \end{cases} \begin{cases} TV_L & ub(t) \geq 0 \\ TV_H & ub(t) < 0 \end{cases}$$

$$LB(t) = lb(t) \times \begin{cases} P & lb(t) \geq 0 \\ Q & lb(t) < 0 \end{cases} \begin{cases} TV_L & lb(t) \geq 0 \\ TV_H & \mathrm{lb}(t) < 0 \end{cases}$$

Where:

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$$ub(t) = RLD\left(R_{sym}\left(F^{lower}(t)\right), rr_{min} \right)$$

$$lb(t) = RLU\left(R_{sym}\left(F^{upper}(t)\right), rr_{min} \right)$$

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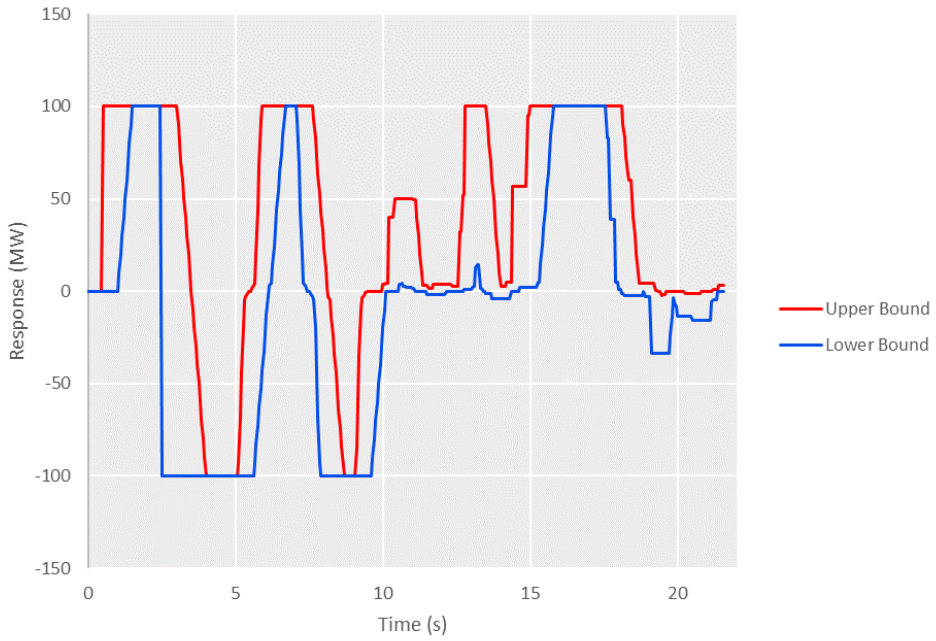

Figure 2: Example of symmetric performance bounds calculation using the frequency bounds from figure 1

Error calculation

The performance monitoring error is zero if the metered response is between the upper and lower performance bounds and is otherwise the difference between the metered response and the closer of the performance bounds.

Error for LF-only

The LF error e_{m_LF} for one time measurement and metered response R:

$$e_{m\_LF} = \begin{cases} LB_{LF} - R & R < LB_{LF} \\ 0 & LB_{LF} \leq R \leq UB_{LF} \\ R - UB_{LF} & R > UB_{LF} \end{cases}$$

Scaled LF error es_{m_LF} for one measurement:

$$es_{m\_LF} = \frac{e_{m\_LF}}{P} \frac{e_{m\_LF}}{TV_L}$$

LF Settlement Period error:

$$E_{LF} = \max_{m\_LF} \left(\text{rolling\_minimum } es_{m\_LF} \text{ over 0.2 seconds} \right)$$

$$E_{LF} = \max_{m\_LF} \left(\text{rolling\_minimum } es_{m\_LF} \text{ over } e_{win} \text{ seconds} \right)$$

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Note that for **Stacked** services, the shortest rolling window will apply.

Error for HF-only

The HF error e_{m_HF} for one time measurement and metered response R:

$$e_{m\_HF} = \begin{cases} LB_{HF} - R & R < LB_{HF} \\ 0 & LB_{HF} \le R \le UB_{HF} \\ R - UB_{HF} & R > UB_{HF} \end{cases}$$

Scaled HF error es_{m_HF} for one measurement:

$$es_{m\_HF} = \frac{~~e_{m\_HF}~~}{~~Q~~} \frac{e_{m\_HF}}{TV_H}$$

HF Settlement Period error:

$$~~E_{HF} = \max_{m\_HF} \left(\text{rolling\_minimum } es_{m\_HF} \text{ over 0.2 seconds} \right)~~$$

~~Error~~$E_{HF} = \max_{m\_HF} \left(\text{rolling\_minimum } es_{m\_HF} \text{ over } e_{win} \text{ seconds} \right)$

Note that for ~~Bundled LF and HF~~**Stacked** services,

~~For bundled LF and HF service delivery, performance bounds are calculated using~~ the ~~**Performance bounds for LF and HF** equation resulting in lower bound (LB) and upper bound (UB). To segregate errors into LF and HF errors, the performance bounds are segregated into LF and HF bounds.~~

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~~For LF errors of bundled service, the UB and LB are calculated as:~~

$$~~UB_{LF} = \begin{cases} UB(t) & UB(t) \ge 0 \\ 0 & otherwise \end{cases}~~$$

$$~~LB_{LF} = \begin{cases} LB(t) & LB(t) \ge 0 \\ 0 & otherwise \end{cases}~~$$

~~The LF error e_{m_LF} for one time measurement and metered response R:~~

$$~~e_{m\_LF} = \begin{cases} LB_{LF} - R & R < LB_{LF} \\ 0 & LB_{LF} \le R \le UB_{LF} \\ R - UB_{LF} & R > UB_{LF} \end{cases}~~$$

~~Scaled LF error es_{m_LF} for one measurement:~~

$$~~es_{m\_LF} = \frac{e_{m\_LF}}{P}~~$$

~~LF Settlement Period error:~~

$$~~E_{LF} = \max_{m\_LF} \left(\text{rolling\_minimum } es_{m\_LF} \text{ over 0.2 seconds} \right)~~$$

~~For HF errors of bundled service, the UB and LB are calculated as:~~

$$~~UB_{HF} = \begin{cases} UB(t) & UB(t) < 0 \\ 0 & otherwise \end{cases}~~$$

$$~~LB_{HF} = \begin{cases} LB(t) & LB(t) < 0 \\ 0 & otherwise \end{cases}~~$$

~~The HF error e_{m_HF} for one time measurement and metered response R:~~

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$$e_{m\_HF} = \begin{cases} LB_{HF} - R & R < LB_{HF} \\ 0 & LB_{HF} \le R \le UB_{HF} \\ R - UB_{HF} & R > UB_{HF} \end{cases}$$

Scaled HF error es_{m_HF} for one measurement:

$$es_{m\_HF} = \frac{e_{m\_HF}}{Q}$$

HF Settlement Period error:

$$E_{HF} = \max_{m\_HF} \left(\underset{\text{over 0.2 seconds}}{\text{rolling\_minimum}\ es_{m\_HF}} \right)$$

K factor calculation

The **Settlement Period** error is used to derive a k factor for each **Settlement Period** of the corresponding **Auction Product**.

Settlement period k factor calculation for LF

For **Settlement Period** j, the Settlement period k factor for LF is:

$$k_{j\_LF} = \begin{cases} 1 & E < A \\ 1 - (E_{LF} - A)/(B - A) & A \le E_{LF} \le B \\ 0 & E > B \end{cases}$$

Where $A = 0.03$ and $B = 0.07$

Settlement period k factor calculation for HF

For **Settlement Period** j, the Settlement period k factor for HF is:

$$k_{j\_HF} = \begin{cases} 1 & E < A \\ 1 - (E_{HF} - A)/(B - A) & A \le E_{HF} \le B \\ 0 & E > B \end{cases}$$

Where $A = 0.03$ and $B = 0.07$

K factor for the Contracted Service Period

The K factor for the **Contracted Service Period** of the corresponding **Auction Product** is then,

K factor for LF:

$$K_e = \min_{j\_LF} k_{j\_LF}$$

K factor for HF:

$$K_e = \min_{j\_HF} k_{j\_HF}$$

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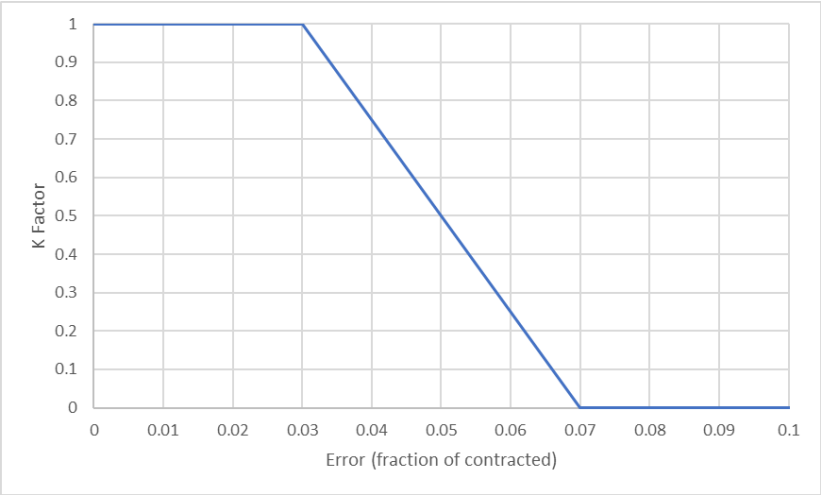

Figure 3: Payment adjustment (K-factor) curve

PART 2 - DETERMINATION OF K FACTOR: DYNAMIC REGULATION

Response Curve

The **Dynamic Regulation** response curve is defined as the linear interpolation between 4 pairs of frequency and response % delivery. The requirement not to deviate from **Operational Baseline** within the "deadband" should be read subject to paragraph 6.11vi

Saturation	$f_{S\pm} = f_0 \pm 0.2$ Hz	$R_{S\pm} = \mp 100\%$
Delivery/deadband	$f_{D\pm} = f_0 \pm 0.015$ Hz	$R_{D\pm} = 0\%$

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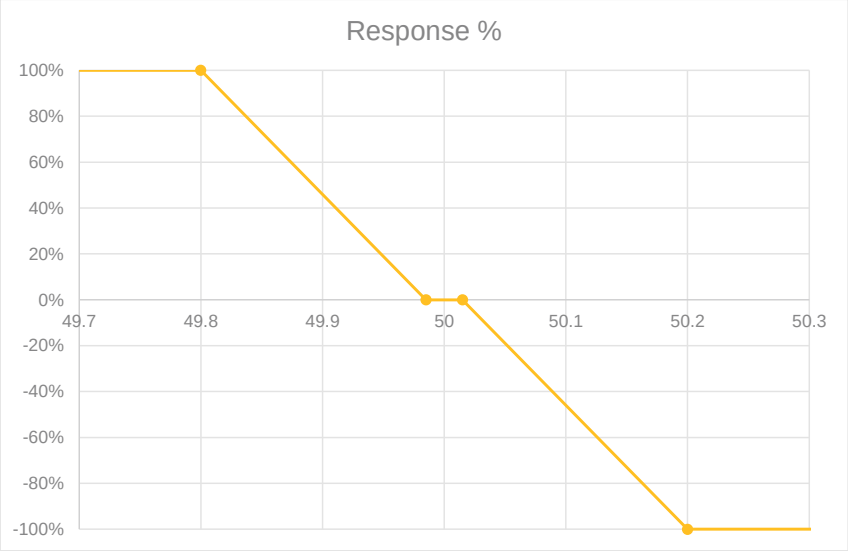

$$R_{sym}(f) = \begin{cases} R_{S-} & : f < f_{S-} \\ \frac{R_{S-}}{f_{S-} - f_{D-}} \times (f - f_{D-}) & : f_{S-} \le f < f_{D-} \\ 0 & : f_{D-} \le f < f_{D+} \\ \frac{R_{S+}}{f_{S+} - f_{D+}} \times (f - f_{D+}) & : f_{D+} \le f < f_{S+} \\ R_{S+} & : f_{S+} \le f \end{cases}$$

These are the equations for LF and HF only regulation response curves.

$$R_{LF}(f) = \begin{cases} R_{S-} & : f < f_{S-} \\ \frac{R_{S-}}{f_{S-} - f_{D-}} \times (f - f_{D-}) & : f_{S-} \le f < f_{D-} \\ 0 & : f_{D-} \le f \end{cases}$$

$$R_{HF}(f) = \begin{cases} 0 & : f < f_{D+} \\ \frac{R_{S+}}{f_{S+} - f_{D+}} \times (f - f_{D+}) & : f_{D+} \le f < f_{S+} \\ R_{S+} & : f_{S+} \le f \end{cases}$$

Lags and ramp limits

Lag upper bound (maximum initiation time): $T_{IMAX} = 2\ s$

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Ramp time upper bound: $tr_{max} = T_{dMAX} - T_{iMAX} = 8\ s$

Ramp rate (proportional) lower bound: $rr_{min} = \frac{1}{tr_{max}} = 0.125\ s^{-1}$

Performance bounds definition

Frequency bounds

The frequency bounds are used in the definition of the performance bounds. The upper and lower frequency bounds describe the highest and lowest frequencies that can be found within the lag window.

Upper frequency band at time t:

$$F^{upper}(t) = \max_{0 \le t_{lag} \le T_{iMAX}} f(t - t_{lag})$$

Lower frequency band at time t:

$$F^{lower}(t) = \min_{0 \le t_{lag} \le T_{iMAX}} f(t - t_{lag})$$

Where $f(t)$ is the **Input Frequency** at time t.

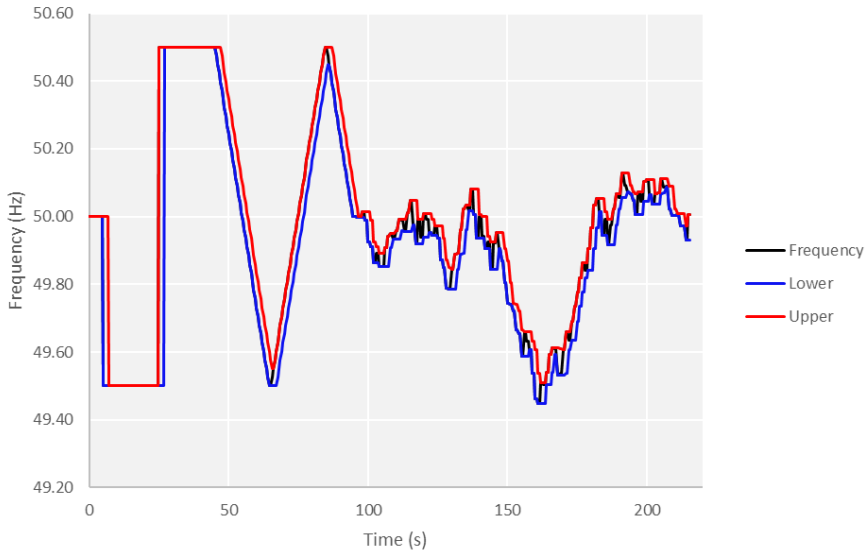

Figure 1: Example of frequency bounds calculation

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Ramp limits

Ramp limits are applied to the response curves used in the calculation of the performance bounds. The ramp limits are defined as limits to the rate of change of response.

Upwards ramp limit for function $R(t)$ with ramp limit r:

$$RLU(R(t), r) = \begin{cases} RLU_{prev} + r \times \Delta t & R(t) > RLU_{prev} + r \times \Delta t \\ R(t) & \text{otherwise} \end{cases}$$

Where $RLU_{prev} = RLU(R(t - \Delta t), r)$.

Downwards ramp limit for function $R(t)$ with ramp limit r:

$$RLD(R(t), r) = \begin{cases} RLD_{prev} - r \times \Delta t & R(t) < RLD_{prev} - r \times \Delta t \\ R(t) & \text{otherwise} \end{cases}$$

Where $RLD_{prev} = RLD(R(t - \Delta t), r)$.

Performance bounds

The upper bound $UB(t)$ is the response curve applied to the lower lagged frequency, with the ramp limit applied when decreasing.

The lower bound $LB(t)$ is the response curve applied to the upper lagged frequency, with the ramp limit applied when increasing.

For the first 2 seconds after a response unit begins delivery, after a period of missing data, or after switching from unavailable to available the upper and lower performance bounds will be set to P and -Q respectively.

To allow time to **change between contracts**, the performance bounds will be calculated for **10 seconds** after the change using whichever of the contracts gives the lower bound, and the higher upper bound. The performance will be assumed to be 100% during suchshortest grace period provided that the scaled error is below 25%. will apply.

Performance bounds for LF only

$$UB_{LF}(t) = RLD\left(R_{LF}\left(F^{lower}(t)\right), rr_{min}\right) \times P$$

$$LB_{LF}(t) = RLU\left(R_{LF}\left(F^{upper}(t)\right), rr_{min}\right) \times P$$

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Performance bounds for HF only

$$UB_{HF}(t) = RLD\left(R_{HF}\left(F^{lower}(t)\right), rr_{min}\right) \times Q$$

$$LB_{HF}(t) = RLU\left(R_{HF}\left(F^{upper}(t)\right), rr_{min}\right) \times Q$$

Performance bounds for LF and HF

$$UB(t) = ub(t) \times \begin{cases} P & ub(t) \geq 0 \\ Q & ub(t) < 0 \end{cases}$$

$$LB(t) = lb(t) \times \begin{cases} P & lb(t) \geq 0 \\ Q & lb(t) < 0 \end{cases}$$

Where:

$$ub(t) = RLD\left(R_{sym}\left(F^{lower}(t)\right), rr_{min}\right)$$

$$lb(t) = RLU\left(R_{sym}\left(F^{upper}(t)\right), rr_{min}\right)$$

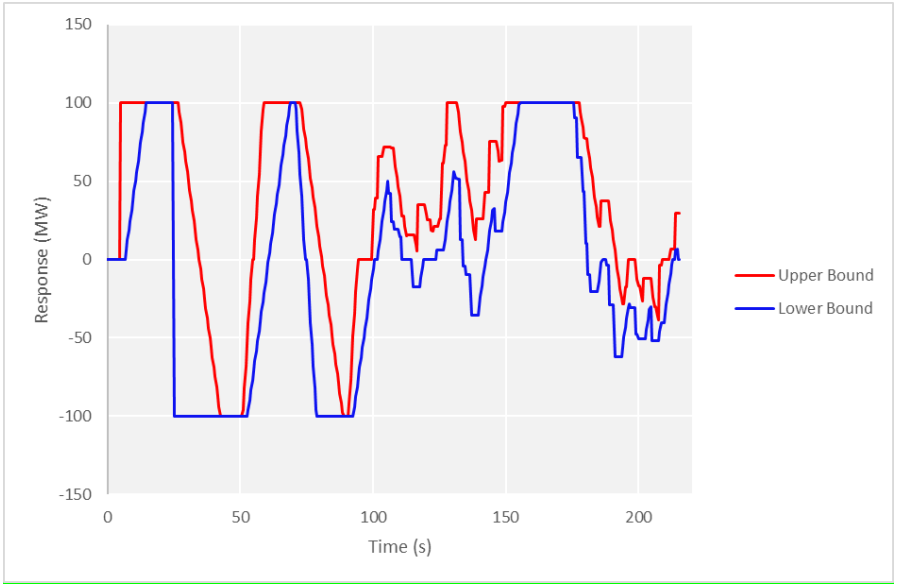

Figure 2: Example of symmetric performance bounds calculation using the frequency bounds from figure 1

Error calculation

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The performance monitoring error is zero if the metered response is between the upper and lower performance bounds and (subject as provided below) is otherwise the difference between the metered response and the closer of the performance bounds.

The performance monitoring error is also zero if the metered response falls between the saturation and the extended response slope when it should be saturated but frequency further deviates from +/- 0.2Hz.

