Unlocking Stacking of BOAs with Frequency Response Services

This document explains how the ESO and energy limited providers can unlock stacking of the new Dynamic Frequency Response (DFR) services (Dynamic Containment (DC), Dynamic Moderation (DM) or Dynamic Regulation (DR)) with bid-offer acceptances (BOAs) in the Balancing Mechanism (BM).

1. Service stacking principles

- Stacking means the simultaneous delivery of two or more services
- It is not permitted to stack two different DFR services together - i.e. DC+DM, DM+DR, etc
- Stacking of a single DFR with the BM is permitted and is explained in detail in this document

To participate in service stacking a provider will need to:

- Ensure EDL and EDT connections (or wider access API) are working;
- Ensure all necessary PN data and commercial data (bid-offer pairs) is submitted in line with BM gate closure timings;
- All Dynamic Data (MEL, MIL, SEL etc.) is submitted showing correct unit availabilities and available volumes. This data can also be submitted in real-time/within the BM gate closure;
- Ensure telephone contact methods are working and available;
- Ensure possibility to receive BOAs manually via telephone if required (this is the backup method if EDL is unavailable);
- Ensure that any data or BOA issues are reported via telephone to the NGESO Control Engineer as soon as possible. **Please note that all BOA rejections, including automatic rejections by a control system, must be immediately followed up by a telephone call from the operator to the NGESO Control Engineer explaining the reason for rejection (this is a 24/7 requirement under the Grid Code).**

Questions

If you have any questions, please contact the team at:
box.futureofbalancingservices@nationalgrideso.com

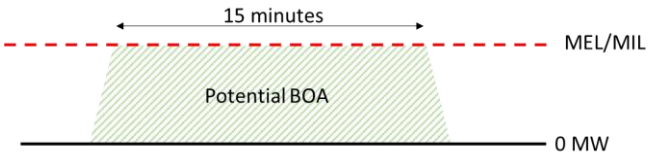
2. Existing principles for energy limited providers in the BM

The Balancing Mechanism (BM) system architecture has some limitations in its representation of storage assets. ESO are working towards developing system solutions to factor real time stored energy capacity/capability of energy storage assets within the BM. Until this work is delivered, ESO

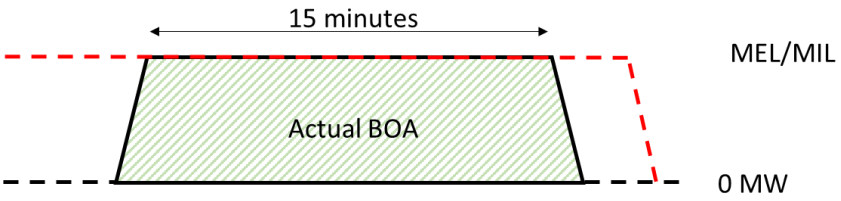
are operating the below principles for energy limited assets within the BM (the rest of this document will use battery energy storage as an example).

The examples below illustrate how battery Balancing Mechanism Units (BMUs) are accessed in the BM. The examples operate on the principle that battery BMUs should be able to operate at their Maximum Export Limit (MEL)/Minimum Import Limit (MIL) for at least 15 minutes.

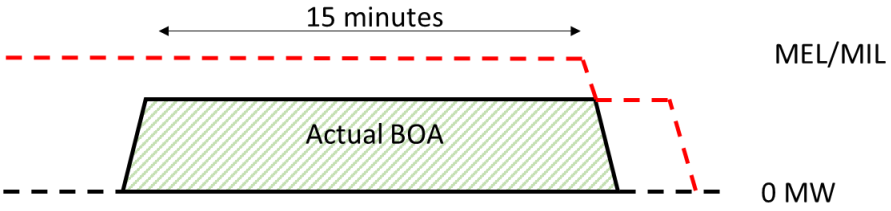
- Battery BMUs should declare their MEL and MIL open-ended such that it reflects the capacity to follow a Bid Offer Acceptance (BOA) which ramps from the current Physical Notification (PN) to the MEL or MIL and remains at the MEL or MIL for a duration of 15 minutes before ramping back to the Physical Notification. Ramping rate to be the Run Up Rate (RUR) or Run-Down Rate (RDR) as applicable.



