Public

MDO/MDB Industry Best Practice Guide v1

For Energy Limited Providers

NESO
National Energy System Operator

Contents

Document Version Management

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Introduction

Ofgem has approved Grid Code modification **GC0166**, introducing new dynamic parameters designed to improve utilisation of electricity storage modules within the Balancing Mechanism (BM).
These changes support more accurate scheduling, clearer representation of storage unit capabilities, and improved operational decision-making for NESO.

- **Grid Code change effective from:** *05 November 2025*
- **NESO readiness for GC0166 data:** *June 2026 (expected)*
- **Grid Code change deadline:** *05 November 2026*
- **Migration:** NESO will schedule a unit-by-unit transition to the new GC0166 arrangements, which will be agreed with lead parties.

For further detail:
Ofgem Decision: https://www.ofgem.gov.uk/publications/gc0166-grid-code-changes

Grid Code GC0166

Parameter Name	Definition
Bid Acceptance	An acceptance by a **BM Unit** of a **Bid-Offer Acceptance** to decrease its export onto, or increase its import from, the **National Electricity Transmission System**, where in this context import and export are as defined in the **BSC**.
Future State of Energy (FSoE)	For each **Electricity Storage Module**, this is a series of MWh figures and associated times, which is calculated by **The Company** using the data provided under BC1.A.11.1, making up an estimated profile of the energy stored in that **Electricity Storage Module**.
Maximum Delivery Offer (MDO)	As defined in BC1.A.1.5 **Dynamic Parameters**.
Maximum Delivery Bid (MDB)	As defined in BC1.A.1.5 **Dynamic Parameters**.
Offer Acceptance	An acceptance by a **BM Unit** of a **Bid-Offer Acceptance** to increase its export onto, or decrease its import from, the **National Electricity Transmission System**, where in this context import and export are as defined in the **BSC**.

BC1.A.1.5 Dynamic Parameters

Maximum Delivery Offer (**MDO**), being a series of MWh figures and associated times making up the profile of the maximum volume of **Offer Acceptances** by a **BM Unit** which can be instructed by **The Company** through **Bid-Offer Acceptances** (**BOA**) via a **BM Participant** with respect to one or more of their **BM Units**, such that within the current **Balancing Mechanism Window Period**, the **BM Unit**'s **Committed Level** can be adhered to, and contracted **Ancillary Services** can be delivered.

Maximum Delivery Bid (**MDB**), being a series of MWh figures and associated times making up the profile of the maximum volume of **Bid Acceptances** by a **BM Unit** which can be instructed by **The Company** through **Bid-Offer Acceptances** (**BOA**) via a **BM Participant** with respect to one or more of their **BM Units**, such that within the current **Balancing Mechanism Window Period**, the **BM Unit**'s **Committed Level** can be adhered to, and contracted **Ancillary Services** can be delivered.

*NB: text in **bold** indicates a defined term in the Grid Code.*

Key Principles & Considerations

1. **Precision of data**
   a. All submitted data must be highly accurate. NESO will use this information inside the BM window for BOA creation and outside the BM window for scheduling.
   b. It must be accurate across the entire PN submission window, which ranges from 18 to 42 hours ahead depending on time of day. Just before the Day-Ahead defaulting at ~11:00, the PN submission horizon is 18-hours (11:00 D to 05:00 D+1). Immediately following the submission of PN data for the next operational day at ~11:00, the horizon is 42-hours (11:00 D to 05:00 D+2).
2. **MDO/MDB is to protect MWh volume**
   a. These values safeguard energy volume availability for NESO BOA instructions and ensure that no BOAs issued can exceed the MWh capability of the asset.
3. **MEL/MIL is to protect power range**
   a. These values safeguard the operating power range for a unit.
4. **All available energy must be provided to NESO**
   a. Providers must ensure MDO/MDB reflects all energy available for BOAs at a given minute subject to the rules described below.
   b. Providers must ensure MDO/MDB reflects all energy available for BOAs based on full capability of the asset but capped to ensure providers are able to meet their planned commitments (PN or contracted reserve or response) without any MEL/MIL redeclarations within BM window.

Data Submission Rules

It is essential that providers manage data submissions to ensure no detrimental impact to the performance of operational systems. A key aspect is to avoid unnecessary data submissions, thus keeping data traffic to a minimum, as described below.