Error for LF only

The LF error e_{m_LF} for one time measurement and metered response R:

$$e_{m\_LF} = \begin{cases} LB_{LF} - R & R < LB_{LF} \\ 0 & LB_{LF} \leq R \leq UB_{LF} \\ R - UB_{LF} & R > UB_{LF} \end{cases}$$

Scaled LF error es_{m_LF} for one measurement:

$$es_{m\_LF} = \frac{e_{m\_LF}}{P}$$

LF Settlement Period error:

$$E_{LF} = \max_{m\_LF}\left(\underset{\text{over 2 seconds}}{\text{rolling\_minimum}}\, es_{m\_LF}\right)$$

Error for HF only

The HF error e_{m_HF} for one time measurement and metered response R:

$$e_{m\_HF} = \begin{cases} LB_{HF} - R & R < LB_{HF} \\ 0 & LB_{HF} \leq R \leq UB_{HF} \\ R - UB_{HF} & R > UB_{HF} \end{cases}$$

Scaled HF error es_{m_HF} for one measurement:

$$es_{m\_HF} = \frac{e_{m\_HF}}{Q}$$

HF Settlement Period error:

$$E_{HF} = \max_{m\_HF}\left(\underset{\text{over 2 seconds}}{\text{rolling\_minimum}}\, es_{m\_HF}\right)$$

Error for Bundled LF and HF

For bundled LF and HF service delivery, performance bounds are calculated using the **Performance bounds for LF and HF** equation resulting in lower bound (LB) and upper bound (UB). To segregate errors into LF and HF errors, the performance bounds are segregated into LF and HF bounds.

For LF errors of bundled service, the UB and LB are calculated as:

$$UB_{LF} = \begin{cases} UB(t) & UB(t) \geq 0 \\ 0 & otherwise \end{cases}$$

$$LB_{LF} = \begin{cases} LB(t) & LB(t) \geq 0 \\ 0 & otherwise \end{cases}$$

The LF error e_{m_LF} for one time measurement and metered response R:

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$$e_{m\_LF} = \begin{cases} LB_{LF} - R & R < LB_{LF} \\ 0 & LB_{LF} \le R \le UB_{LF} \\ R - UB_{LF} & R > UB_{LF} \end{cases}$$

Scaled LF error es_{m_LF} for one measurement:

$$es_{m\_LF} = \frac{e_{m\_LF}}{P}$$

LF Settlement Period error:

$$E_{LF} = \max_{m\_LF}\left(\underset{\text{over 2 seconds}}{\text{rolling\_minimum}\ es_{m\_LF}}\right)$$

For HF errors of bundled service, the UB and LB are calculated as:

$$UB_{HF} = \begin{cases} UB(t) & UB(t) < 0 \\ 0 & otherwise \end{cases}$$

$$LB_{HF} = \begin{cases} LB(t) & LB(t) < 0 \\ 0 & otherwise \end{cases}$$

The HF error e_{m_HF} for one time measurement and metered response R:

$$e_{m\_HF} = \begin{cases} LB_{HF} - R & R < LB_{HF} \\ 0 & LB_{HF} \le R \le UB_{HF} \\ R - UB_{HF} & R > UB_{HF} \end{cases}$$

Scaled HF error es_{m_HF} for one measurement:

$$es_{m\_HF} = \frac{e_{m\_HF}}{Q}$$

HF Settlement Period error:

$$E_{HF} = \max_{m\_HF}\left(\underset{\text{over 2 seconds}}{\text{rolling\_minimum}\ es_{m\_HF}}\right)$$

K factor calculation

The **Settlement Period** error is used to derive a k factor for each **Settlement Period** of the corresponding **Auction Product**.

Settlement period k factor calculation for LF

For **Settlement Period** j, the Settlement period k factor for LF is:

$$k_{j\_LF} = \begin{cases} 1 & E < A \\ 1 - (E_{LF} - A)/(B - A) & A \le E_{LF} \le B \\ 0 & E > B \end{cases}$$

Where $A = 0.05$ and $B = 0.25$

Settlement period k factor calculation for HF

For **Settlement Period** j, the Settlement period k factor for HF is:

$$k_{j\_HF} = \begin{cases} 1 & E < A \\ 1 - (E_{HF} - A)/(B - A) & A \le E_{HF} \le B \\ 0 & E > B \end{cases}$$

Where $A = 0.05$ and $B = 0.25$

K factor for the Contracted Service Period

The K factor for the **Contracted Service Period** of the corresponding **Auction Product** is then,

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K factor for LF:

$$K_e = \min_{f\_LF} k_{f\_LF}$$

K factor for HF:

$$K_e = \min_{f\_HF} k_{f\_HF}$$

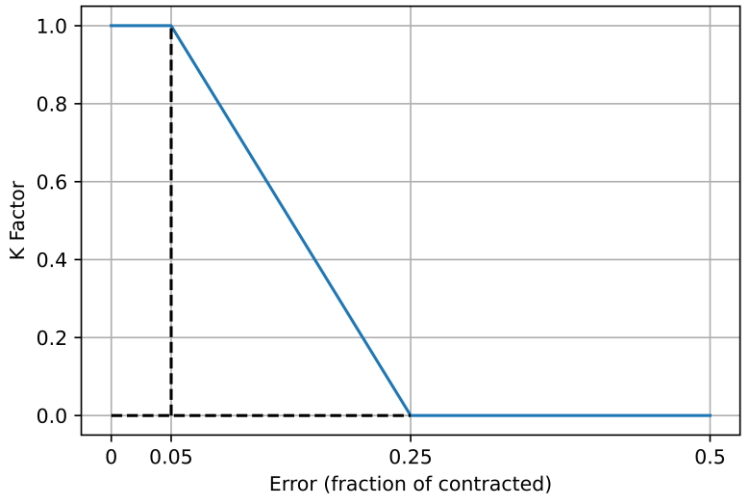

Figure 3: Payment adjustment (K factor) curve

PART 3 - DETERMINATION OF K FACTOR: DYNAMIC CONTAINMENT

Response Curve

The **Dynamic Containment** response curve is defined as the linear interpolation between 6 pairs of frequency and response % delivery.

Saturation	$f_{s\pm} = f_0 \pm 0.5$ Hz	$R_{s\pm} = \mp 100\%$

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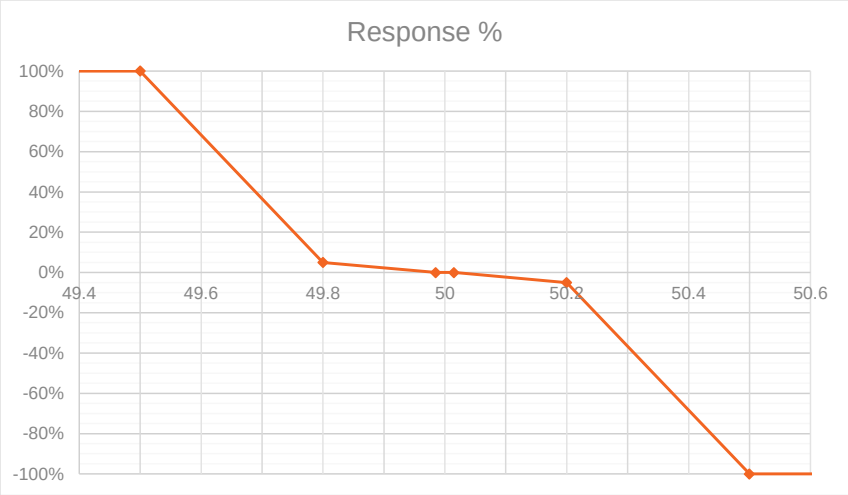
Activation	$f_{A\pm} = f_0 \pm 0.2$ Hz	$R_{A\pm} = \mp 5\%$
Delivery/deadband	$f_{D\pm} = f_0 \pm 0.015$ Hz	$R_{D\pm} = 0\%$



$$R_{sym}(f) = \begin{cases} R_{S-} & : f < f_{S-} \\ R_{A-} + \frac{R_{S-} - R_{A-}}{f_{S-} - f_{A-}} \times (f - f_{A-}) & : f_{S-} \le f < f_{A-} \\ \frac{R_{A-}}{f_{A-} - f_{D-}} \times (f - f_{D-}) & : f_{A-} \le f < f_{D-} \\ 0 & : f_{D-} \le f < f_{D+} \\ \frac{R_{A+}}{f_{A+} - f_{D+}} \times (f - f_{D+}) & : f_{D+} \le f < f_{A+} \\ R_{A+} + \frac{R_{S+} - R_{A+}}{f_{S+} - f_{A+}} \times (f - f_{A+}) & : f_{A+} \le f < f_{S+} \\ R_{S+} & : f_{S+} \le f \end{cases}$$

These are the equations for LF and HF only containment response curves.

$$R_{LF}(f) = \begin{cases} R_{S-} & : f < f_{S-} \\ R_{A-} + \frac{R_{S-} - R_{A-}}{f_{S-} - f_{A-}} \times (f - f_{A-}) & : f_{S-} \le f < f_{A-} \\ \frac{R_{A-}}{f_{A-} - f_{D-}} \times (f - f_{D-}) & : f_{A-} \le f < f_{D-} \\ 0 & : f_{D-} \le f \end{cases}$$

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$$R_{HF}(f) = \begin{cases} 0 & : f < f_{D+} \\ \frac{R_{A+}}{f_{A+} - f_{D+}} \times (f - f_{D+}) & : f_{D+} \le f < f_{A+} \\ R_{A+} + \frac{R_{S+} - R_{A+}}{f_{S+} - f_{A+}} \times (f - f_{A+}) & : f_{A+} \le f < f_{S+} \\ R_{S+} & : f_{S+} \le f \end{cases}$$

Lags and ramp limits

Lag upper bound (maximum initiation time): $T_{IMAX} = 0.50\ s$

Lag upper bound tolerance: $tol_{IMAX} = 0.05\ s$

Ramp time upper bound: $tr_{max} = T_{dMAX} - T_{IMAX} = 0.50 s$

Ramp rate (proportional) lower bound: $rr_{min} = \frac{1}{tr_{max}} = 2\ s^{-1}$

Performance bounds definition

Frequency bounds

The frequency bounds are used in the definition of the performance bounds. The upper and lower frequency bounds describe the highest and lowest frequencies that can be found within the lag window.

Upper frequency band at time t:

$$F^{upper}(t) = \max_{0 \le t_{lag} \le T_{IMAX} + tol_{IMAX}} f(t - t_{lag})$$

Lower frequency band at time t:

$$F^{lower}(t) = \min_{0 \le t_{lag} \le T_{IMAX} + tol_{IMAX}} f(t - t_{lag})$$

Where $f(t)$ is the **Input Frequency** at time t.

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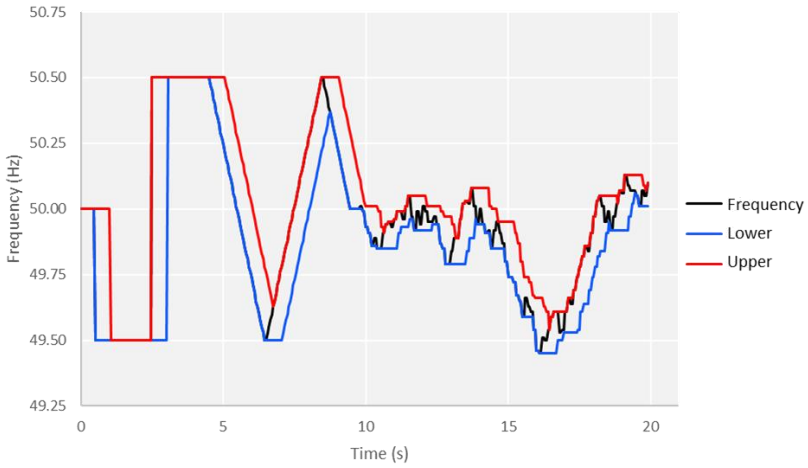

Figure 1: Example of frequency bounds calculation

Ramp limits

Ramp limits are applied to the response curves used in the calculation of the performance bounds. The ramp limits are defined as limits to the rate of change of response.

Upwards ramp limit for function $R(t)$ with lower ramp limit r:

$$RLU(R(t),r) = \begin{cases} RLU_{prev} + r \times \Delta t & R(t) > RLU_{prev} + r \times \Delta t \\ R(t) & \text{otherwise} \end{cases}$$

Where $RLU_{prev} = RLU(R(t - \Delta t), r)$

Downwards ramp limit for function $R(t)$ with lower ramp limit r:

$$RLD(R(t),r) = \begin{cases} RLD_{prev} - r \times \Delta t & R(t) < RLD_{prev} - r \times \Delta t \\ R(t) & \text{otherwise} \end{cases}$$

Performance bounds

The upper bound $UB(t)$ is the response curve applied to the lower lagged frequency, with the ramp limit applied when decreasing.

The lower bound $LB(t)$ is the response curve applied to the upper lagged frequency, with the ramp limit applied when increasing.

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For the first 0.55 seconds after a response unit begins delivery, after a period of missing data, or after switching from unavailable to available the upper and lower performance bounds will be set to P and -Q respectively.

To allow time to **change between contracts**, the performance bounds will be calculated for **2 seconds** after the change using whichever of the contracts gives the lower bound, and the higher upper bound. The performance will be assumed to be 100% during such grace period provided that the scaled error is below 25%.

Performance bounds for LF only

$$UB_{LF}(t) = RLD\left(R_{LF}\left(F^{lower}(t)\right), rr_{min}\right) \times P$$

$$LB_{LF}(t) = RLU\left(R_{LF}\left(F^{upper}(t)\right), rr_{min}\right) \times P$$

Performance bounds for HF only

$$UB_{HF}(t) = RLD\left(R_{HF}\left(F^{lower}(t)\right), rr_{min}\right) \times Q$$

$$LB_{HF}(t) = RLU\left(R_{HF}\left(F^{upper}(t)\right), rr_{min}\right) \times Q$$

Performance bounds for LF and HF

$$UB(t) = ub(t) \times \begin{cases} P & ub(t) \geq 0 \\ Q & ub(t) < 0 \end{cases}$$

$$LB(t) = lb(t) \times \begin{cases} P & lb(t) \geq 0 \\ Q & lb(t) < 0 \end{cases}$$

Where:

$$ub(t) = RLD\left(R_{sym}\left(F^{lower}(t)\right), rr_{min}\right)$$

$$lb(t) = RLU\left(R_{sym}\left(F^{upper}(t)\right), rr_{min}\right)$$

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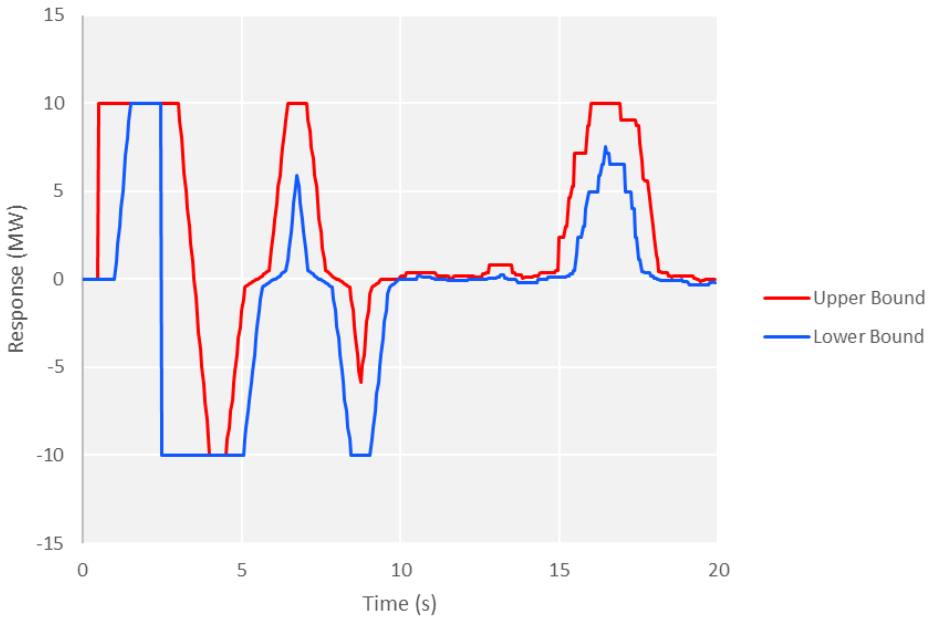

Figure 2: Example of symmetric performance bounds calculation using the frequency bounds from figure 1

Error calculation

The performance monitoring error is zero if the metered response is between the upper and lower performance bounds and is otherwise the difference between the metered response and the closer of the performance bounds.

Error for LF only

The LF error e_{m_LF} for one time measurement and metered response R:

$$e_{m\_LF} = \begin{cases} LB_{LF} - R & R < LB_{LF} \\ 0 & LB_{LF} \le R \le UB_{LF} \\ R - UB_{LF} & R > UB_{LF} \end{cases}$$

Scaled LF error es_{m_LF} for one measurement:

$$es_{m\_LF} = \frac{e_{m\_LF}}{P}$$

LF Settlement Period error:

$$E_{LF} = \max_{m\_LF}\left(\underset{\text{over 0.2 seconds}}{\text{rolling\_minimum}}\ es_{m\_LF}\right)$$

Error for HF only

The HF error e_{m_HF} for one time measurement and metered response R:

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$$~~e_{m\_HF} = \begin{cases} LB_{HF} - R & R < LB_{HF} \\ 0 & LB_{HF} \leq R \leq UB_{HF} \\ R - UB_{HF} & R > UB_{HF} \end{cases}$$~~

~~Scaled HF error es_{m_HF} for one measurement:~~

$$~~es_{m\_HF} = \frac{e_{m\_HF}}{Q}$$~~

~~HF Settlement Period error:~~

$$~~E_{HF} = \max_{m\_HF} \left(\text{rolling\_minimum } es_{m\_HF} \text{ over 0.2 seconds} \right)$$~~

Error for Bundled LF and HF

For bundled LF and HF service delivery, performance bounds are calculated using the **Performance bounds for LF and HF** equation resulting in lower bound (LB) and upper bound (UB). To segregate errors into LF and HF errors, the performance bounds are segregated into LF and HF bounds.

For LF errors of bundled service, the UB and LB are calculated as:

$$UB_{LF} = \begin{cases} UB(t) & UB(t) \geq 0 \\ 0 & otherwise \end{cases}$$

$$LB_{LF} = \begin{cases} LB(t) & LB(t) \geq 0 \\ 0 & otherwise \end{cases}$$

The LF error e_{m_LF} for one time measurement and metered response R:

$$e_{m\_LF} = \begin{cases} LB_{LF} - R & R < LB_{LF} \\ 0 & LB_{LF} \leq R \leq UB_{LF} \\ R - UB_{LF} & R > UB_{LF} \end{cases}$$

Scaled LF error es_{m_LF} for one measurement:

$$es_{m\_LF} = ~~\frac{e_{m\_LF}}{P}~~ \frac{e_{m\_LF}}{TV_L}$$

~~LF Settlement Period error:~~

$$~~E_{LF} = \max_{m\_LF} \left(\text{rolling\_minimum } es_{m\_LF} \text{ over 0.2 seconds} \right)$$~~

LF Settlement Period error:

$$E_{LF} = \max_{m\_LF} \left(\text{rolling\_minimum } es_{m\_LF} \text{ over } e_{win} \text{ seconds} \right)$$

Note that for **Stacked** services, the shortest grace period will apply.