- If a BOA is issued to MEL/MIL, the State of Energy should be recalculated, and the MEL or MIL should be redeclared as soon as possible starting from the point at which the current MEL/MIL level could not be sustained if the BOA were to be extended. This redeclaration will be a minimum of 17 minutes from the first point of instruction (15 minutes duration and 1-minute ramp either side) but may be longer.



- If a BOA is issued which part-loads a unit below MEL/MIL, then the above principle should also be applied for a subsequent MEL/MIL based upon the State of Charge at the end of the current BOA. The MEL/MIL should remain at the original level for the first 16 minutes of the BOA (reflecting the 1-minute ramp and 15-minute duration), and then drop to the new level no sooner than the end of the BOA.



- On returning to PN, the BMU should resubmit their MEL/MIL as per the first bullet point.

Should any of these principles contradict with the Grid Code at any point, then the Grid Code will take precedence.

3. DFR and BM interaction

For the ESO, DFR services are crucial to operational security so we will take a cautious staged approach to implementing BM stacking. Providers of DFR wishing to participate in the BM should ensure that any BM activity does not unintentionally erode or compromise the ability to deliver their DFR obligations.

General principles

1. **Maximum Export Limit (MEL) and Minimum Import Limit (MIL)** - these should reflect the physical capability of the unit.
2. **Bid-Offer Data (BOD)** - pricing data can be used to 'price out' tranches of capability to indicate that the unit committed that quantity to the DFR service.
3. **Stable Export Limit (SEL) and Stable Import Limit (SIL)** - these should reflect the physical capability of the unit.
4. **Operational Baseline (OB)** - this should match the Physical Notification.
5. **Notice to Deliver Offers (NTO) and Notice to Deliver Bids (NTB)** - we advise a minimum of 1 minute, but this can remain at the discretion of the providing units.
6. **Run-Up Rate (RUR) and Run-Down Rate (RDR)** - we have updated the service terms to make it clear that the baseline ramp-rate rules will not apply to baselines adjusted by BOAs. So RUR and RDR can remain as technical parameters.

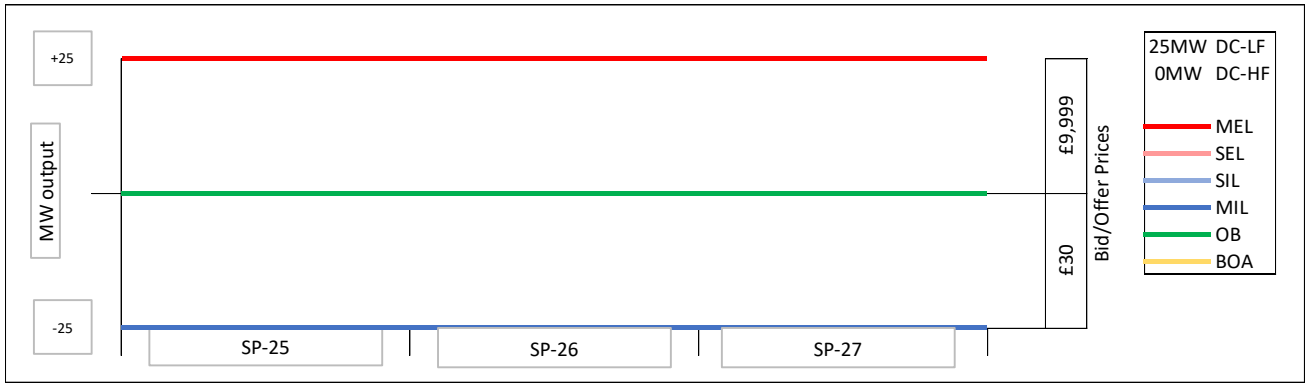
Worked examples to support

These worked examples use Dynamic Containment as the DFR service but the rules and guidance apply equally to Dynamic Moderation and Dynamic Regulation.