1. Data Submissions:

a. As outlined in the Data Validation, Consistency & Defaulting rules document, all MDO/MDB submissions must be sent via EDL only.

b. Data must be submitted accurately for the entire PN submission time horizon.

c. The data submissions must be done using “from” and “to” time ranges rather than individual minute-by-minute entries. In the example below, only 3 MDO data submissions are needed (as opposed to 1,080 submissions of 1-minute granularity for the same time period).

Data Name	BMU	Time From	From Level (MWh)	Time To	To Level (MWh)
MDO	BMU-1	05:00	50	18:00	50
MDO	BMU-1	18:00	0	19:00	0
MDO	BMU-1	19:00	50	23:00	50

d. Redeclarations should only be submitted for the specific time intervals where changes to the data have occurred.

e. All data redeclarations made within the BM window must be submitted immediately to ensure dispatch reflects the most up-to-date operational position. Our dispatch systems will not utilise an asset further until a redeclaration has been received, once a BOA has been issued, hence this should be done ASAP.

f. Planned data submissions outside of the BM window should be timed to align with changes to BM gate closure and the national optimiser calculation runs wherever possible. This will ensure the latest data submissions are considered. The national optimiser runs every 5-minutes and therefore to pick up new data, planned submissions outside of the BM window should ideally be made between 01 and 03 or 31 and 33 minutes past the hour, to account for data processing time prior to these runs

g. MDO values will always be positive MWh figures. MDB values will always be negative MWh figures.

2. Redeclarations rules

a. If a BOA is accepted, providers must immediately redeclare MDO/MDB to reflect the updated state of energy (SoE) and revised future energy availability. A further BOA will not be sent until the update is received.

b. If a new or updated PN is submitted, providers must redeclare MDO/MDB to reflect the updated state of energy (SoE) and revised future energy availability.

c. If a new reserve/response contract is awarded, providers must redeclare MDO/MDB to reflect the updated state of energy (SoE) and revised future energy availability.

3. Situations where MDO/MDB can be updated inside the BM gate

As described in Grid Code BC2.5.3.4, after gate closure the values of MDO/MDB within the BM window can only be updated in response to one of the following circumstances:

a. A technical fault
b. NESO issues a BOA that is accepted
c. The BMU has fully utilised the energy reserved for an Ancillary Service
d. There is a PN change in the Settlement Period immediately after the BM window period

In addition to the conditions a) to d) explicitly described in the Grid Code, NESO would expect to see changes to MDO/MDB within the BM window for the following circumstances:

e. To release previously protected volume back to NESO at the end of a contracted reserve delivery period when the reserve was not fully utilised and thus additional volume is available for NESO.
f. To release previously protected volume back to NESO at the end of a contracted response delivery period where the minimum contracted response energy volume was not fully utilised and thus additional volume is available for NESO.
g. If an Emergency Instruction is issued (see 'Ad-hoc Scenarios' section below).
h. Any time the available energy deviates from submitted MDO/MDB values by >1MWh for any reason (this could be for a variety of different reasons but for example, due to unusual asset behaviour under extreme temperatures or inaccuracies in forecast energy availability). 1MWh is considered an appropriate materiality threshold for data to be updated and these updates should be submitted half-hourly as described in section 1(e, f) above.

Where circumstances are not explicitly captured in Grid Code BC2.5.3.4, they are covered by Grid Code BC2.5.3.1.

Protection of Energy Volumes

- **Protected Volume**

  The energy volume (MWh) that must be withheld to fulfil reserve or response contract obligations, as defined in the Service Terms, or to meet a submitted FPN within BM window. This withheld volume is reflected in submitted MDO/MDB values. This volume is cumulative if the unit holds multiple contracts.

- **Protected Period**

  The time window where the above protected volume must be safeguarded to ensure availability for reserve/response/PN delivery. The protection period differs for reserve/response/PN as described below. The definitions and examples in this document specify a protection period of four settlement periods. However, where a unit can be brought to the required SoC in fewer than four settlement periods, volumes may be protected for a shorter duration, with a minimum protection period of two settlement periods.