For HF errors of bundled service, the UB and LB are calculated as:

$$UB_{HF} = \begin{cases} UB(t) & UB(t) < 0 \\ 0 & otherwise \end{cases}$$

$$LB_{HF} = \begin{cases} LB(t) & LB(t) < 0 \\ 0 & otherwise \end{cases}$$

The HF error e_{m_HF} for one time measurement and metered response R:

$$e_{m\_HF} = \begin{cases} LB_{HF} - R & R < LB_{HF} \\ 0 & LB_{HF} \leq R \leq UB_{HF} \\ R - UB_{HF} & R > UB_{HF} \end{cases}$$

Scaled HF error es_{m_HF} for one measurement:

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$$es_{m\_HF} = \frac{e_{m\_HF}}{Q} \frac{e_{m\_HF}}{TV_H}$$

~~HF Settlement Period error:~~

$$E_{HF} = \max_{m\_HF} \left(\text{rolling\_minimum } es_{m\_HF} \text{ over 0.2 seconds} \right)$$

HF Settlement Period error:

$$E_{HF} = \max_{m\_HF} \left(\text{rolling\_minimum } es_{m\_HF} \text{ over } e_{win} \text{ seconds} \right)$$

Note that for stacked services, the shortest grace period will apply.

K factor calculation

The **Settlement Period** error is used to derive a k factor for each **Settlement Period** of the corresponding **Auction Product**.

Settlement period k factor calculation for LF

For **Settlement Period** j, the Settlement period k factor for LF is:

$$k_{j\_LF} = \begin{cases} 1 & E < A \\ 1 - (E_{LF} - A)/(B - A) & A \le E_{LF} \le B \\ 0 & E > B \end{cases}$$

~~Where $A = 0.03$ and $B = 0.07$~~

~~Settlement period k factor calculation~~Note that for ~~HF~~

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~~For **Settlement Period** j~~**Stacked** services, the ~~Settlement period k factor for HF is:~~lowest A and B values will apply.

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Settlement period k factor calculation for HF

For **Settlement Period** j, the Settlement period k factor for HF is:

$$k_{j\_HF} = \begin{cases} 1 & E < A \\ 1 - (E_{HF} - A)/(B - A) & A \le E_{HF} \le B \\ 0 & E > B \end{cases}$$

~~$$k_{j\_HF} = \begin{cases} 1 & E < A \\ 1 - (E_{HF} - A)/(B - A) & A \le E_{HF} \le B \\ 0 & E > B \end{cases}$$~~

~~Where $A = 0.03$ and $B = 0.07$~~

Note that for **Stacked** services, the lowest A and B values will apply.

K factor for the **Contracted Service Period**

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The K factor for the **Contracted Service Period** of the corresponding **Auction Product** is then,

K factor for LF:

$$~~K_e~~K_{LF} = \min_{j\_LF} k_{j\_LF}$$

K factor for HF:

~~K factor for HF:~~

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$$~~K_E~~K_{HF} = \min_{j\_HF} k_{j\_HF}$$

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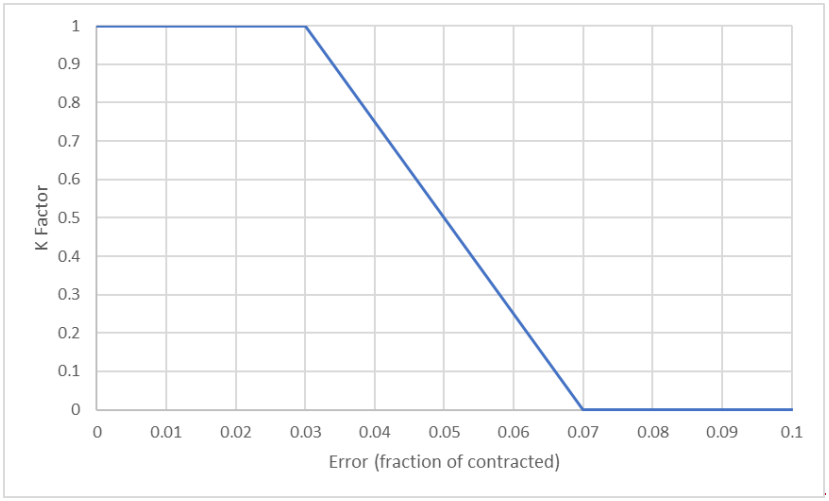

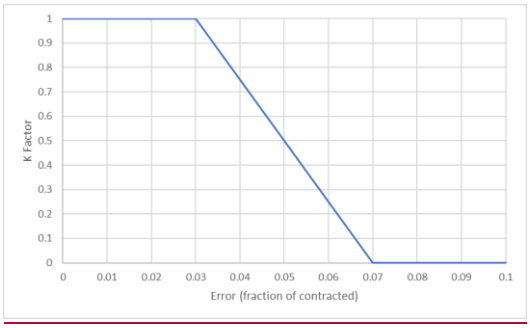

Figure 3: Payment adjustment (K factor) curve for DC and DM.

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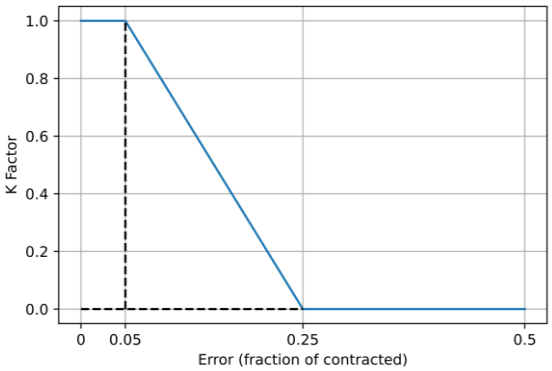

Figure 3: Payment adjustment (K factor) curve for DR.

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SCHEDULE ~~34~~ 34 - PAYMENT PROVISIONS

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Where amounts falling due by or to **NGESO** under these **Response Service Terms** are expressed to be payable in accordance with this Schedule ~~34~~ 34, then with respect to all and any such amounts the following provisions shall apply.

1. On the eighth (8th) **Business Day** of each calendar month **NGESO** shall send to the **Service Provider** a statement (the **"Monthly Statement"**) ~~setting out~~which shall include, for each **Response Contract**, details of the following (to the extent applicable) in respect of the preceding calendar month, together with such other information as may be required to be provided under ~~the~~ these **Response Service Terms**:-
   a. the aggregate number of hours of service provision, together with any **Applicable Balancing Services Volume Data**, with respect to both availability and utilisation (as applicable);
   b. details of events of default or service failures, and any consequential amounts withheld by or payable to **NGESO** with respect thereof;
   c. the amounts payable by or to **NGESO** as a result; and
   d. in relation to all **Response Contracts**, the total net amount falling due to or from the **Service Provider**.
2. If the **Service Provider** disagrees with the content of any **Monthly Statement**, it may notify **NGESO** in writing, with evidence upon which it relies in support of such disagreement, no later than the date falling ten (10) **Business Days** after receipt thereof, but in the absence of any such notification by such date the **Monthly Statement** shall be final and binding on the **Parties** subject only to paragraph 4.
3. Where a disagreement is notified by the **Service Provider** pursuant to paragraph 2, the **Parties** shall discuss and endeavour to resolve the same in good faith, and any revisions to a **Monthly Statement** agreed as a result thereof shall be reflected in a revised **Monthly Statement**, which shall promptly be issued by **NGESO**. In the absence of agreement, the **Monthly Statement** shall be binding upon the **Parties** until such time as otherwise agreed in writing between the **Parties** or as may otherwise be determined by an **Expert** following a referral by either **Party** to an **Expert** for determination, and which in each case shall be reflected in a revised **Monthly Statement** which shall promptly be issued by **NGESO**.
4. Where, having regard to any **Settlement Run** or to the results of any other monitoring by **NGESO** of service delivery, **NGESO** or the **Service Provider** discovers that some or all of any calculations and/or amounts falling due shown in any **Monthly Statement** are incorrect, then it shall promptly notify the other in writing whereupon **NGESO** shall, at its discretion, revise the **Monthly Statement** and re-issue the same to the **Balancing Service Provider**, and the provisions of paragraphs 2 and 3 shall apply mutatis mutandis to such revised **Monthly Statement**.
5. In the absence of fraud, neither **NGESO** nor the **Balancing Service Provider** may invoke the provisions of paragraph 4, with respect to the contents of any **Monthly Statement** (including any revised **Monthly Statement**) after the period of twelve (12) months has elapsed following submission of the original **Monthly Statement** in which the calculations and/or amounts in question were first stated, after which date such calculations and/or amounts shown in the last **Monthly Statement** (including any revised **Monthly Statement**) issued by **NGESO** shall be final and conclusive.
6. No later than the eighteenth (18th) **Business Day** of each month, **NGESO** will issue a self-billing invoice (or credit note) in accordance with paragraph 11 reflecting the **Monthly Statement** issued pursuant to paragraph 1 (as may have been revised pursuant to the foregoing provisions), and no

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later than five (5) **Business Days** after such date of issue **NGESO** shall pay to the **Service Provider** (or the **Service Provider** shall pay to **NGESO**, as the case may be) the net amount shown as due from **NGESO** to the **Service Provider** (or from the **Service Provider** to **NGESO**, as the case may be) in that **Monthly Statement** (or revised **Monthly Statement**).

7. All payments shall be made in pounds sterling by direct bank transfer or equivalent transfer of immediately available funds to the other **Party's** bank account, details of which shall be as notified by each **Party** to the other from time to time in accordance with these **Response Service Terms**.
8. If by virtue of the foregoing provisions, it is determined or agreed that:-
   a. the **Service Provider** was entitled to a further payment from **NGESO**, then the **Service Provider** shall be entitled to interest at the **Base Rate** on the amount of such further payment from the due date until the date of actual payment; or
   b. the **Service Provider** was not entitled to any payment it has received, then **NGESO** shall be entitled to interest at the **Base Rate** on such amount from the date of payment by **NGESO** until the date of repayment by the **Service Provider** (or, as the case may be, until the date when **NGESO** makes a payment to the **Service Provider** pursuant to paragraph 6 against which such amount is offset).
9. All amounts specified falling due and payable pursuant to these **Response Service Terms** shall be exclusive of any **Value Added Tax** or other similar tax and **NGESO** ~~shall pay to~~(or the **Service Provider** where amounts are due to **NGESO**) shall the **Value Added Tax** at the rate for the time being and from time to time properly chargeable in respect of the making available and/or provision of the applicable **Auction Product** under these **Response Service Terms**.
10. Sums payable by one **Party** to the other pursuant this Schedule ~~3~~4 whether by way of charges, interest or otherwise, shall (except to the extent permitted by these **Response Service Terms** or otherwise required by **Law**) be paid in full, free and clear of and without deduction, set-off or deferment in respect of any disputes or claims whatsoever provided that either **Party** shall be entitled to set off any payment due and payable by the other **Party** under this Schedule ~~3~~4 against any payment it makes to that **Party** under this Schedule ~~3~~4.
11. For so long as the **Service Provider** is a **Registered Response Participant**, the **Service Provider** agrees that **NGESO** shall maintain a self-billing system whereby each **Monthly Statement** shall constitute a self-billing invoice for **VAT** purposes. Accordingly, **NGESO** and the **Balancing Service Provider** shall enter into a self-billing agreement in accordance with **VAT** legislation and published guidance from HM Revenue and Customs from time to time, and agree to comply with all relevant requirements in relation to self-billing, and for such purpose the **Service Provider** hereby warrants and undertakes to **NGESO** that:-
   a. it is registered for **VAT** and will inform **NGESO** forthwith if its ceases to be so registered or changes its **VAT** registration number;
   b. it will account to HM Revenue and Customs for the **VAT** paid by **NGESO** pursuant to paragraph 9; and
   c. it will not issue its own **VAT** invoices for provision of the applicable **Auction Product**.
12. The provisions of this Schedule ~~3~~4 shall survive the termination of any **Response Contract**.

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SCHEDULE 5 – TESTING

All assets seeking to pre-qualify as **Eligible Assets** for the **Response Services** will be required to pass testing prior to pre-qualification. For all **Auction Products**, testing will be the responsibility of the **Registered Response Participant** and subject as provided below should be undertaken/verified by an **Independent Technical Expert** (**ITE**). Testing is required at 20Hz or 2Hz depending on the service being tested. Please note that a single duration test can be used for all **Response Services** (i.e., DC, DM and DR) provided the duration test is for the longest duration required by any service, e.g. the duration test of 60 minutes for DR can be used for DM and DC.

NGESO will require an **ITE** approval report as part of any submission of an **Eligible Asset** for pre-qualification. The report shall be deemed accepted by **NGESO** once submitted. However, should any queries be raised the **Eligible Asset** shall not be capable of being allocated to a **Response Unit** for participation in the daily auctions until any queries have been satisfied.

Testing shall also be required before the **Maximum Registered Product Capacity** of an existing **Eligible Asset** can be increased.

All example graphs in this Schedule 3 are for illustrative purposes only.

Part 1 - Dynamic Containment Test Requirements

The **Dynamic Containment** tests assess the capability of the **Registered Response Participant** to deliver dynamic response in accordance with a **Response Contract**.

Service description

Dynamic Containment is a fast-acting frequency response service to contain frequency within the statutory range of +/-0.5Hz in the event of a sudden demand or generation loss. The service delivers very quickly and proportionally to frequency deviation.

Table 4- Dynamic Containment Service Specification

Service specification	***Details***
Deadband delivery	*0% (+/- 0.015Hz)*
Small linear delivery	*Between 0.015Hz and 0.2Hz (maximum of 5% at 0.2Hz)*
Knee point activation	*+/- 0.2Hz is 5%*
Full delivery	*+/- 0.5Hz is 100%*
Linear delivery knee point	*0.2Hz*
Full activation	*0.5Hz*
Full delivery	*1s*

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For more details see: https://www.nationalgrideso.com/industry-information/balancing-services/frequency-response-services/dynamic-containment

Figure 4 – Dynamic Containment Delivery Requirements

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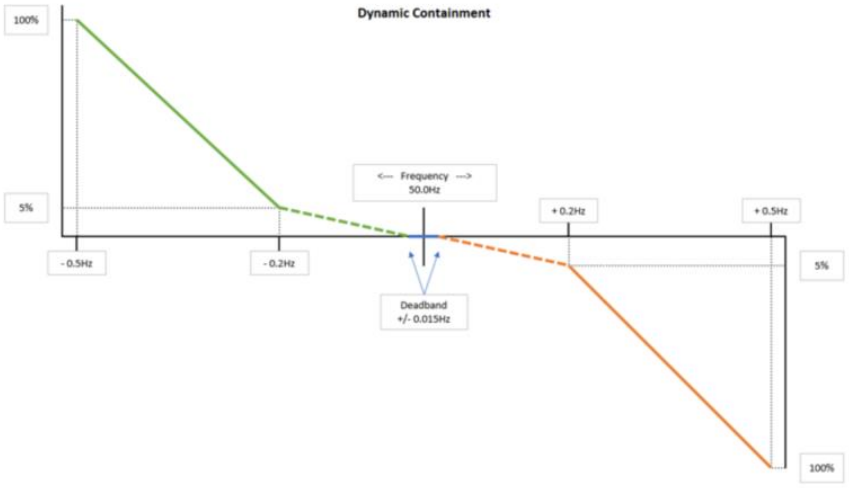

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Dynamic Containment Test Requirements

The **Dynamic Containment** tests assess the capability of the **Plant** and **Apparatus** to deliver dynamic response in accordance with the balancing service contract.

Tests 1, 2 and 3 assess response against injected frequency profiles. Test 4 assesses response whilst connected to live system frequency. The frequency profile can be injected either at site or remotely. The minimum sample rate for all tests is 20Hz. See Appendix A for information on test signals.

Test 1 – Step Test

The purpose of Test 1 is to assess the ability of the **Plant** and **Apparatus** to deliver the required response at discreet frequency deviations.

The frequency injections to be used are shown in **Figure 2** and **Table 2** below.

Table 12 - Test 1 Frequency Injection Profile corresponding with times

Test	Parameter	Values					
	Time /s	0	30	30	210	210	240
1.1	Frequency /Hz	50	50	50.01	50.01	50	50
1.2	Frequency /Hz	50	50	49.99	49.99	50	50
1.3	Frequency /Hz	50	50	50.02	50.02	50	50
1.4	Frequency /Hz	50	50	49.98	49.98	50	50
1.5	Frequency /Hz	50	50	50.1	50.1	50	50
1.6	Frequency /Hz	50	50	49.9	49.9	50	50
1.7	Frequency /Hz	50	50	50.2	50.2	50	50
1.8	Frequency /Hz	50	50	49.8	49.8	50	50

- Each step is sustained for 180 seconds to verify the response.
- The frequency will then be returned to 50Hz for a minimum of 30 seconds, or until the output is stable, before the next injection is applied.
- The minimum sample rate for Test 1 is 20Hz.

Pass Criteria for Test 1

- For Tests 1.1 and 1.2, the **Plant** and **Apparatus** should not provide any response within the deadband. Where there are any non-zero values here these need to be explained by the ITE in the test report using the comments field.
- For tests 1.3 and 1.4 all that is required is a noticeable change in power in the correct direction.
- For Tests 1.5 to 1.12 the active power response within each 3 minute timescale should fall within tolerances shown in
- **Table 6** and shown graphically in **Figure 3.** (Performance monitoring criteria used to calculate tolerance bands)

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- A response following a change of frequency should occur before 0.55 seconds.
- Delivery of active power due to a change in frequency should be achieved in the required timescale.
- The Unit should monotonically progress to its required response.

Figure 5 - Test 1

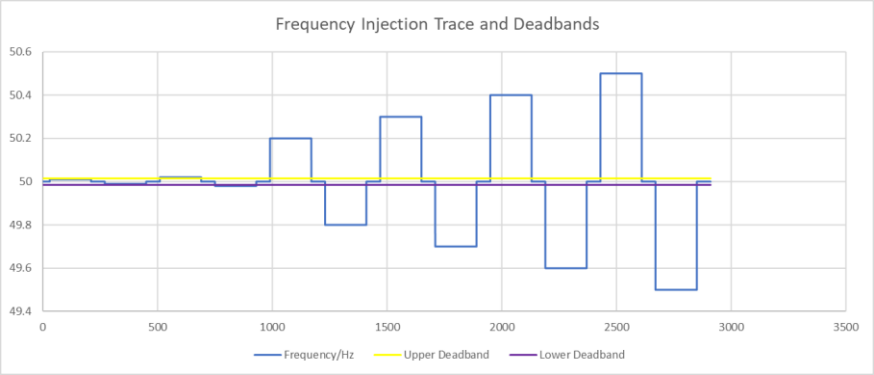

Table 5 - Test 1 Frequency Injection Profile corresponding with times

Test	Parameter	Values					
	Time /s	0	30	30	210	210	240
1.1	Frequency /Hz	50	50	50.01	50.01	50	50
1.2	Frequency /Hz	50	50	49.99	49.99	50	50
1.3	Frequency /Hz	50	50	50.02	50.02	50	50
1.4	Frequency /Hz	50	50	49.98	49.98	50	50
1.5	Frequency /Hz	50	50	50.2	50.2	50	50
1.6	Frequency /Hz	50	50	49.8	49.8	50	50
1.7	Frequency /Hz	50	50	50.3	50.3	50	50
1.8	Frequency /Hz	50	50	49.7	49.7	50	50
1.9	Frequency /Hz	50	50	50.4	50.4	50	50
1.10	Frequency /Hz	50	50	49.6	49.6	50	50
1.11	Frequency /Hz	50	50	50.5	50.5	50	50
1.12	Frequency /Hz	50	50	49.5	49.5	50	50

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Table 6 - Test 1 Frequency Injection and expected response value.

For values with an asterisk(*) a noticeable change in power in the correct direction is all that is required.