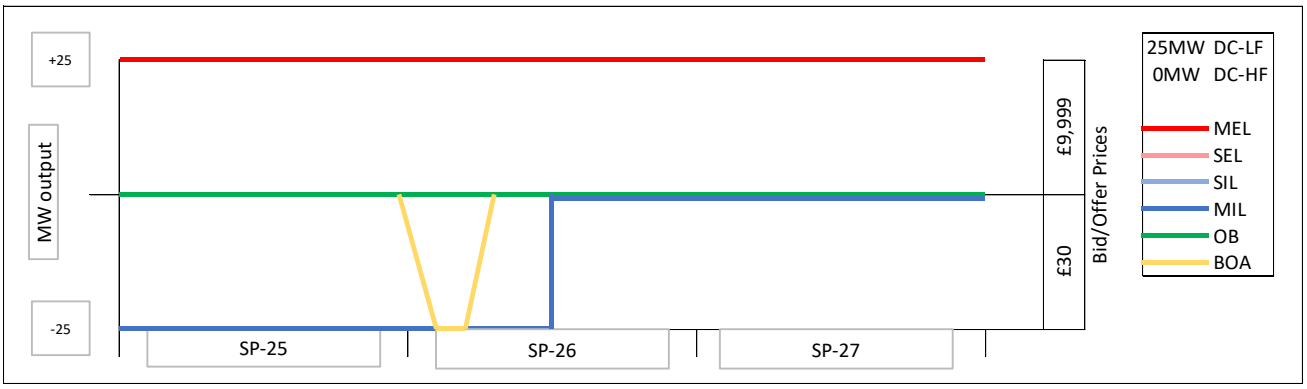
Scenario 1: DC-LF only contract, BM bids (to charge) only

The opportunity here is for the provider to offer and the ESO to access downwards BM actions (bids). These bids may be competitively priced as they allow the DC providing unit to re-charge following depletion when providing DC-LF.

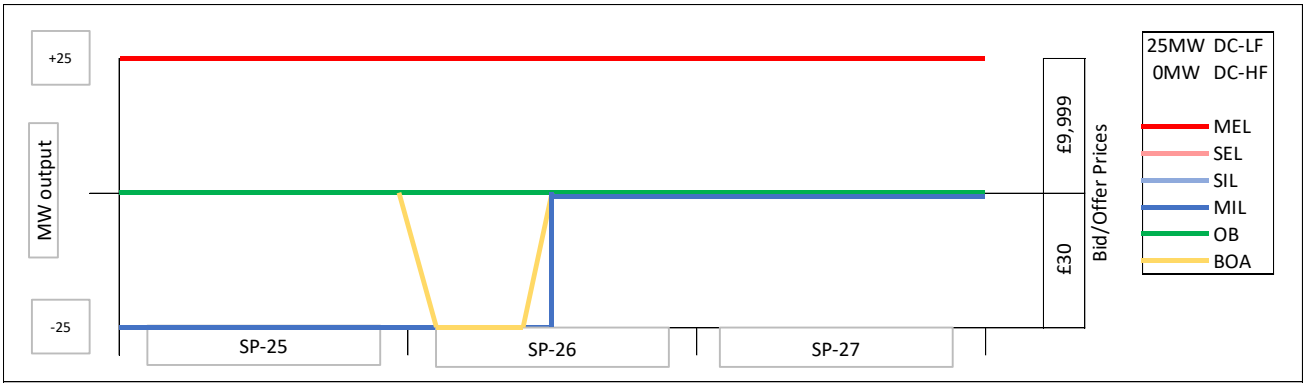
1. The MEL and MIL reflect the physical capability of the unit and comply with the existing BM principles for battery storage in the BM (specifically, output at the MEL or MIL could be sustained for at least 15+2 minutes).
2. BOD pricing is used to indicate that the unit should not receive offers (£9999 offer price) as the output quantity has been reserved for provision of DC. The bid price is competitive to indicate that the unit may receive bids.
3. SEL and SIL reflect the physical capability of the unit and will be expected to be at 0MW.
4. The OB follows its normal course and can be expected to be at or around zero in most cases.