Test Number	Frequency Step	Expected Response	Allowable Power Tolerance (% of Maximum Contracted)
1.1	50.01	0%	n/a
1.2	49.99	0%	n/a
1.3	50.02	0.135%	*
1.4	49.98	0.135%	*
1.5	50.2	5%	+/- 3%.
1.6	49.8	5%	+/- 3%.
1.7	50.3	37%	+/- 3%.
1.8	49.7	37%	+/- 3%.
1.9	50.4	68%	+/- 3%.
1.10	49.6	68%	+/- 3%.
1.11	50.5	100%	+/- 3%.
1.12	49.5	100%	+/- 3%.

For values with an asterisk (*) a noticeable change in power in the correct direction is all that is required.

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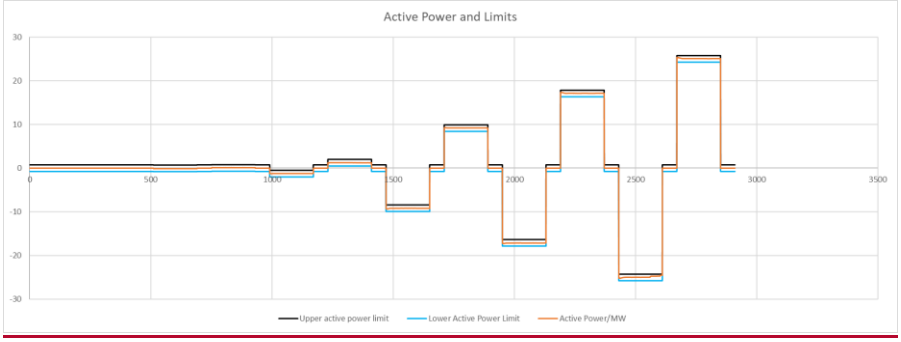
Figure 6 Graphical representation of tolerance bands for the expected response at different frequencies – sample data



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Test 2 – Frequency Sweep Test

Test 2 assesses the performance of the **Plant** and **Apparatus** against a varying frequency over the entire performance envelope.

- The frequency injections to be used are shown in

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- **Figure** 17 and **Figure** 18 and **Table** 14 below.

- The minimum sample rate for Tests 2.1 and 2.2 is 20Hz.

Pass Criteria for Tests 2.1 and 2.2

- For Test 2.1 and 2.2, active power response is within the tolerances in **Figure** 19/**Figure** 20 and **Table** 15. (Performance monitoring criteria used to calculate tolerance bands)

Figure 7 **- Test 2.1**

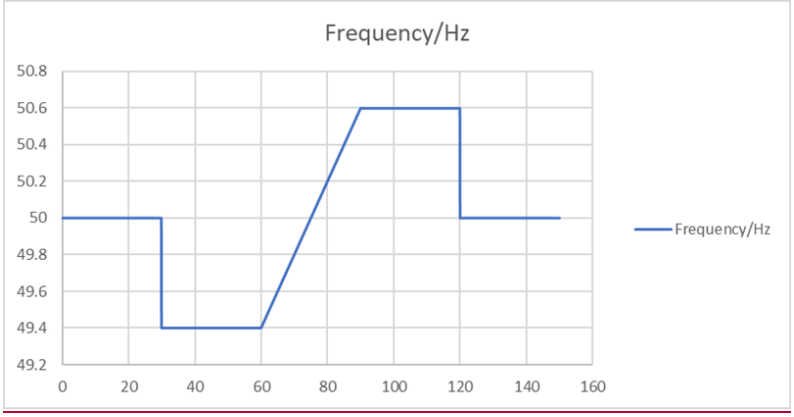

Figure 8 **- Test 2.2**

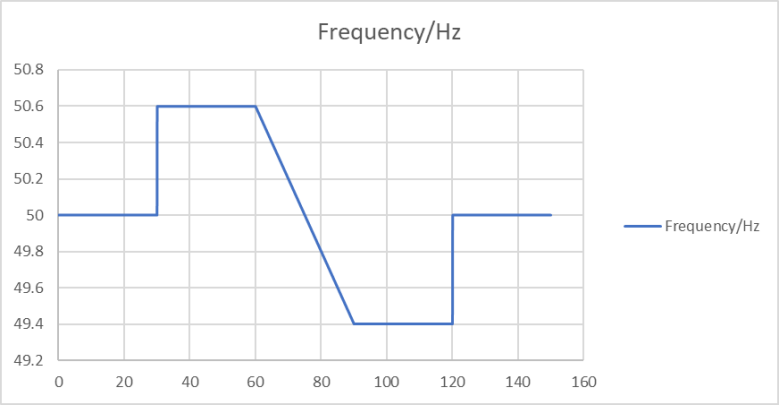

Table 7 **- Test 2 Frequency Injection Profiles**

Time /s	*Injected Frequency /Hz*

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	Test 2.1	***Test 2.2***
0	*50*	*50*
30	*50*	*50*
30	*49.4*	*50.6*
60	*49.4*	*50.6*
65	*49.6*	*50.4*
70	*49.8*	*50.2*
75	*50*	*50*
80	*50.2*	*49.8*
85	*50.4*	*49.6*
90	*50.6*	*49.4*
120	*50.6*	*49.4*
120	*50*	*50*
150	*50*	*50*

Figure 9 - Test 2.1 Tolerance

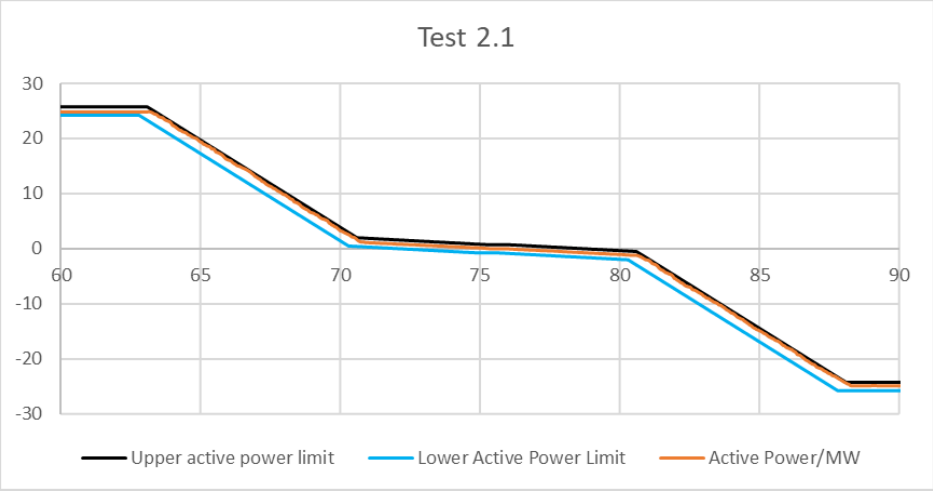

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Figure 10 - Test 2.2 Tolerance

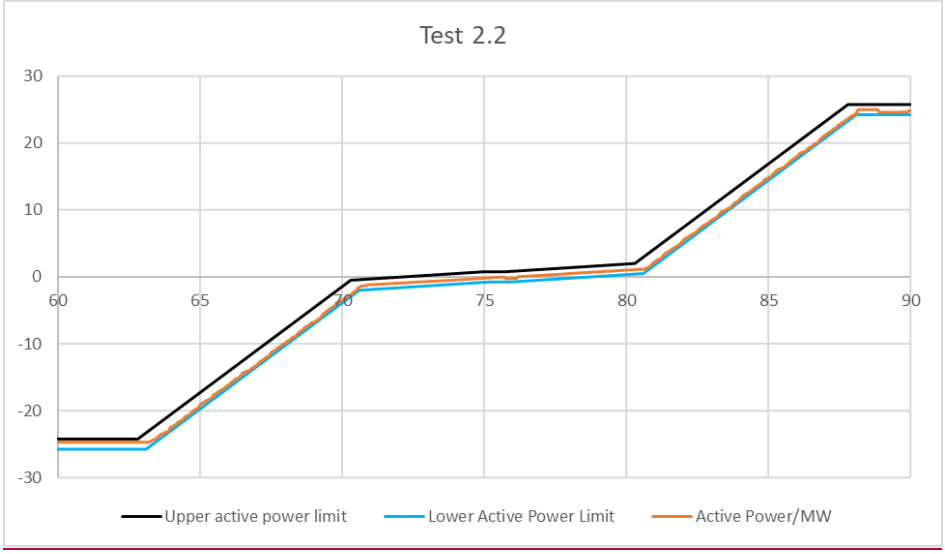

***Table 8* - Test 2.1 and 2.2 Sweep Test tolerances (Without time delay to reach required delivery included)**

	Test 2.1 and Test 2.2	
Frequency (Hz)	Expected Percentage Active Power Response(%)	Tolerance (% of Maximum Contracted)
50.6	100	+/-3%
50.5	100	+/- 3%.
50.4	68.3	+/- 3%.
50.3	36.7	+/- 3%.
50.2	5	+/- 3%.
50.1	2.3	+/- 3%.
50	0	0%
49.9	2.3	+/- 3%.
49.8	5	+/- 3%.
49.7	36.7	+/- 3%.

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49.6	68	+/- 3%.
49.5	100	+/- 3%.
49.4	100	+/- 3%.

Test 3 Duration Test

Test 3 assesses the ability of the **Plant** and **Apparatus** to sustain full response for 15 minutes.

- Operation will be tested at ±100% of capability to ensure the system is compliant.
- This is carried out by a frequency step of ±0.6Hz onto the system for 15 minutes.
- The frequency injection profiles are shown in **Figure 21** and **Figure 22** and **Table 16** and **Table 17** below

Pass criteria for test 3:

- The standard deviation of load error at steady state over a 900 second period must not exceed 2.5% of the maximum contracted active power.
- Sustain response for 15 minutes.

Figure 11 Test 3.1 Injection Profile

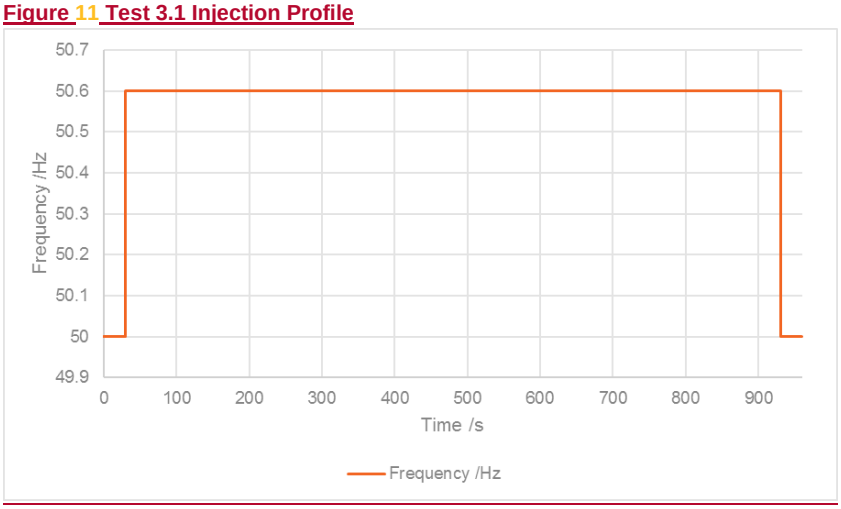

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Figure 12 Test 3.2 Injection Profile

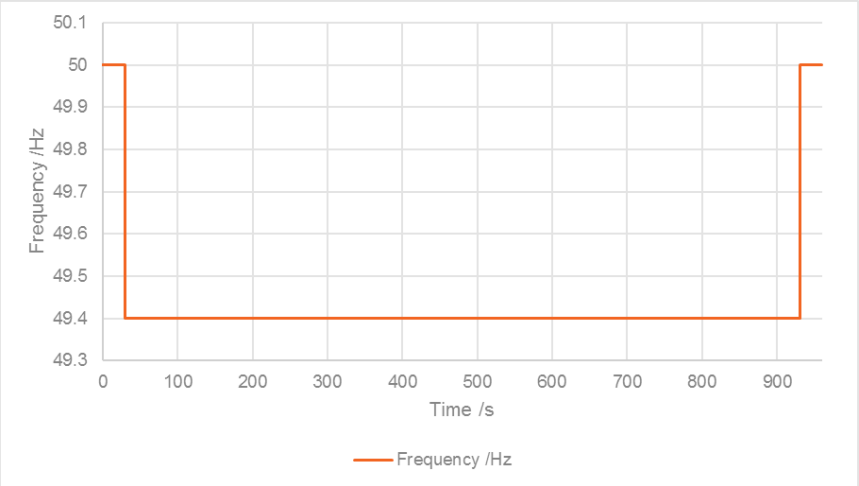

Table 9: Test 3.1 Frequency Injection Table Corresponding with times

	Test 3.1 Frequency injection table					
Time /s	*0*	*30*	*30*	*930*	*930*	*960*
Frequency /Hz	*50*	*50*	*50.6*	*50.6*	*50*	*50*

Table 10: Test 3.2 Frequency Injection Table Corresponding with times

	Test 3.2 Frequency injection table					
Time /s	*0*	*30*	*30*	*930*	*930*	*960*
Frequency /Hz	*50*	*50*	*49.4*	*49.4*	*50*	*50*

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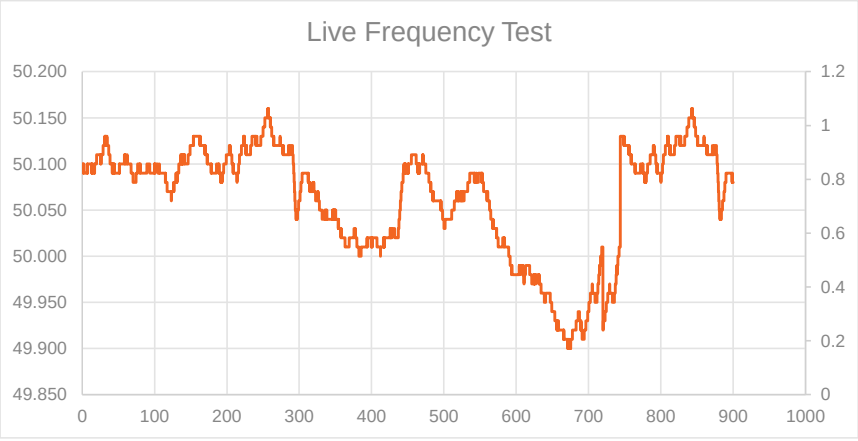
Test 4 – Live System Frequency Response Test

Test 4 assesses the response of the **Plant** and **Apparatus** to system frequency in a live environment. The minimum sample rate for this test is 20Hz and duration is 15 minutes where system frequency and active power response will be recorded. As part of test 4, the **Registered Response Participant** is required to provide evidence that the protection settings are in line with the Grid Code (+/- of 5% of 50Hz).

Pass Criteria for Test 4

- Provide an active power response consistent with the contracted performance within timescales.
- Provide evidence protection setting comply with Grid Code.

Figure 13 - Sample System Frequency



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Appendix A – Test Signals

The limits of error and minimum sample rates for testing are shown below in **Table 11**. All success criteria are subject to the stated limit of error/accuracy threshold.

Table 11 - Limits of error and minimum sample rates for Dynamic Service Testing

	Limit of error/ Accuracy threshold	Minimum Sample rate Test 1	Minimum Sample rate Tests 2 and 3
Injection Frequency (Hz)	±0.01 Hz	20Hz	20Hz
Active Power (MW)	Please see pass criteria	20Hz	20Hz
	Limit of error/ Accuracy threshold	Minimum Sample rate Test 4	
Measured System Frequency (Hz)	±0.001 Hz	20Hz	
Active Power (MW)	Please see pass criteria	20Hz	

Simulations / simulated tests are not permitted. Each test submitted must record real time data from the plant and sites under test: The test data submitted must come from the specific site to be contracted; substituted data will not be accepted. Test results must not be changed before submission for analysis.

Test Signals

In ALL cases, the data should record ALL required signals for at least 30 seconds BEFORE the application of the frequency injection signal and for at least 30 seconds AFTER the completion of the test.

For ALL services, the data for the following signals will need to be provided

a) Time
b) Active Power
c) System Frequency or Injected frequency as appropriate
d) Any other relevant signals that may affect the success criteria such as Relay Logic for non-dynamic.

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Appendix B - Dynamic Containment Test Data Format

Figure 14 - Sample Dynamic Containment Test Data Format

Provider	Company Name	
Date	xx-xx-xxxx	
Test	1	
Service	Dynamic Containment	
Location	AA	
Site	AA	
Time (s)	Injected Frequency (Hz)	Measured Power (MW)
0	50.00	0.000
0.05	50.00	0.000
0.1	50.00	0.000
0.15	50.00	0.000
0.2	50.00	0.000
0.25	50.50	5.000
0.3	50.50	5.000
0.35	50.50	5.000
0.4	50.50	5.000
0.45	50.50	5.000
0.5	50.50	5.000
0.55	50.50	5.000
0.6	50.00	0.000
0.65	50.00	0.000
0.7	50.00	0.000
0.75	50.00	0.000
0.8	50.00	0.000

- Frequency Injection should be to 2 decimal places
- Measured Power should be to 3 decimal places
- Measured frequency for test 4 should be to 3 decimal places

Further columns can be added to include data for several sites if required.

For Test 4 replace 'Injected Frequency' with 'Measured Frequency'.

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Appendix C – Dynamic Containment Test Assessment

Excel Analysis Tool published with User Guide.

See Test certificate template in Appendix D for further guidance.

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Appendix D – Dynamic Containment Test Certificate Template

Please use this Test Certificate format and submit to NGESO, along with the test data and CV of the ITE employed by the prospective response provider.

Prospective Response Provider Company Details

Contracted company name	
Primary contact name	
Contact number/s	
Email address	

Contract Details

Contract ID	
Service type	
Asset type, e.g. diesel generator, battery etc	
Unit make up, e.g. single or aggregated Aggregation methodology (if appropriate)	*Describe here what is included in this test e.g. Single asset, group of assets, asset/s being assessed within an existing Unit.*
Unit location / ID	
Do any assets associated with this report have a condition in their DNO connection agreement whereby they are signed up to an Active Network management (ANM) Scheme / Flexibility Connection? If yes, please ensure contracted party speaks to their ESO account manager.	
Contract signed date	
Service start date	
Test date	

Dynamic Service Details (*example here is for a 5MW Unit*)

Deadband	±0.015Hz
Response / MW	5

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Test Results

Further relevant test description/commentary here

Test	Pass Criteria	Pass/Fail	Comment
1.1, 1.2	No delivery within deadband. Where there are any non-zero values here these need to be explained by the ITE in the test report using the comments field.		
1.3,1.4	For Test 1.3 and 1.4 a noticeable change in active power in the correct direction is all that is required.		
1.5-1.12	Active power response within each 3 minute timescale remains within tolerances.	Pass	Note result here (See Figure …)
1.5-1.12	A response following a change of frequency should occur before 0.55 seconds.		
1.5-1.12	Delivery of active power due to a change in frequency is achieved in the required timescale	Pass	
1.5-1.12	The Unit should monotonically progress to its required response	Pass	
2.1 2.2	Active power response is within the allowed tolerances.	Pass	Show in figure below with tolerance bands overlaid.
3	Response is sustained for 15 minutes	Pass	Refer to figures

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Test	Pass Criteria	Pass/Fail	Comment
3	The standard deviation of load error at steady state over a 900 second period must not exceed 2.5% of the maximum contracted active power.	Pass	Standard deviation is assessed from 1 second until 900 seconds after the frequency step.
4	Provide an active power response consistent with the contracted performance timescales.		Figure should show the active power following frequency as expected.
	Overall Test Result		

Test Result Graphs

Plot frequency injection and active power response vs time for each test.