The ESO issues a short (<15 min) BOA bid from (PN to MIL) to the unit which is accepted. Following BOA acceptance, the BMU re-declares its MIL in-line with the principles described in the section above. The MIL is re-declared at a point at least 15+2 minutes after the point of instruction.



If the BOA was issued at maximum length for a battery BMU, the unit may re-declare its MIL at the point where the BOA ends as shown below for a 15+2min BOA.



Scenario 2: DC-HF only contract, BM offers (to discharge) only

The opportunity here is for the provider to offer and the ESO to access upwards BM actions (offers). These offers may be competitively priced as they allow the DC providing unit to discharge following charging when providing DC-HF.

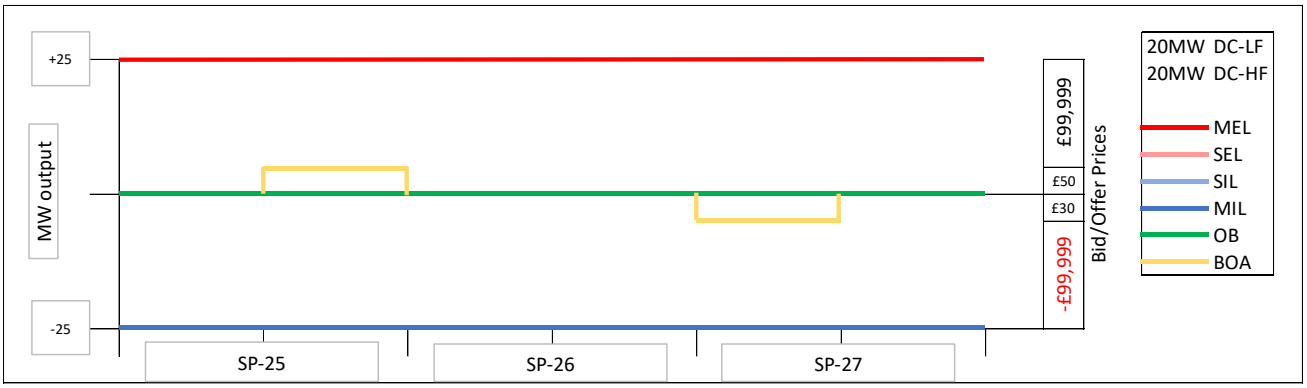
1. The MEL and MIL reflect the physical capability of the unit and comply with the existing BM principles for battery storage in the BM (specifically, output at the MEL or MIL could be sustained for at least 15+2 minutes).
2. BOD pricing is used to indicate that the unit should not receive bids (£9999 bid price) as the charging quantity has been reserved for provision of DC-HF. The offer price is competitive to indicate that the unit may receive offers.
3. SEL and SIL reflect the physical capability of the unit and will be expected to be at 0MW.
4. The OB follows its normal course and can be expected to be at or around zero in most cases.

The examples in this scenario would look exactly the same as for scenario 1, except inverted to show offers (rather than bids) and a changing MEL (rather than MIL).

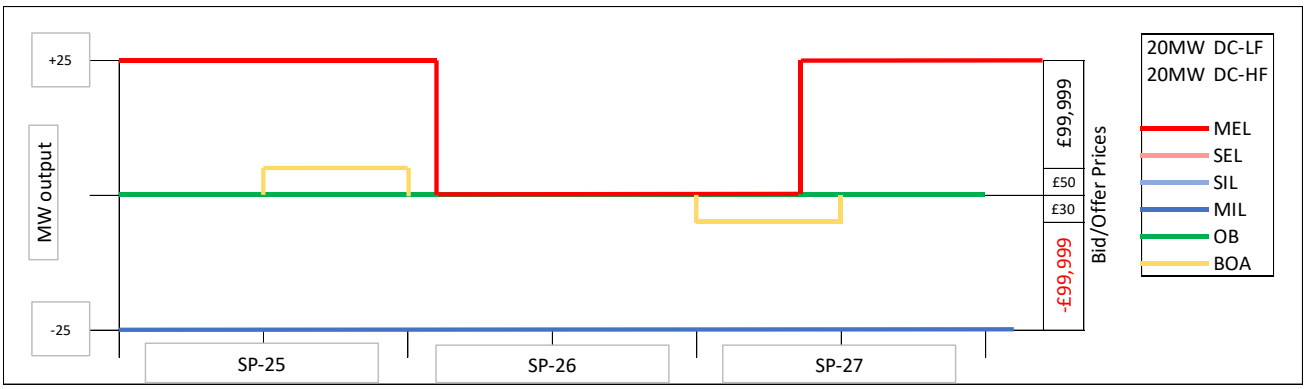
Scenario 3a: DC-LF and DC-HF contract, available for BM bids and offers - no erosion of response capability (ACTIVE - see key principles below)

The opportunity here is for the provider to offer and the ESO to access both upwards and downwards flexibility while avoiding any erosion of the unit's capability to deliver response. This example is more complex and relies upon pricing the offer and bid volume in tranches.

1. The MEL and MIL still reflect the physical capability of the unit and comply with the existing BM principles for battery storage in the BM (specifically, output at the MEL or MIL could be sustained for at least 15+2 minutes).
    a. Note in this example that the unit is providing 20MW of DC-LF and DC-HF but has a MEL and MIL of +25MW and -25MW respectively. Some headroom/footroom is required for the unit to manage SoE. The amount will vary per asset and contract quantity but all the headroom can be made available in the BM.
2. There are two tranches to the BOD for both offers and bids. The first 5MW (the headroom/footroom) is priced competitively. The remaining MW to MEL/MIL is priced at +/- £99999.
    a. This extreme pricing is used to indicate to ESO that the MW quantity above the headroom/footroom is required for delivery of response and any BOA issued into that range would erode provision of that response.
3. SEL and SIL reflect the physical capability of the unit and will be expected to be at 0MW.
4. The OB follows its normal course and can be expected to be at or around zero in most cases.



A simple case shown above where the issue of BOAs (one offer and one bid) does not require the unit to redeclare its MEL or MIL. The same BOA instructions are shown below but including a MEL to zero to reflect that the unit cannot accept any additional BOA offers.