Figure 1 – Test 1 Active Power Response

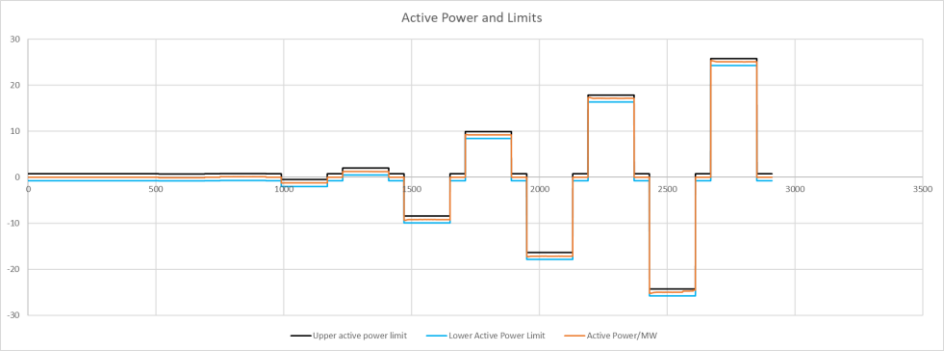

Figure 2 – Test 1.1

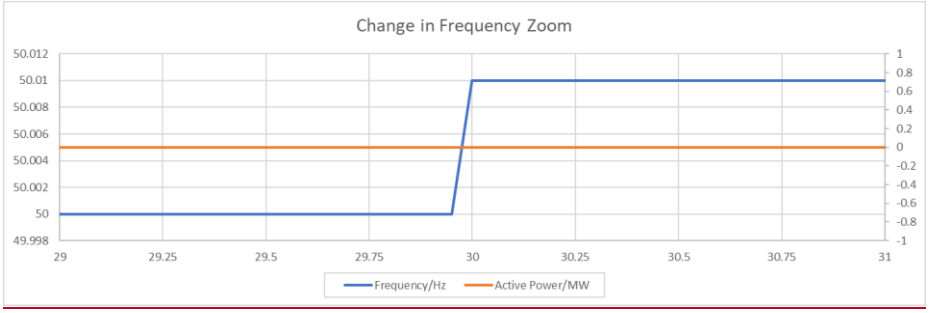

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Figure 3 – Test 1.3

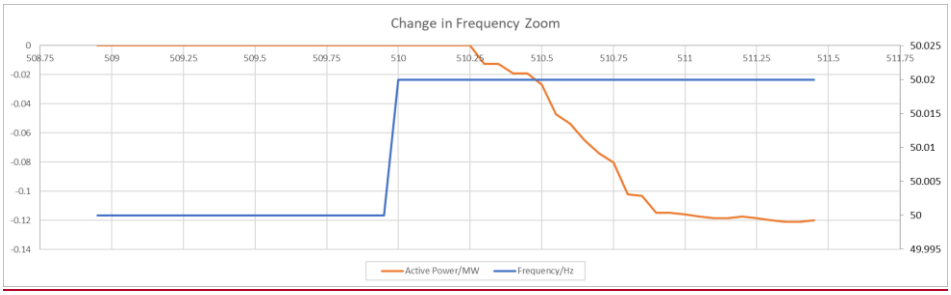

Figure 4 – Test 1.5

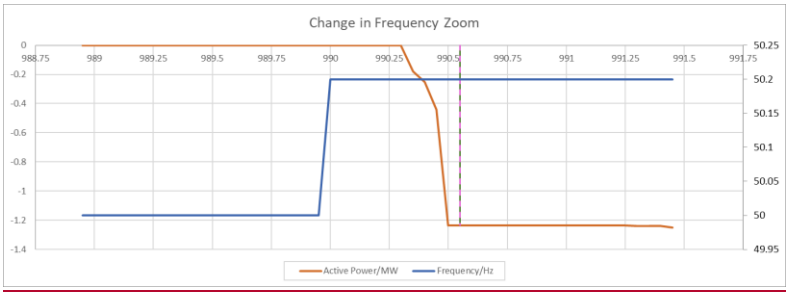

Figure 5 – Test 1.11

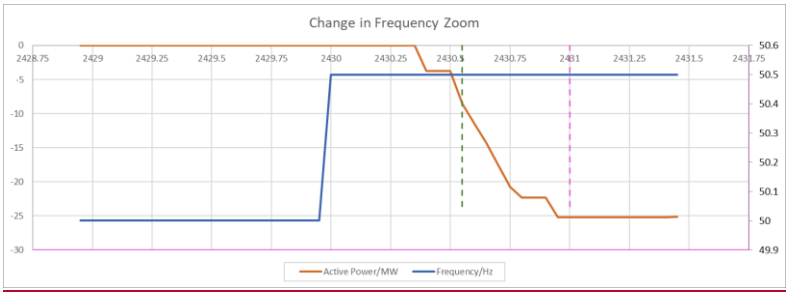

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Figure 6 – Test 2.1

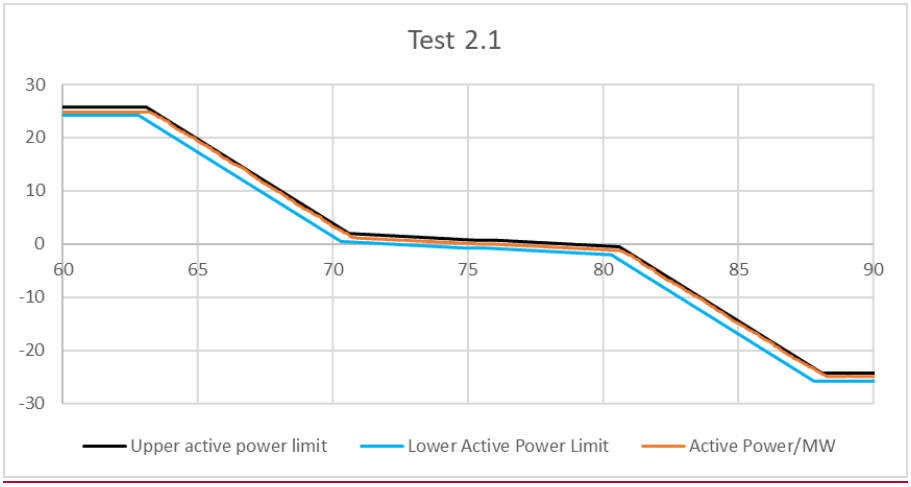

Figure 7 – Test 2.2

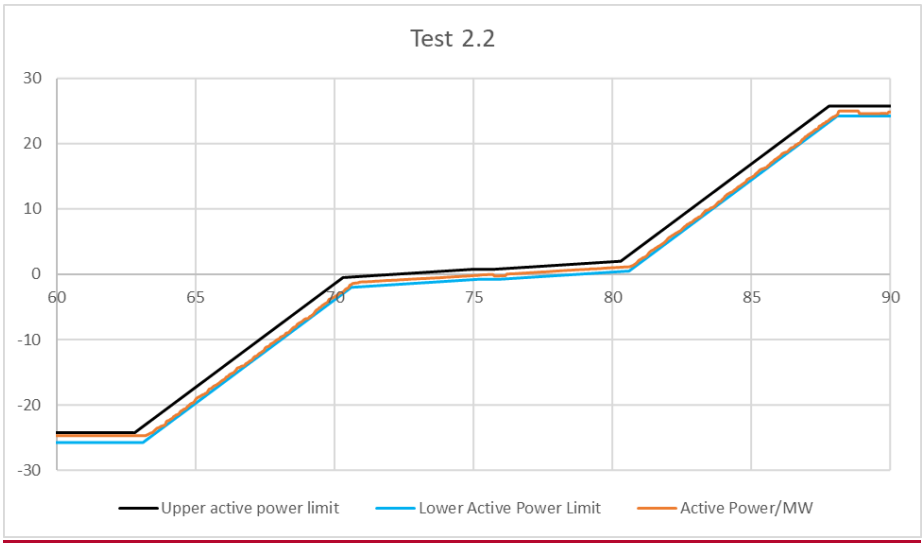

Figure 8 – Test 3.1

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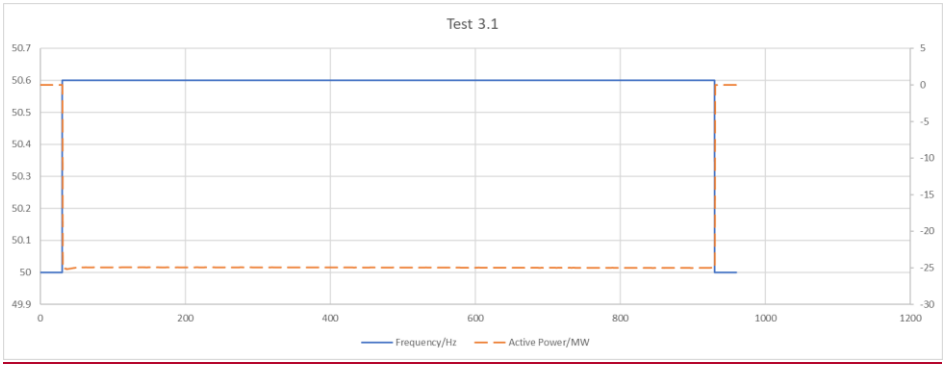


Figure 9 – Test 3.2

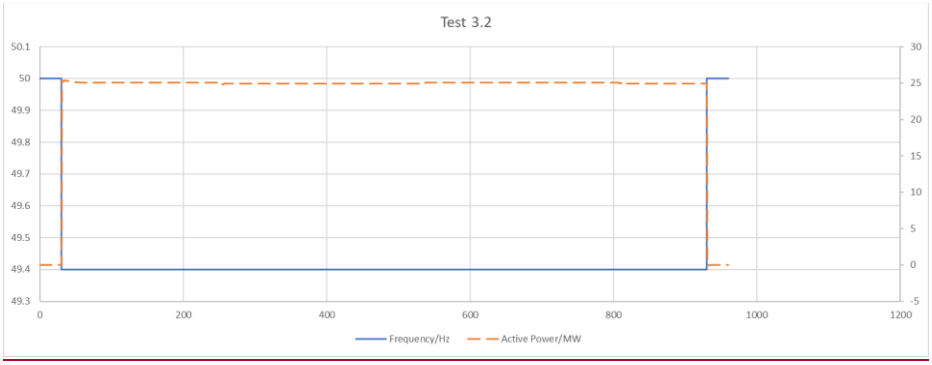
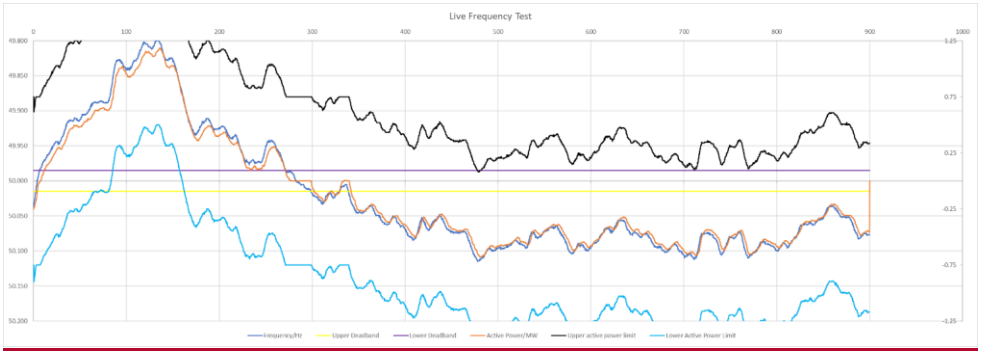


Figure 10 – Test 4



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Independent Technical Expert (ITE) Details

Company name

Primary contact name

Contact number /s

Email address

I / We confirm that I / We the following:

(a) I/We am a/are Independent Technical Expert(s) (as defined in NGESO's Response Procurement Documentation;
(b) I/We have carried out an assessment of the [asset] described above in accordance with the Testing Rules contained in that documentation;
(c) the above details are, to my/our best knowledge and belief, true, accurate, complete and not misleading; and
(d) the CV attached of my/our experience is to my/our best knowledge and belief, true, accurate, complete and not misleading.

Signed:

Date:

Part 2 - Dynamic Moderation Test Requirements

The **Dynamic Moderation** tests assess the capability of the **Registered Response Participant** to deliver dynamicresponse in accordance with a **Response Contract**.

Tests 1, 2 and 3 assess response against injected frequency profiles. Test 4 assesses response whilst connected to live **System Frequency**. The frequency profile can be injected either at site or remotely. The minimum sample rate for all tests is 20Hz. See Appendix A for information on test signals.

Aggregation/Test Approach

These tests are designed to meet the **NGESO** requirement for service validation as well as being equally suitable for all types of **Plant and Apparatus** (both single-site or multi-site) and technology types (generation, storage, demand or a combination of same). The tests also consider how **Registered Response Participants** add to and evolve their aggregated portfolios over time can have additional assets validated.

The dynamic tests can assess the capability of

- A single asset
- A group of assets
- Asset/s to be added to an existing aggregated facility

Test 1 – Step Test

The purpose of Test 1 is to assess the ability of the **Plant** and **Apparatus** to deliver the required response at discreet frequency deviations.

The frequency injections to be used are shown in **Figure *15*** and below.

- Each step is sustained for 180 seconds to verify the response.
- The frequency will then be returned to 50Hz for a minimum of 30 seconds, or until the output is stable, before the next injection is applied.

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- The minimum sample rate for Test 1 is 20Hz.

Pass Criteria for Test 1

- For Tests 1.1 and 1.2, the **Plant** and **Apparatus** should not provide any response within the deadband. Where there are any non-zero values here these need to be explained by the **ITE** in the test report using the comments field.
- For tests 1.3 and 1.4 all that is required is a noticeable change in power in the correct direction.
- For Tests 1.5 to 1.8 the active power response within each 3 minute timescale should fall within tolerances shown in **Table 3** and shown graphically in **Figure 3.**
- (Performance monitoring criteria used to calculate tolerance bands)
- A response following a change of frequency should occur before 0.5 second.
- Delivery of active power due to a change in frequency should be achieved in the required timescale.
- The **Plant** and **Apparatus** should monotonically progress to its required response.

Figure 15 - Test 1

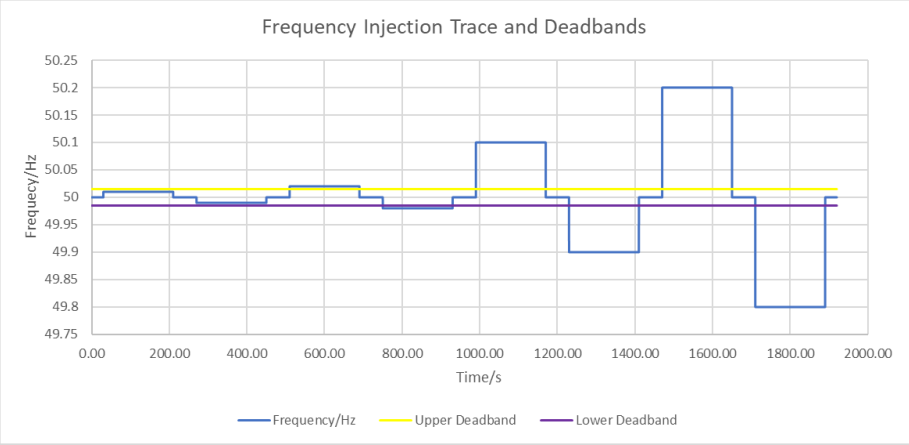

Table 12 - Test 1 Frequency Injection Profile corresponding with times

Test	Parameter	Values					
	Time /s	0	30	30	210	210	240
1.1	Frequency /Hz	50	50	50.01	50.01	50	50
1.2	Frequency /Hz	50	50	49.99	49.99	50	50
1.3	Frequency /Hz	50	50	50.02	50.02	50	50
1.4	Frequency /Hz	50	50	49.98	49.98	50	50
1.5	Frequency /Hz	50	50	50.1	50.1	50	50
1.6	Frequency /Hz	50	50	49.9	49.9	50	50
1.7	Frequency /Hz	50	50	50.2	50.2	50	50
1.8	Frequency /Hz	50	50	49.8	49.8	50	50

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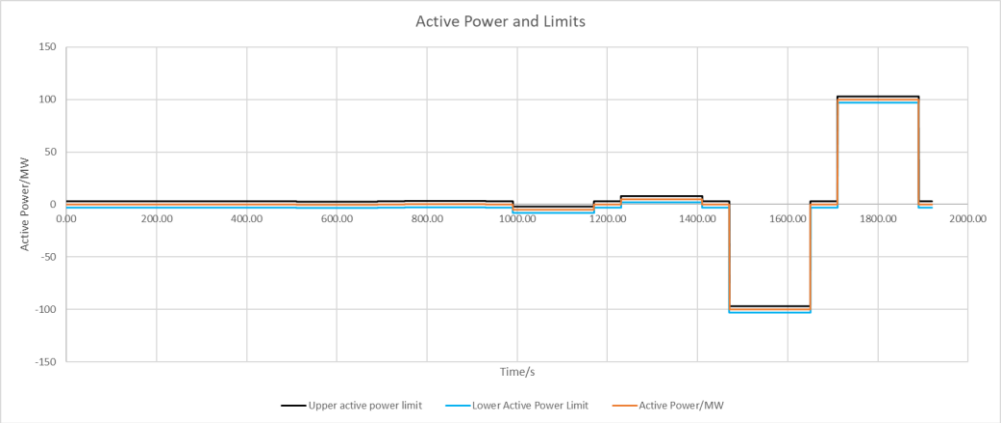
Table 13 - Test 1 Frequency Injection and expected response value.

Test Number	Frequency Step	Expected Response	Allowable Power Tolerance (% of Maximum Contracted)
1.1	50.01	0%	n/a
1.2	49.99	0%	n/a
1.3	50.02	0.135%	*
1.4	49.98	0.135%	*
1.5	50.1	5%	± 3%
1.6	49.9	5%	± 3%
1.7	50.2	100%	± 3%
1.8	49.8	100%	± 3%

For values with an asterisk (*) a noticeable change in power in the correct direction is all that is required.

Figure 16 - Graphical representation of tolerance bands for the expected response at different frequencies – sample data



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Test 2 – Frequency Sweep Test

Test 2 assesses the performance of the **Plant** and **Apparatus** against a varying frequency over the entire performance envelope.

- The frequency injections to be used are shown in

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- Figure 17 and Figure *18* and Table *14* below.
- The minimum sample rate for Tests 2.1 and 2.2 is 20Hz.