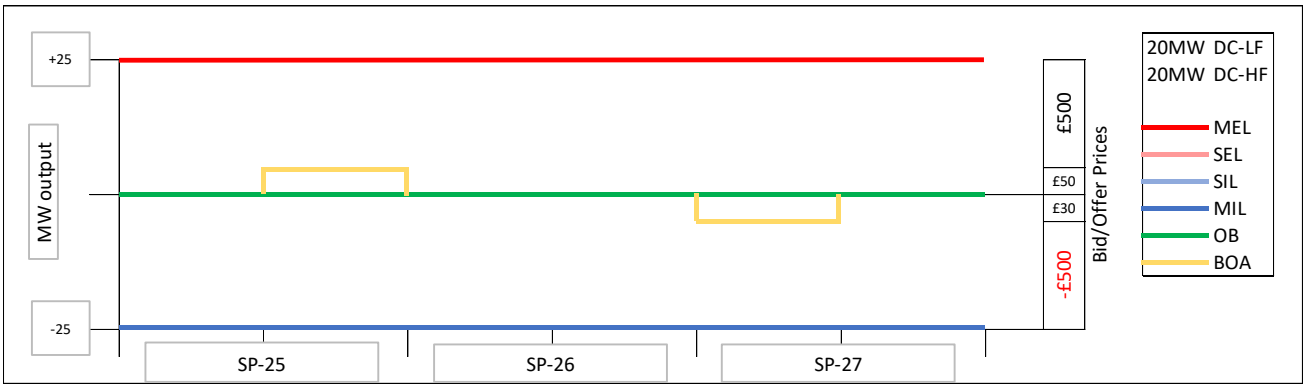


The MEL is redeclared to a positive value (+25MW in this example) when the unit is confident that the stored energy has returned to a level that would allow the unit to receive another offer acceptance of at least 15+2 minutes. In the example above, the issuing of a BM bid assists the unit in recovery of its stored energy.

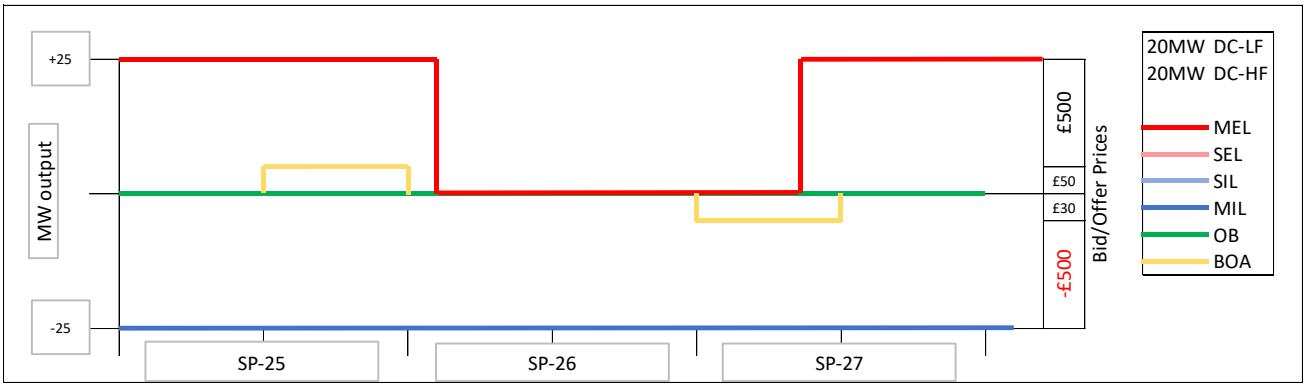
Scenario 3b: DC-LF and DC-HF contract, available for BM bids and offers - with erosion of response capability (INACTIVE - see key principles below)

The opportunity here is for the provider to offer and the ESO to access both upwards and downwards flexibility. This example is more complex and relies upon pricing the offer and bid volume in tranches.

1. The MEL and MIL still reflect the physical capability of the unit and comply with the existing BM principles for battery storage in the BM (specifically, output at the MEL or MIL could be sustained for at least 15+2 minutes).
    a. Note in this example that the unit is providing 20MW of DC-LF and DC-HF but has a MEL and MIL of +25MW and -25MW respectively. Some headroom/footroom is required for the unit to manage SoE. The amount will vary per asset and contract quantity but all the headroom can be made available in the BM.
2. There are two tranches to the BOD for both offers and bids. The first 5MW (the headroom/footroom) is priced competitively. The remaining MW to MEL/MIL is priced at the opportunity cost of the DC availability fee.
    a. The opportunity cost here is shown as £500 but will of course depend on the clearing price of DC. The advantage is that the unit can still offer its full flexibility to the ESO but only at a cost that indicates the ESO would be eroding provision of DC and at a cost that compensates the unit for lost DC availability fee.
3. SEL and SIL reflect the physical capability of the unit and will be expected to be at 0MW.
4. The OB follows its normal course and can be expected to be at or around zero in most cases.



A simple case shown above where the issue of BOAs (one offer and one bid) does not require the unit to redeclare its MEL or MIL. The same BOA instructions are shown below but including a MEL to zero to reflect that the unit cannot accept any additional BOA offers.

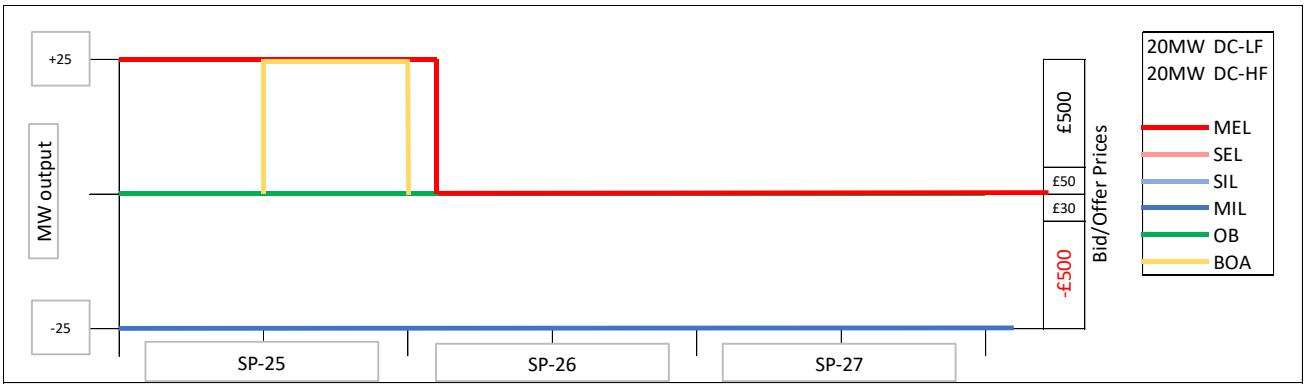


The MEL is redeclared to a positive value (+25MW in this example) when the unit is confident that the stored energy has returned to a level that would allow the unit to receive another offer

acceptance of at least 15+2 minutes. In the example above, the issuing of a BM bid assists the unit in recovery of its stored energy.

In the example below, the ESO has issued a BOA for the full capacity of the unit. It pays up to £500/MWh according to the submitted price data. During the period of the BOA and until the stored energy is replaced the unit is unavailable to deliver its contracted Dynamic Containment (low frequency) obligation. The unit will forfeit its availability fee (for DC-LF) for this duration.

The unit has MEL'd to zero and, following the principles of SoE management in the service terms, will be expected to re-baseline at the next opportunity to recover its stored energy.



The key principles:

- MEL and MIL should always reflect the enduring principles for energy storage participation in the BM. This means that the MEL/MIL quantity should be sustainable for 15 minutes.
- A MEL or MIL 'to zero' will indicate to the ESO control room that the unit is not available for BOAs.
- Unavailability of Dynamic Containment should be communicated directly to the ESO control room via the methods laid out in the Service Terms.
- Any bid/offer acceptance does not remove the contractual obligation to deliver Dynamic Containment
    - A unit can offer its full capacity in the BM but should be prepared to forfeit its Dynamic Containment availability fee if any bid/offer acceptance effectively erodes its capability to deliver the contracted quantity of Dynamic Containment.
- Performance monitoring will be based on the BM-adjusted baseline - i.e. the PN + any BOA
- In line with our approach to gradually introduce service stacking, we ask that providers follow the advice given in example 3a (i.e. to avoid erosion of response) when offering LF+HF together.
    - The approach described in example 3b will be made available to providers once the ESO is satisfied with the performance of response services during stacking with the BM.

4. Performance data submissions

Performance data is submitted through an API service as CSV files. The operational baseline needs to be adjusted to reflect the BOA. Providers should add/subtract the BOA quantity from their original operational baseline.