Pass Criteria for Tests 2.1 and 2.2

- For Test 2.1 and 2.2, active power response is within the tolerances in **Figure 19/Figure 20** and Table 15. (Performance monitoring criteria used to calculate tolerance bands)

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Figure 17 - Test 2.1

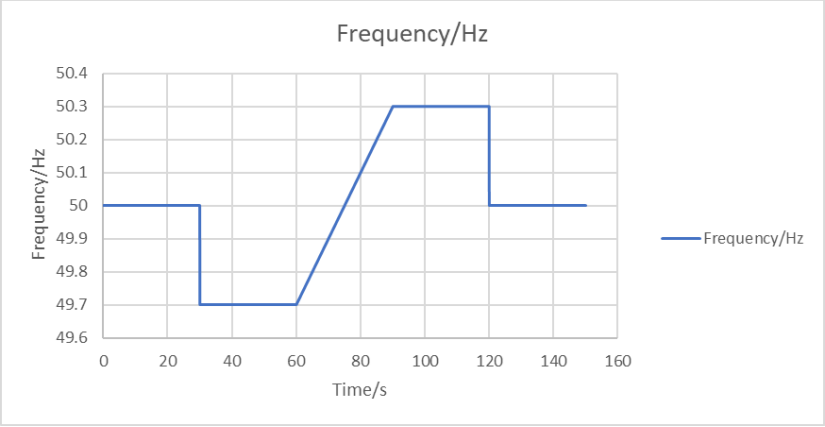

Figure 18 - Test 2.2

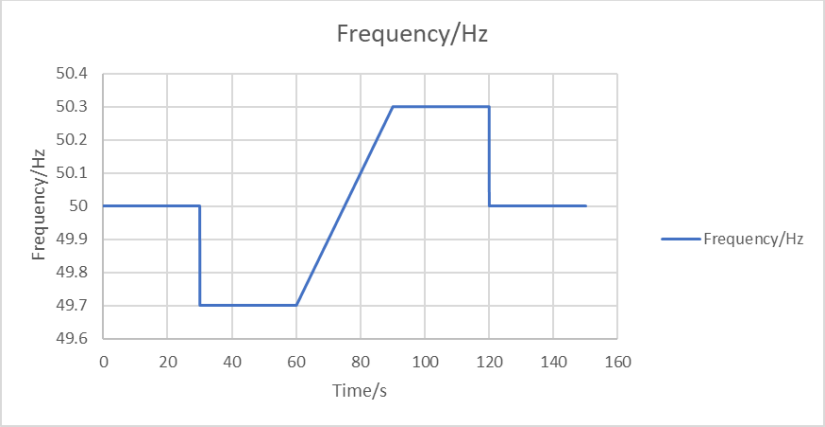

Table 14 - Test 2 Frequency Injection Profiles

Time /s	Injected Frequency /Hz	
	Test 2.1	Test 2.2
0	50	50
30	50	50
30	49.7	50.3
60	49.7	50.3
75	50	50
90	50.3	49.7
120	50.3	49.7
120	50	50
150	50	50

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Figure 19 - Test 2.1 Tolerance

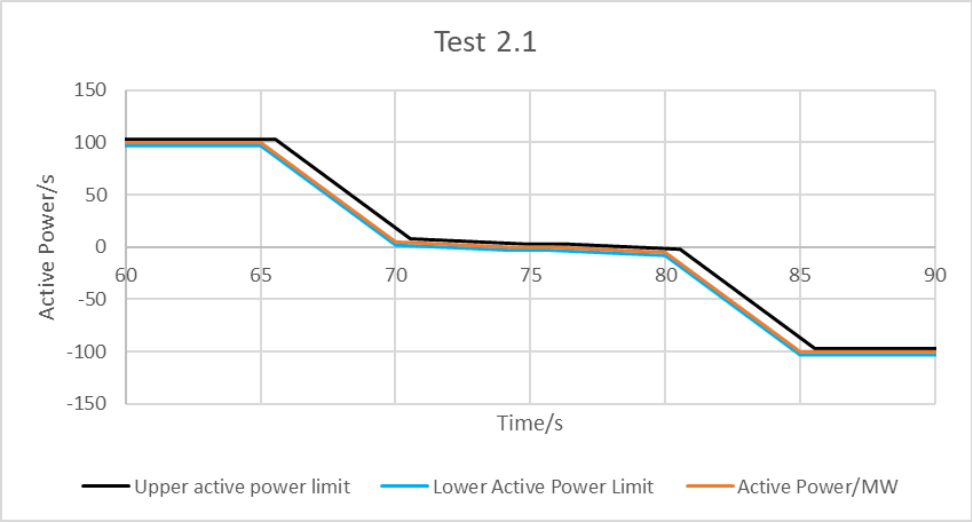

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Figure 20 - Test 2.2 Tolerance

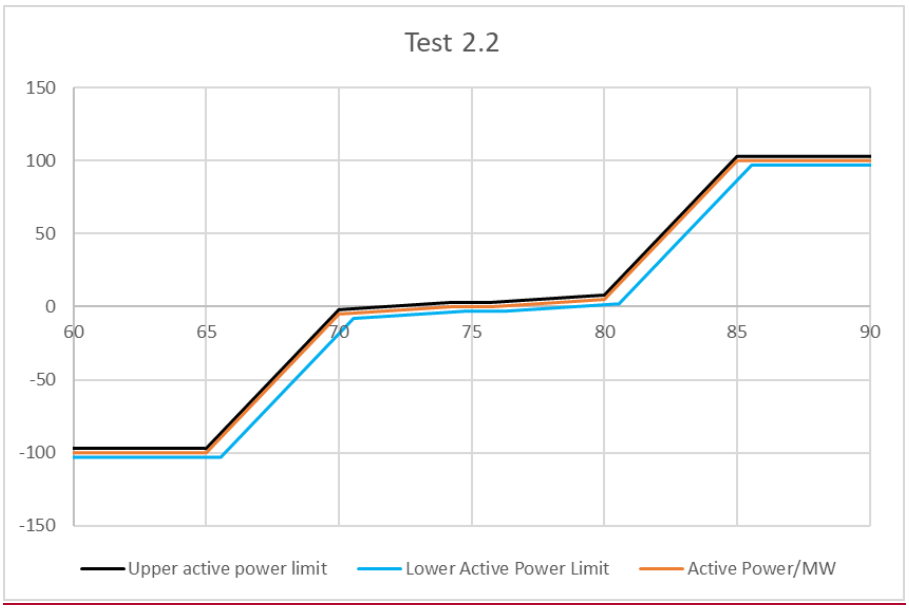

Table 15 - Test 2.1 and 2.2 Sweep Test tolerances (Without time delay to reach required delivery included)

	Test 2.1 and Test 2.2	
Frequency (Hz)	Expected Percentage Active Power Response (%)	Tolerance (% of Maximum Contracted)
50.3	100	±3%
50.2	100	± 3%
50.1	5	± 3%
50.0	0	0%
49.9	5	± 3%
49.8	100	± 3%
49.7	100	± 3%

Test 3 Duration Test

Test 3 assesses the ability of the **Plant** and **Apparatus** to sustain full response for 30 minutes.

- Operation will be tested at ±100% of capability to ensure the system is compliant.
- This is carried out by a frequency step of ±0.3Hz onto the system for 30 minutes.

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- The frequency injection profiles are shown in Figure 21 and Figure *22* and Table *16* and Table *17* below

Please note that **Registered Response Participants** can reuse existing duration tests for an asset, providing that they are for the same duration or longer and have the same MW value.

Pass criteria for test 3:

- The standard deviation of load error at steady state over a 30-minute period must not exceed 2.5% of the maximum contracted active power.
- Sustain response for 30 minutes.

Figure 21 Test 3.1 Injection Profile

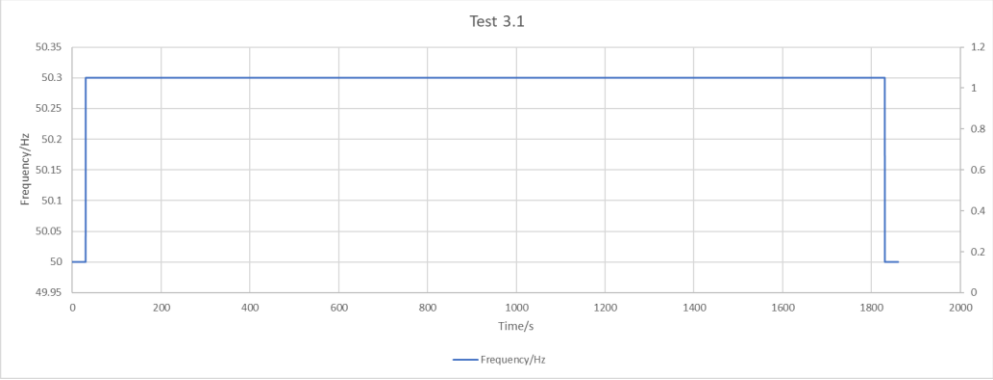

Figure 22 Test 3.2 Injection Profile

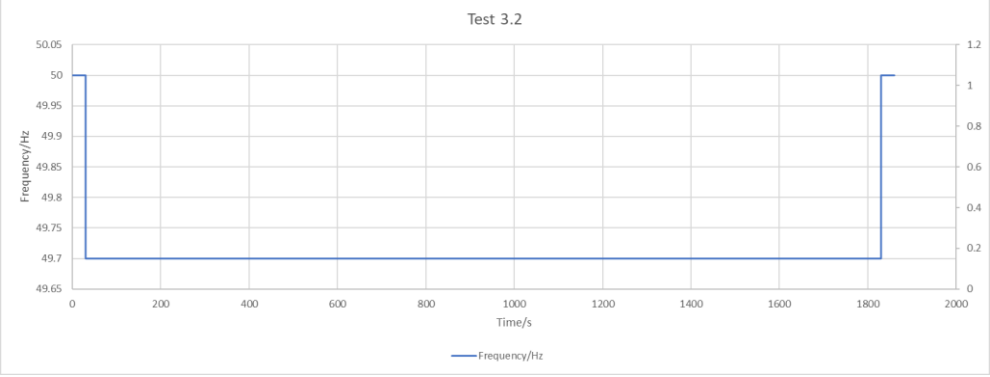

Table 16: Test 3.1 Frequency Injection Table Corresponding with times

	Test 3.1 Frequency injection table					
Time /s	0	30	30	1830	1830	1860
Frequency /Hz	50	50	50.3	50.3	50	50

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Table 17: Test 3.2 Frequency Injection Table Corresponding with times

	Test 3.2 Frequency injection table					
Time /s	0	30	30	1830	1830	1860
Frequency /Hz	50	50	49.7	49.7	50	50

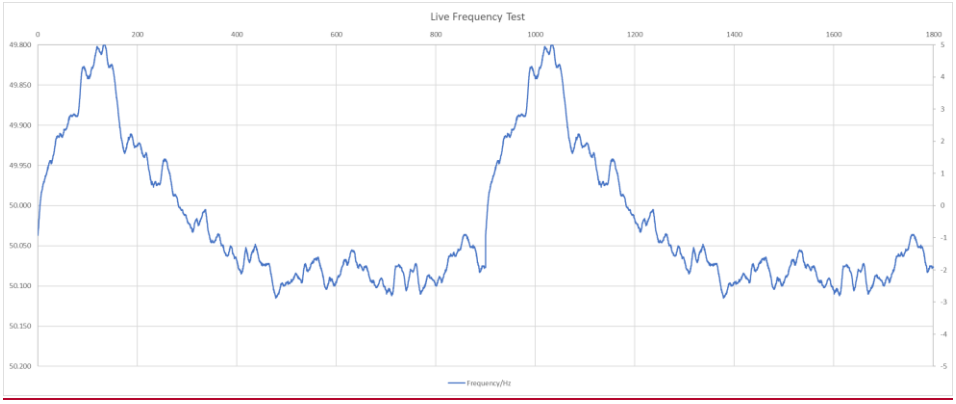
Test 4 – Live System Frequency Response Test

Test 4 assesses the response of the **Plant** and **Apparatus** to system frequency in a live environment. The minimum sample rate for this test is 20Hz and duration is 30 minutes where system frequency and active power response will be recorded. As part of test 4, **Registered Response Participants** are required to provide evidence that the protection settings are in line with the **Grid Code** (± of 5% of 50Hz).

Pass Criteria for Test 4

- Provide an active power response consistent with the contracted performance within timescales.
- Provide evidence protection setting comply with **Grid Code**.

Figure 23 - Sample System Frequency



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Appendix A – Test Signals

The limits of error and minimum sample rates for testing are shown below in **Table** *11*. All success criteria are subject to the stated limit of error/accuracy threshold.

Table 18 - Limits of error and minimum sample rates for Dynamic Moderation Testing

	Limit of error/ Accuracy threshold	Minimum Sample rate Test 1	Minimum Sample rate Tests 2 and 3
Injection Frequency (Hz)	±0.01 Hz	20Hz	20Hz
Active Power (MW)	Please see pass criteria	20Hz	20Hz
	Limit of error/ Accuracy threshold	Minimum Sample rate Test 4	
Measured System Frequency (Hz)	±0.001 Hz	20Hz	
Active Power (MW)	Please see pass criteria	20Hz	

Simulations / simulated tests are not permitted. Each test submitted must record real time data from the plant and sites under test: The test data submitted must come from the specific site to be contracted; substituted data will not be accepted. Test results must not be changed before submission for analysis.

Test Signals

In ALL cases, the data should record ALL required signals for at least 30 seconds BEFORE the application of the frequency injection signal and for at least 30 seconds AFTER the completion of the test.

For ALL services, the data for the following signals will need to be provided

e) Time
f) Active Power
g) System Frequency or Injected frequency as appropriate
h) Any other relevant signals that may affect the success criteria such as Relay Logic for non-dynamic.

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Appendix B - Dynamic Moderation Test Data Format

Figure 24 - Sample Dynamic Moderation Test Data Format

Provider	Company Name	
Date	xx-xx-xxxx	
Test	1	
Service	Dymanic Moderation	
Location	AA	
Site	AA	
Time/s	Injected Frequency/s	Measred Power/MW
0	50.00	0.00
0.05	50.00	0.00
0.1	50.00	0.00
0.15	50.00	0.00
0.2	50.00	0.00
0.25	50.30	5.00
0.3	50.30	5.00
0.35	50.30	5.00
0.4	50.30	5.00
0.45	50.30	5.00
0.5	50.30	5.00
0.55	50.30	5.00
0.6	50.00	0.00
0.65	50.00	0.00
0.7	50.00	0.00
0.75	50.00	0.00
0.8	50.00	0.00

- Frequency Injection should be to 2 decimal places
- Measured Power should be to 3 decimal places
- Measured frequency for test 4 should be to 3 decimal places

Further columns can be added to include data for several sites if required.

For Test 4 replace ‘Injected Frequency’ with ‘Measured Frequency’.

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Appendix C – Dynamic Moderation Test Assessment

Excel Analysis Tool published with User Guide.

See Test certificate template in Appendix D for further guidance.

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Appendix D – Dynamic Moderation Test Certificate Template

Please use this Test Certificate format and submit to NGESO, along with the test data and CV of the ITE employed by the prospective response provider.

Prospective Response Provider Company Details

Contracted company name	
Primary contact name	
Contact number/s	
Email address	

Contract Details

Contract ID	
Service type	
Asset type, e.g. battery	
Unit make up, e.g. single or aggregated	*Describe here what is included in this test e.g. Single asset, group of assets, asset/s being assessed within an existing Unit.*
Aggregation methodology (if appropriate)	
Unit location / ID	
Do any assets associated with this report have a condition in their DNO connection agreement whereby they are signed up to an Active Network management (ANM) Scheme / Flexibility Connection? **If yes, please ensure contracted party speaks to their ESO account manager.**	
Contract signed date	
Service start date	
Test date	

Dynamic Service Details *(example here is for a 5MW Unit)*

Deadband	±0.015Hz
Response / MW	5

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Test Results

Further relevant test description/commentary here

Test	Pass Criteria	Pass/Fail	Comment
1.1, 1.2	No delivery within deadband. Where there are any non-zero values here these need to be explained by the ITE in the test report using the comments field.		
1.3,1.4	For Test 1.3 and 1.4 a noticeable change in active power in the correct direction is all that is required.		
1.5-1.8	Active power response within each 3 minute timescale remains within tolerances.	Pass	Note result here (See Figure …)
1.5-1.8	A response following a change of frequency should occur within 0.5 second.		
1.5-1.8	Delivery of active power due to a change in frequency is achieved in the required timescale	Pass	
1.5-1.8	The Unit should monotonically progress to its required response	Pass	
2.1 2.2	Active power response is within the allowed tolerances.	Pass	Show in figure below with tolerance bands overlaid.
3	Response is sustained for 30 minutes	Pass	Refer to figures

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Test	Pass Criteria	Pass/Fail	Comment
3	The standard deviation of load error at steady state over a 1800 second period must not exceed 2.5% of the maximum contracted active power.	Pass	Standard deviation is assessed from 1 second until 1800 seconds after the frequency step.
4	Provide an active power response consistent with the contracted performance timescales.		Figure should show the active power following frequency as expected.
	Overall Test Result		

Test Result Graphs

Plot frequency injection and active power response vs time for each test.

Figure 1 – Test 1 Active Power Response

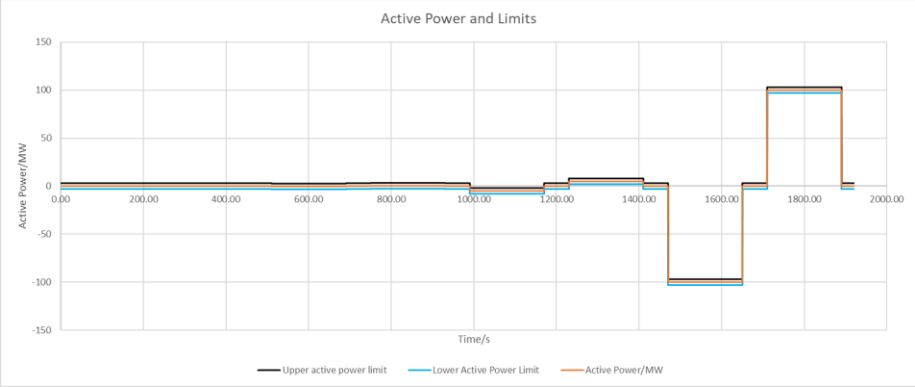

Figure 2 – Test 1.1

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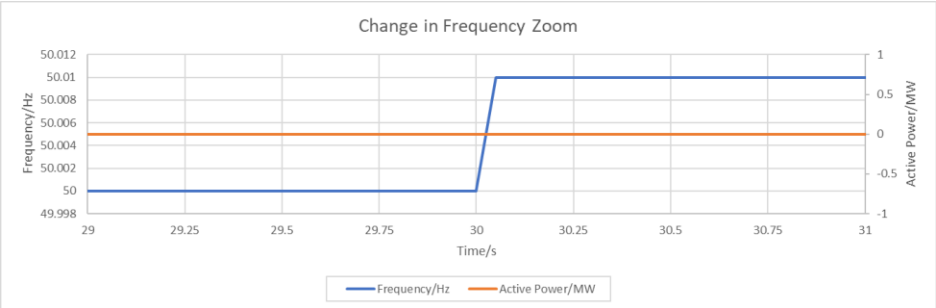

Figure 3 – Test 1.3

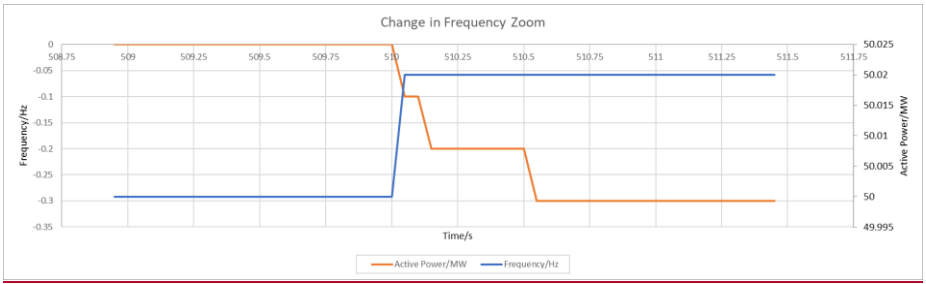

Figure 4 – Test 1.6

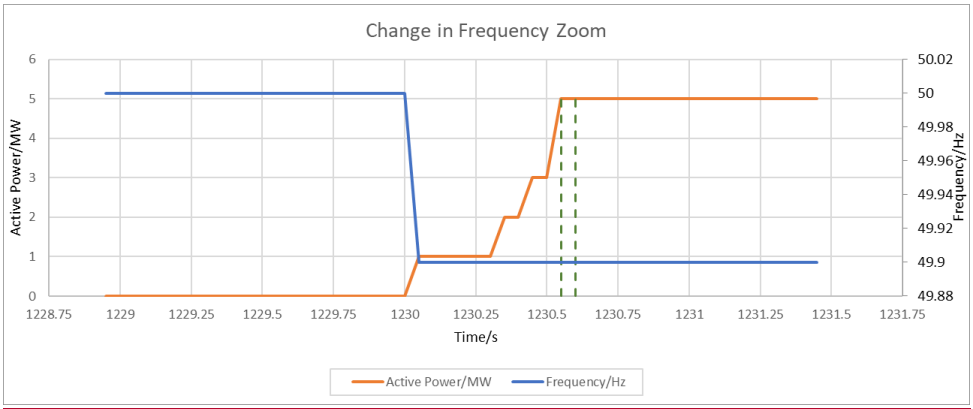

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Figure 5 – Test 1.7

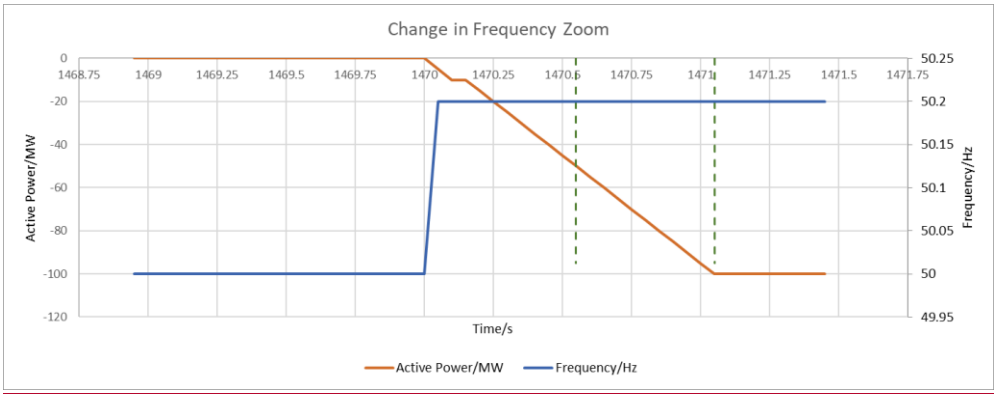

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Figure 6 – Test 2.1

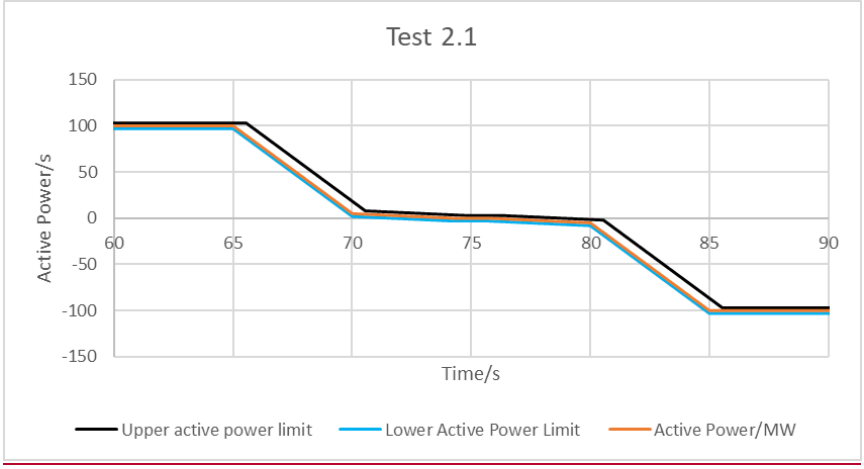

Figure 7 – Test 2.2

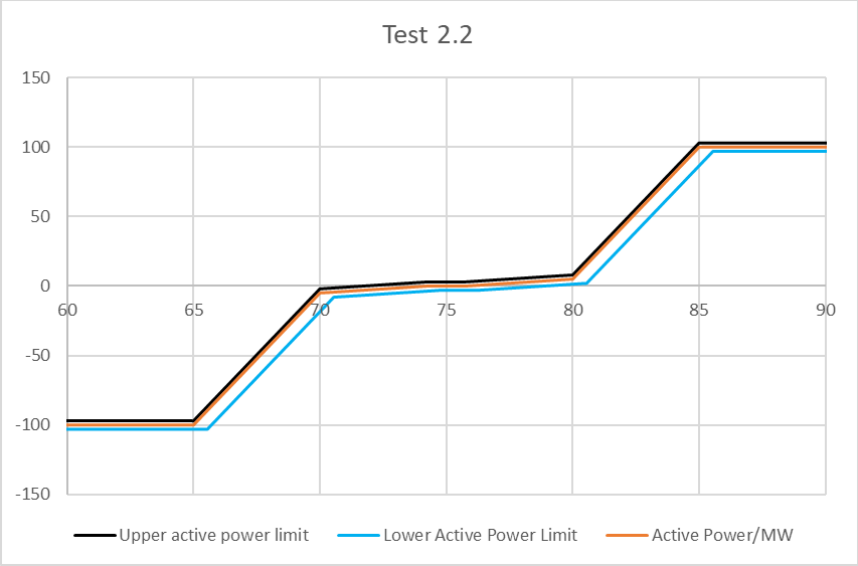

Figure 8 – Test 3.1

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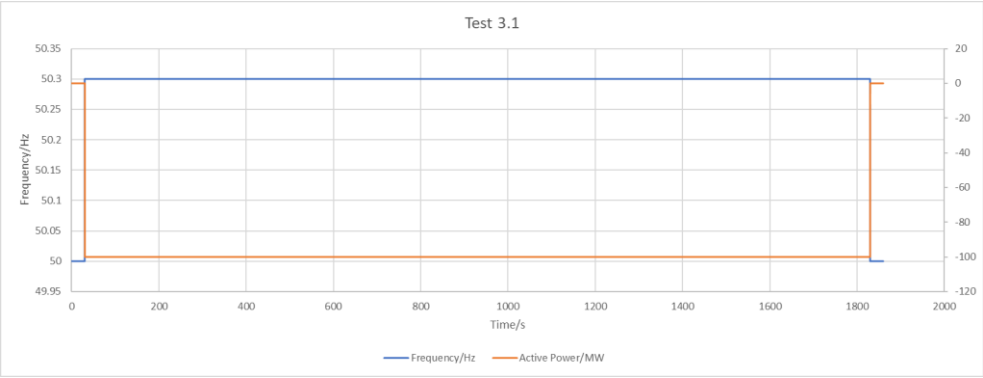


Figure 9 – Test 3.2

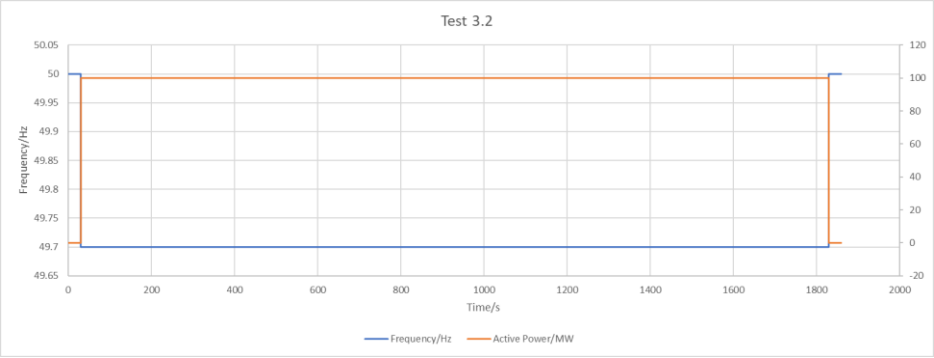
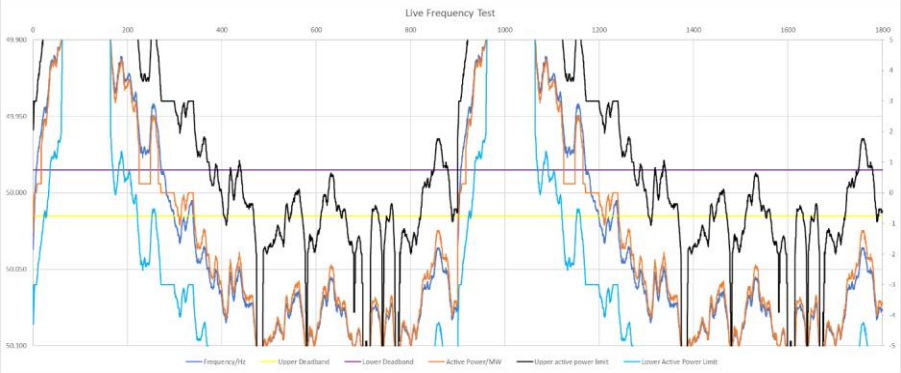


Figure 10 – Test 4



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Independent Technical Expert (ITE) Details

Company name

Primary contact name

Contact number /s

Email address

I / We confirm that I / We the following:

(e) I/We am a/are Independent Technical Expert(s) (as defined in NGESO's Response Procurement Documentation);
(f) I/We have carried out an assessment of the [asset] described above in accordance with the Testing Rules contained in that documentation;
(g) the above details are, to my/our best knowledge and belief, true, accurate, complete and not misleading; and
(h) the CV attached of my/our experience is to my/our best knowledge and belief, true, accurate, complete and not misleading.

Signed:

Date:

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Part 3 - Dynamic Regulation Test Requirements

The **Dynamic Regulation** tests assess the capability of the **Registered Response Participant** to deliver dynamic response in accordance with a **Response Contract**.

Tests 1 and 2 assess response against injected frequency profiles. Test 3 assesses response whilst connected to live system frequency. The frequency profile can be injected either at site or remotely. The minimum sample rate for Test 1 is 10Hz and for Tests 2 and 3 2Hz. See Appendix A for information on test signals.

Aggregation/Test Approach

These tests are designed to meet the **NGESO** requirement for service validation as well as being equally suitable for all types of **Plant** and **Apparatus** (both single-site or multi-site) and technology types (generation, storage, demand or a combination of same). The tests also consider how providers adding to and evolving their aggregated portfolios over time can have additional assets validated.

The three dynamic tests can assess the capability of

- A single asset
- A group of assets
- Asset/s to be added to an existing aggregated facility

Test 1 – Duration Test

The two tests described here can be carried out at the individual or group of assets level. These tests confirm the volume of response the **Plant** and **Apparatus** can deliver, and both demonstrate response within the requisite timescales as well as provision of delivery of the **Plant** and **Apparatus** for required period of the service. The sum of the demonstrated outer-envelope responses for each tested **Eligible Asset** in a **Response Unit** (being the aggregated **Registered Quantities**) constitutes (after rounding) the maximum possible **Contracted Quantity** for the **Response Unit**.

The data can be presented with the new tested volume (presented site by site) aggregated by itself, or where adding volume to an existing **Plant** and **Apparatus**, aggregated with the step test data from that existing pre-tested **Plant** and **Apparatus**.

The minimum sample rate for Tests 1.1 and 1.2 is 10Hz.

The frequency injections to be used are shown in **Table 2**, **Figure 2** and **Figure 3** below.

Table 2 - Test 1 Frequency Injection Profile

Time (s)	Injected Frequency (Hz)	
	Test 1.1	Test 1.2
0	50	50
30	50	50
30	49.8	50.2
3630	49.8	50.2
3630	50	50
3660	50	50

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Figure 2 - Test 1.1

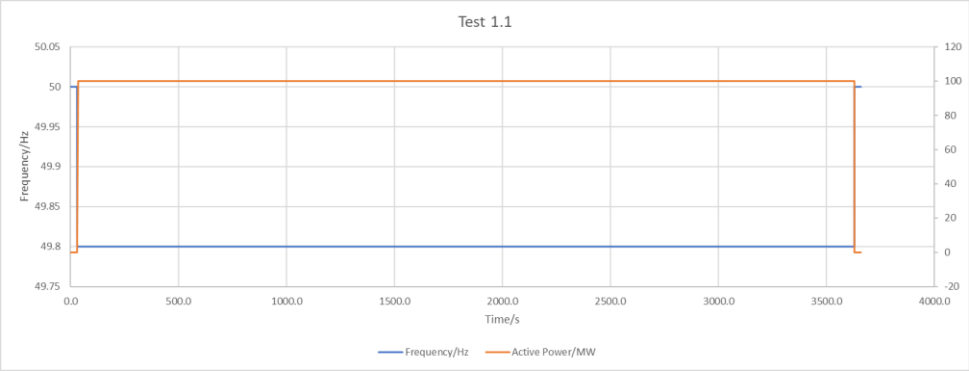
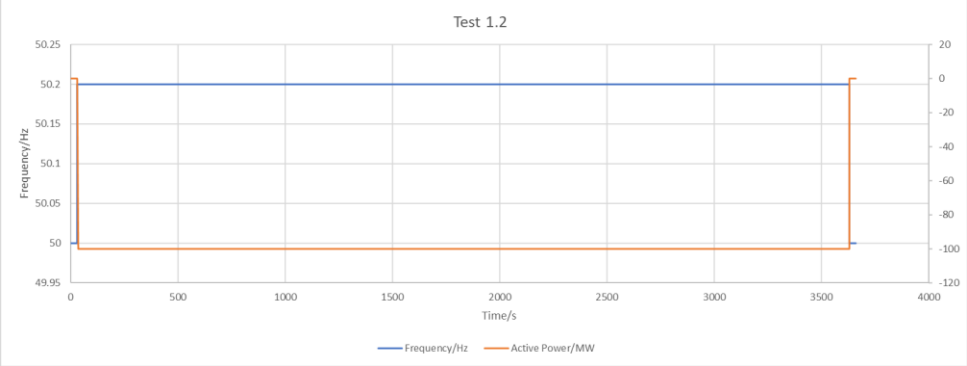


Figure 3 - Test 1.2



Assessment Criteria for Test 1

Single Asset which will be assessed as part of an aggregated facility

- Record the minimum response achieved within the 10 second to 60 minute timescale.
- How long is the response sustained? (In some cases this may be less than 60 minutes for a single asset which is part of an aggregated asset).

Pass criteria for Unit level (single asset or aggregation)

- The sum of minimum response achieved within the 10 second to 60 minute timescale constitute the total volume of the **Response Unit**. (i.e. the minimum total response achieved within each timescale).
- Delay in response of active power due to a change in frequency is no greater than 2 seconds.
- The **Plant** and **Apparatus** should monotonically progress to its maximum response.

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- The standard deviation of load error at steady state over a 60 minute period must not exceed 2.5% of the maximum contracted active power response (standard deviation is assessed from 10 seconds until 60 minutes after the frequency step).
- Sustain response for 60 minutes.
- Please note that **Registered Response Participants** can reuse existing duration tests for an asset, providing that they are for the same duration or longer and have the same MW value.

Test 2 – Response Tests

This test assesses the capability to deliver the following:

- No response inside the deadband
- Response just outside the deadband
- Proportional response at discreet frequency levels
- Response to changing frequency varying over the entire performance envelope

The minimum sample rate is 2Hz for the response tests.

Aggregation/Test Approach

Test Scenario 1: Where a volume is being tested by itself for validation, the two response tests should be carried out on the asset/s to demonstrate the response of the asset/s for the full range of frequency.

Test Scenario 2: Where a new "in-test" volume is being added to an existing (tested) volume (which it is dependent upon for compliance), the tests would be carried out within an existing aggregated asset that has been withdrawn from the market for the test period.

Table 3 - Test 2 Frequency Injection Profiles

Time (s)	Injected Frequency (Hz)		Sub-test reference for assessment
	Test 2.1	Test 2.2	
0	50	50	
30	50	50	
30	49.99	50.01	a
60	49.99	50.01	a
60	49.98	50.02	b
90	49.98	50.02	b
90	49.9	50.1	c
120	49.9	50.1	c
120	49.8	50.2	d
150	49.8	50.2	d
150	49.7	50.3	e
180	49.7	50.3	f
195	50	50	f
210	50.3	49.7	f
240	50.3	49.7	
240	50	50	
270	50	50	

Figure 4 - Test 2 Injection Profile

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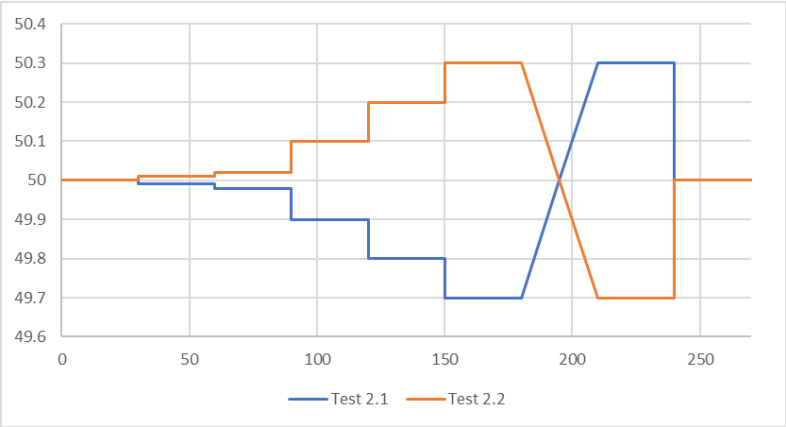

Pass Criteria for Tests 2.1 and 2.2

- For 2.1a and 2.2a the **Plant** and **Apparatus** should not provide any response within the deadband save that, as referred to in paragraph 6.11 vi of the **Response Service Terms**, a **Response Unit** which is not **Energy Limited** may deviate from its **Operational Baseline** whilst **System Frequency** is within such "deadband" to the extent it is providing equivalent **Mode A Frequency Response** up to the **Contracted Quantity**. Where there are any non-zero values here these need to be explained by the ITE in the test report using the comments field.

- Tests 2.1b and 2.2b a noticeable change in power in the correct direction is observed. This test ensures that the **Plant** and **Apparatus** will respond to small frequency deviations outside the deadband.

- For ±0.1Hz, ±0.2Hz and steps ±0.3Hz (Tests c, d and e) the response values achieved are proportional. Also ±0.3Hz sections should reflect total maximum volume from Test 1. For each 30 second step the minimum response from 10-30 seconds should be assessed against the contracted delivery volume.

- For Test 2.1f and 2.2f, active power response is within the tolerances in Table 4 (Figure 5 and Figure 6). (Performance monitoring criteria used to calculate tolerance bands).