In the future, we intend to add an additional column to the performance reporting file specifically to record delivered BOA quantities. Any changes such as this will follow the normal consultation approach before being implemented.

The table below illustrates how an operational baseline of 0MW may be updated to reflect a BOA acceptance. The unadjusted baseline would normally be flat at 0MW.

unit	t	f_hz	baseline_mw	p_mw	soe_import_mwh	soe_export_mwh	availability
ABCDE	2020-08-04T12:29:00.850Z	50.0	0	0	25.0000	25.0000	1
ABCDE	2020-08-04T12:29:00.900Z	50.0	0	0	25.0000	25.0000	1
ABCDE	2020-08-04T12:29:00.950Z	50.0	0	0	25.0000	25.0000	1
ABCDE	2020-08-04T12:30:00.000Z	50.0	0	0	25.0000	25.0000	1
ABCDE	2020-08-04T12:30:00.050Z	50.0	-0.0208	-0.0208	25.0000	25.0000	1
ABCDE	2020-08-04T12:30:00.100Z	50.0	-0.0416	-0.0416	25.0000	25.0000	1
ABCDE	2020-08-04T12:30:00.150Z	50.0	-0.0624	-0.0624	25.0000	25.0000	1
ABCDE	2020-08-04T12:30:00.200Z	50.0	-0.0832	-0.0832	25.0000	25.0000	1
ABCDE	2020-08-04T12:30:00.250Z	50.0	-0.1040	-0.1040	25.0000	25.0000	1

Point of instruction

BM BOA instructions are timestamped with a granularity of minutes. However, we acknowledge that units with 0 or 1-minute NDZ can receive a BOA after its point of instruction. E.g. a BOA with an instruction to start at 12:01:00 may be received anywhere up to 12:01:59. For this reason, and to encourage the use of 0 and 1-minute NDZs which provides value to ESO, we propose that providers use their discretion when incorporating the BOA into their baseline. The guiding principle should be that the reported baseline is an accurate representation of what the asset was doing without any response provision.

In the case where a BOA stamped to start at 14:02:00 was received at 14:02:37 (for example), we would accept an operational baseline that included this BOA change at any point between 14:02:00 and 14:03:00 - not constrained only to the minute boundary. The BOA will be submitted by NGESO in-line with the unit's run-up and run-down rate parameters, the adjusted baseline should reflect this. Imbalance arising from not following a BOA will be treated in the normal way - providers may wish to consider this when following a BOA instruction and representing this in their operational baseline. As it stands with regards to performance monitoring, we will not penalise any small differences between the operational baseline and the BOA-adjusted FPN.

5. Operational metering & settlement

Operational metering

No change required. ENCC will be able to follow the delivery of the BOA and any DFR response using existing tools.

Settlement

The response energy computation for DFR is unaffected by this change and will continue to be based on accepted MW and system frequency deviation from the target frequency.

Consequently, any BOA will not impact the determination of response energy volume data which is provided to Elexon under the Applicable Balancing Services Volume Data (ABSVD) submission, and an imbalance will arise if the service provider does not supply the tendered level of response.

6. Additional clarifications of the Service Terms

Providers should always seek to ensure they are following the latest version of the Service Terms.

Further clarifications of the Service Terms can be found below.

Submission of baseline, MEL, MIL, SEL & SIL

We would like to clarify that a baseline does not have to be at the same level throughout a settlement period.

Baseline ramp-rates

Clause 6.8 states that baselines (for energy limited providers) must comply with a maximum ramp rate. Clause 6.9.i describes, with reference to the guidance document, how the maximum ramp rate is to be calculated. Clause 6.9.iii confirms that and baseline adjusted by a BOA is considered compliant with the ramp rate limitation.

Therefore, there is no need to change the (BM parameters) 'RUR' or 'RDR' for DFR participating units to comply with the baseline ramp rate limitation.