Table 4 - Test 2 Tolerances (Without time delay to reach required delivery included)

Frequency Deviation (Hz)	**Expected Response (Percentage of maximum)**	**Tolerance (Percentage of Maximum Contracted)**
0.01	n/a	n/a
0.02	*	*
0.1	~50**	± 5%
0.2	100	± 5%

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0.3	100	± 5%

**At 0.1% the actual expected response is 45.9459% due to linear delivery between 0.015Hz (deadband) to 0.2Hz

Figure 5 - Test 2.1 Tolerance

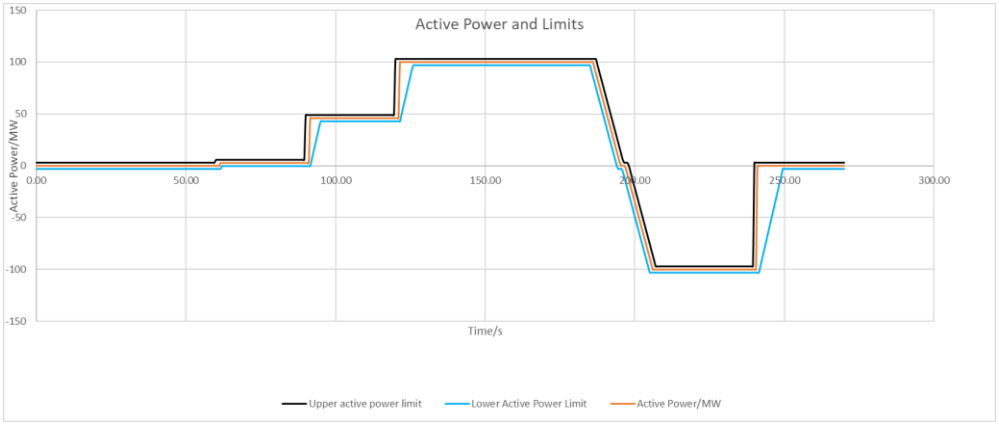
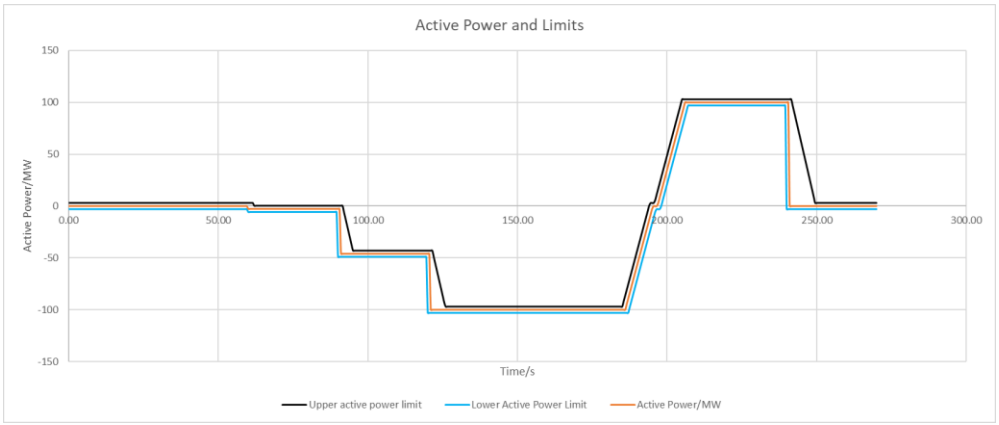


Figure 6 - Test 2.2 Tolerance



Test 3 – Live System Frequency Response Test

Test 3 assesses the response of the **Plant** and **Apparatus** to system frequency in a live environment. The minimum sample rate for this test is minimum 2Hz and duration is 1 hour where system frequency and active power response will be recorded. As part of test 3, you are required to provide evidence that the protection settings are in line with the Grid Code (± of 5% of 50Hz).

Aggregation

The options for the live test are as follows.

1. A single asset capable of meeting the DR service specification on its own.

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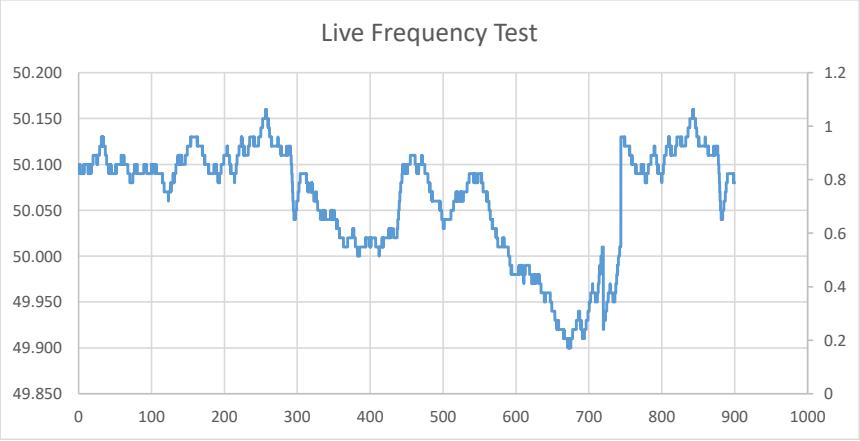
2. A group of 'new' assets capable of meeting the DR service specification can be tested simultaneously. These could then contract as a standalone Response Unit or be added to an existing Response Unit.
3. New asset/s to be added to an existing Response Unit can carry out a live test where the new "in-test" assets would be added to the existing Response Unit and run following the system frequency (equivalent of being in-market) for a period of 1 hour. (See Appendix E for further details).

Pass Criteria for Test 3

- Provide an active power response consistent with the contracted performance within timescales.

- Provide evidence protection settings comply with Grid Code.

Figure 7 - Sample System Frequency



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Appendix A – Test Signals

The limits of error and minimum sample rates for testing are shown below in **Table 5**. All success criteria are subject to the stated limit of error/accuracy threshold.

Table 5 - Limits of error and minimum sample rates for Dynamic Regulation Testing

	Limit of error/ Accuracy threshold	Minimum Sample rate Test 1	Minimum Sample rate Tests 2 and 3
Injection Frequency (Hz)	±0.01 Hz	10Hz	2Hz
Active Power (MW)	Please see pass criteria	10Hz	2Hz

Simulations / simulated tests are not permitted. Each test submitted must record real time data from the plant and sites under test: The test data submitted must come from the specific site to be contracted; substituted data will not be accepted. Test results must not be changed before submission for analysis.

Test Signals

In ALL cases, the data should record ALL required signals for at least 30 seconds BEFORE the application of the frequency injection signal and for at least 30 seconds AFTER the completion of the test.

For ALL services, the data for the following signals will need to be provided

i) Time
j) Active Power
k) System Frequency or Injected frequency as appropriate
l) Any other relevant signals that may affect the success criteria such as Relay Logic for non-dynamic.

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Appendix B - Dynamic Regulation Test Data Format

Table 6 - Sample Dynamic Regulation Test Data Format

Time/s	Injected Frequency/s	Measred Power/MW
0.0	50.00	0.00
0.5	50.00	0.00
1.0	50.00	0.00
1.5	50.00	0.00
2.0	50.00	0.00
2.5	50.30	5.00
3.0	50.30	5.00
3.5	50.30	5.00
4.0	50.30	5.00
4.5	50.30	5.00
5.0	50.30	5.00
5.5	50.30	5.00
6.0	50.00	0.00
6.5	50.00	0.00
7.0	50.00	0.00
7.5	50.00	0.00
8.0	50.00	0.00

- Frequency Injection should be to 2 decimal places
- Measured Power should be to 3 decimal places
- Measured frequency for test 3 should be to 3 decimal places

Further columns can be added to include data for several sites if required.

For Test 3 replace 'Injected Frequency' with 'Measured Frequency'.

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Appendix C - Dynamic Regulation Test Assessment

Excel Analysis Tool published with User Guide.

See Test certificate template in Appendix D for further guidance.

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Appendix D – Dynamic Regulation Test Certificate Template

Please use this Test Certificate format and submit to NGESO, along with the test data and CV of the ITE employed by the prospective response provider.

Prospective Response Provider Company Details

Contracted company name	
Primary contact name	
Contact number/s	
Email address	

Contract Details

Contract ID	
Service type	
Asset type, e.g. battery	
Unit make up, e.g. single or aggregated	*Describe here what is included in this test e.g. Single asset, group of assets, asset/s being assessed within an existing Unit.*
Aggregation methodology (if appropriate)	
Unit location / ID	
Do any assets associated with this report have a condition in their DNO connection agreement whereby they are signed up to an Active Network management (ANM) Scheme / Flexibility Connection? **If yes, please ensure contracted party speaks to their ESO account manager.**	
Contract signed date	
Service start date	
Test date	

Dynamic Service Details *(example here is for a 5MW Unit)*

Deadband	±0.015Hz
Response / MW	5

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Test Results

Further relevant test description/commentary here

Test	Pass Criteria	Pass/Fail	Comment
Single Asset which will be assessed as part of an aggregated facility			
1	Record the minimum response achieved within the 10second to 30minute timescale.	N/A	Note result here (See Figure …)
1	Record how long is the response sustained	N/A	Note result here. (Some assets which are part of an aggregated unit may not be able to maintain response for 30 minutes.)
Pass criteria for Unit level (single asset or aggregation)			
1	Delay in response of active power due to a change in frequency is no greater than 2 seconds.	Pass	a response was observed within 2 seconds of the frequency change. This is illustrated in Figure …
1	Record the minimum response achieved within the 10second to 30minute timescale.	Pass	Record result here. Should align with the in-test volume in Table 1.
1	The Unit should monotonically progress to its maximum response.	Pass	Refer to Figures below.
1	The standard deviation of load error at steady state over a 60 minute period must not exceed 2.5% of the maximum contracted active power response.	Pass	Standard deviation is assessed from 10 seconds until 60 minutes after the frequency step.
1	Sustain response for 60 minutes.	Pass	
2.1a 2.2a	No response within the deadband	Pass	
2.1b 2.2b	A noticeable change in power in the correct direction is observed.		
2.1,2.2 c,d,e	For ±0.1Hz, ±0.2Hz and steps ±0.3Hz (Tests c, d and e) the response values achieved are proportional.	Pass	
2.1c-f 2.2c-f	Active power response is within the allowed tolerances.	Pass	Show in figure below with tolerance bands overlaid.

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3	Provide an active power response consistent with the contracted performance timescales.	Pass
	Overall Test Result	**PASS**

Test Result Graphs

Plot frequency injection and active power response vs time for each test.

Figure 1 – Test 1.1

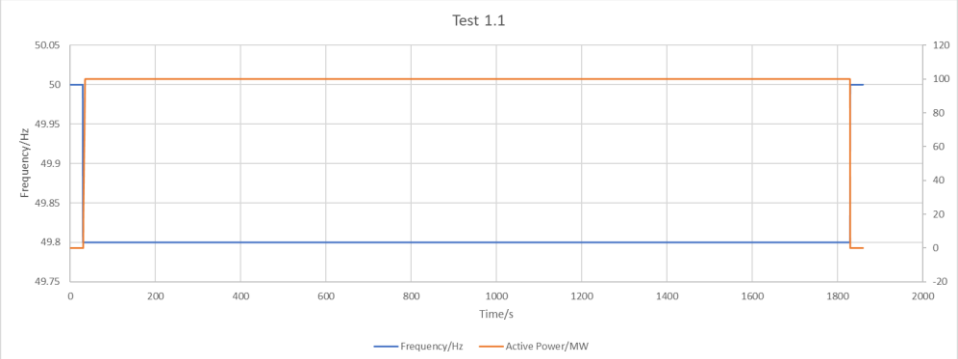

Figure 2 – Test 1.1 Change in Frequency Zoom

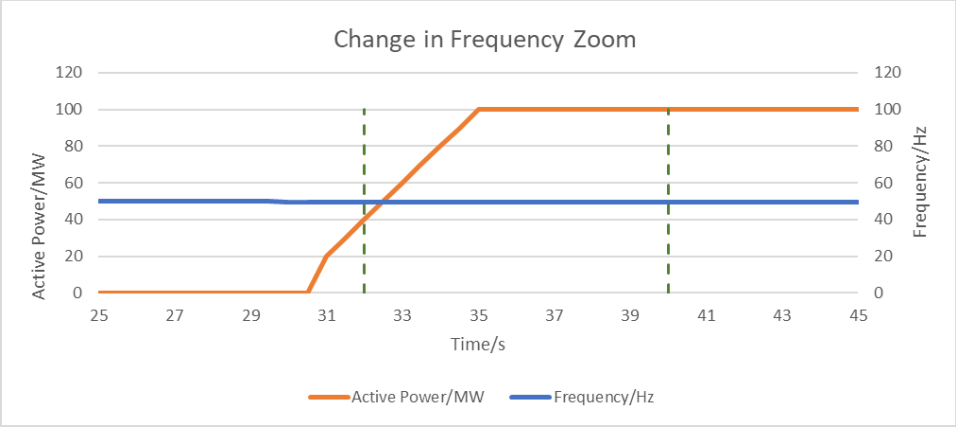

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Figure 3 – Test 1.2

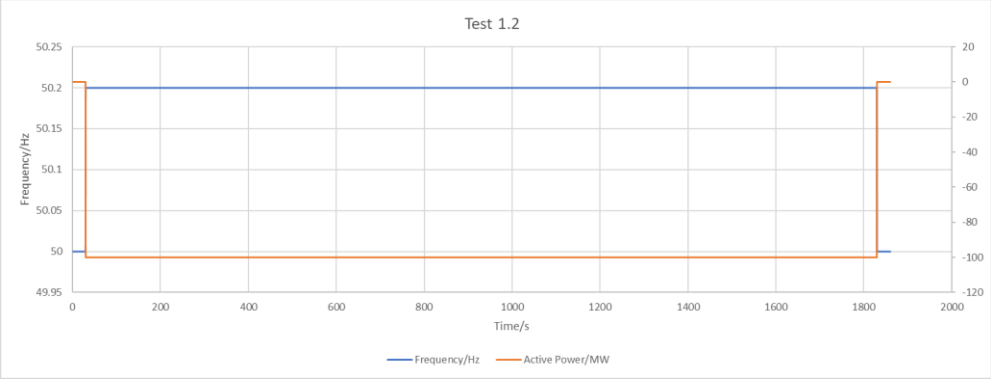

Figure 4 – Test 2.1

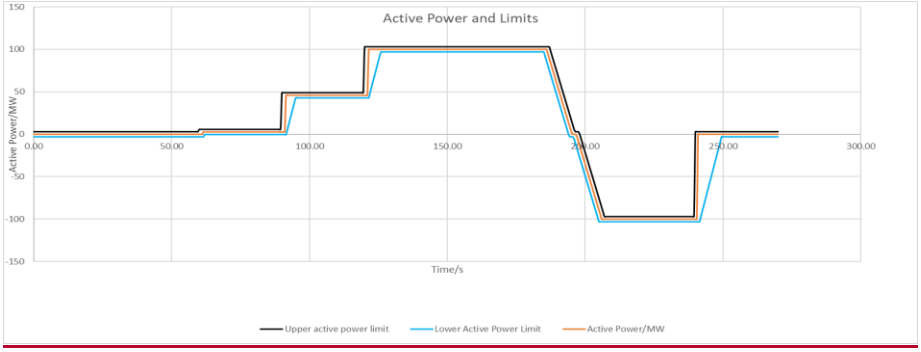

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Figure 5 – Test 2.2

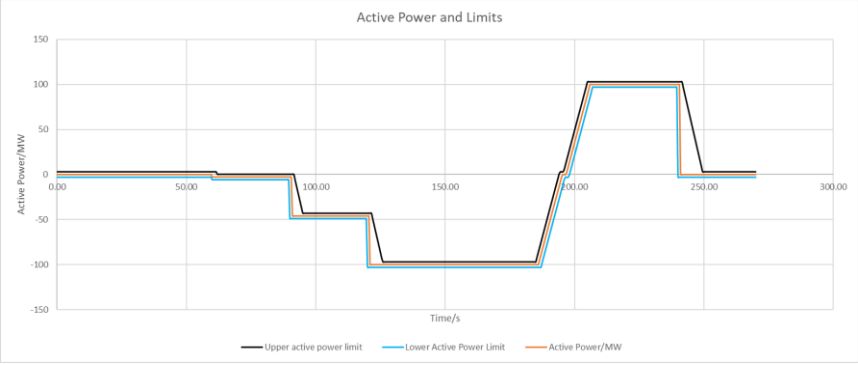
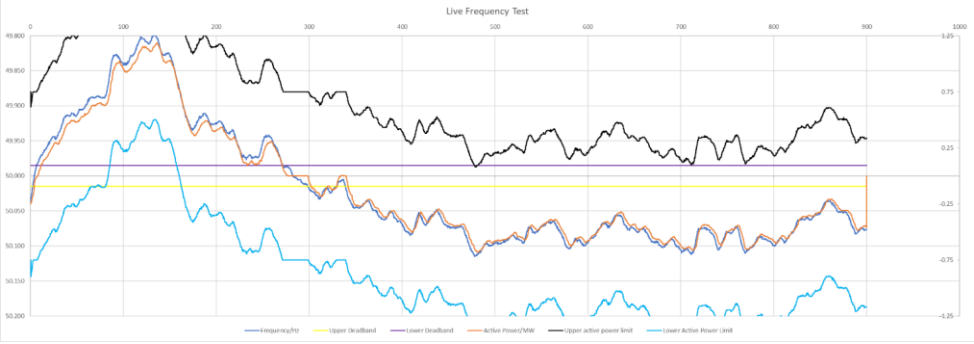


Figure 6 – Test 4



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Independent Technical Expert (ITE) Details

Company name

Primary contact name

Contact number /s

Email address

I / We confirm that I / We the following:

(a) I/We am a/are Independent Technical Expert(s) (as defined in NGESO's Response Procurement Documentation);
(b) I/We have carried out an assessment of the [asset] described above in accordance with the Testing Rules contained in that documentation;
(c) the above details are, to my/our best knowledge and belief, true, accurate, complete and not misleading; and
(d) the CV attached of my/our experience is to my/our best knowledge and belief, true, accurate, complete and not misleading.

Signed:

Date:

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Appendix E – Test 3 Approach

The options for the live test are as follows.

1. A single asset capable of meeting DR criteria on its own. The single asset would be run following the system frequency (equivalent of being in-market) for a period of 1 hour
2. A group of 'new' assets capable of meeting DR criteria can be tested simultaneously. The 'new' assets would be aggregated and run following the system frequency (equivalent of being in-market) for a period of 1 hour. This would validate that the volume responds as required to system frequency in a live environment. This group of assets could then contract as a standalone unit or be added to an existing DR Unit.
3. New asset/s to be added to an existing DR Unit can carry out a live test where the new "in-test" assets would be added to the existing DR Unit and run following the system frequency (equivalent of being in-market) for a period of 1 hour. Where the new "in test" assets were being added to a DR Unit already in market, then they should be combined and aggregated with the live "in-market" unit to show the overall portfolio operating as required based on the "in-market" and "in-test" combined volume. The existing portfolio does not need to be withdrawn from market during this test but NGESO should be informed.

The test approach, described in option 3 above, would be carried out for an agreed 1-hour period with NGESO. This agreement will detail what assets are being added to the portfolio and the expected resulting change from its standard operation. For example, if six assets adding up to a 2MW total were added to a 10MW portfolio, the portfolio would usually be expected to behave like a 12MW portfolio. This validates that the combined volume responds as required against the system frequency in a live environment.

Data submission for this test shall include the frequency, response of the existing portfolio, response of each new asset in the new combined portfolio, and the combined total response of the portfolio.

If testing for Option 3, above, the frequency data and combined "in-test" and "in-market" volume response data would be submitted for validation

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SCHEDULE 6 – INDEPENDENT TECHNICAL EXPERT: DEFINITIONS

Test results for all **Response Services** will be assessed by an **Independent Technical Expert** (ITE) who will prepare a **Test Certificate.**

The following definitions shall apply:

Group means, for any person, another person who is the direct or indirect **Holding Company** of that person and any **Subsidiary** of that **Holding Company**.

Holding Company means, in relation to a company, any other company in respect of which it is a **Subsidiary**.

Independent Technical Expert means an experienced technical expert with expertise in the operation of demand side response (DSR) or generating units or electricity Interconnectors (as the case may be), **Independent** of the prospective response provider, engaged by the prospective response provider at its expense to carry out a technical assessment and prepare a **Test Certificate.**

Independent means, for any technical expert and the applicable prospective response provider, that the technical expert is:

(a) not in the same **Group** as the prospective response provider; and

(b) neither engaged on terms, nor party to any other arrangements, which could allow the prospective response provider or any member of its **Group** to exercise undue influence on any assessment of the **Test Certificate** prepared by that technical expert or otherwise compromise the objectivity of any such assessment and test certificate to the **Required Technical Standard**.

Required Technical Standard means, with respect to any assessment and **Test Certificate** prepared by an **Independent Technical Expert** that:

(a) to the best of the **Independent Technical Expert**'s knowledge and belief all information provided in it is accurate, complete and not misleading; and

(b) any opinions or forecasts in the assessment have been conservatively prepared on assumptions which it considers to be fair and reasonable.

Subsidiary means a subsidiary within the meaning of section 1159 of the Companies Act 2006 (but relation to an Interconnector, or shareholder in such provider, subsection (1)(a) of that section shall apply as if a "majority of the voting rights" included 50% only of those rights)

Test Certificate means a certificate in the relevant form set out in Schedule 5 prepared by an **Independent Technical Expert**.

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