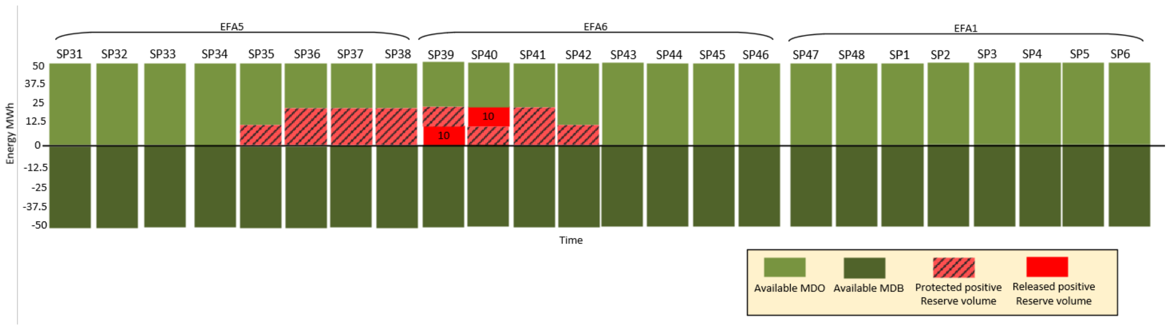
Reserve

The protection period for reserve is defined as:

4 settlement periods before the contracted window (plus any additional time needed for trading) and 2 settlement periods after. The protected volume for reserve is the full volume that was awarded under the reserve contract. Note that for reserve, this volume is **released back** to NESO (using MDO/MDB data) such that it can be instructed in the BM, as per service design.

Example

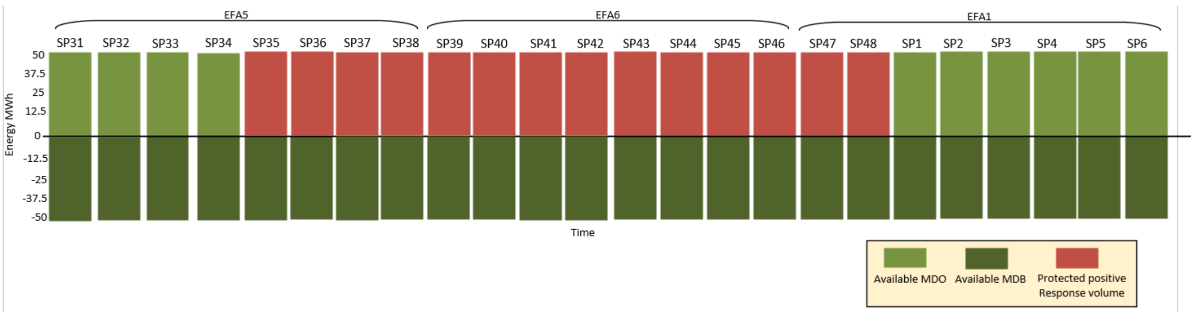
A unit has a 20MW positive reserve contract in 2 Settlement Periods (**SP39** and **SP40**), which is 10MWh of energy for each contract. In this example, only MDO is impacted. The Protected Period for the contract in **SP39** would be from **SP35 to SP38** inclusive (plus any additional trading time if required) and **SP40 to SP41** inclusive. For the contract in **SP40** it would be from **SP36 to SP39** inclusive (plus any additional trading time if required) and **SP41 to SP42** inclusive as shown below. The volume will be released back in **SP39** and **SP40** to NESO so it can be instructed, if required.



Response

The protection period for response is defined as:
4 settlement periods before the contracted window (plus any additional time needed for trading) and 2 settlement periods after. Response must also be protected during the contract period as it is delivered automatically based on the system frequency and not instructed like reserve. Therefore, the protection is needed throughout to avoid the risk that NESO instruct the volume in the BM for energy balancing and inadvertently sterilise the response, which would also result in non-delivery penalties for the provider. Note: MEL is used to protect the MW range for response.

Example
A unit has a Dynamic Regulation Low (DRL) response contract for 50MW in EFA6 (**SP39 to SP46**) The protected volume is the Contracted Response Energy Volume as defined in the service terms for the response contract that was awarded (see table below). In the example below it is 50MWh and only impacts MDO. The Protected Period for the contract would be from **SP35 to SP48** inclusive (plus any additional trading time if required).



Contracted Response Energy Volume
At the start of a contract delivery period the unit must satisfy a minimum state of energy requirement which would allow the unit to deliver the contracted quantity for the maximum delivery duration (this is the Contracted Response Energy Volume).

Service	Continuous Delivery	Example (50 MW contract)	Contracted Response Energy Volume
Dynamic Containment	15 mins	50 MW × 0.25h	12.5 MWh
Dynamic Moderation	30 mins	50 MW × 0.5h	25 MWh
Dynamic Regulation	60 mins	50 MW × 1h	50 MWh

Note:
This protected volume is *not released* during the contracted window as response delivery occurs automatically based on system frequency. *Further information on energy recovery rules for units to maintain minimum SoE to meet response contract obligations are defined in the Response Service terms (link below in Useful Documents section)*

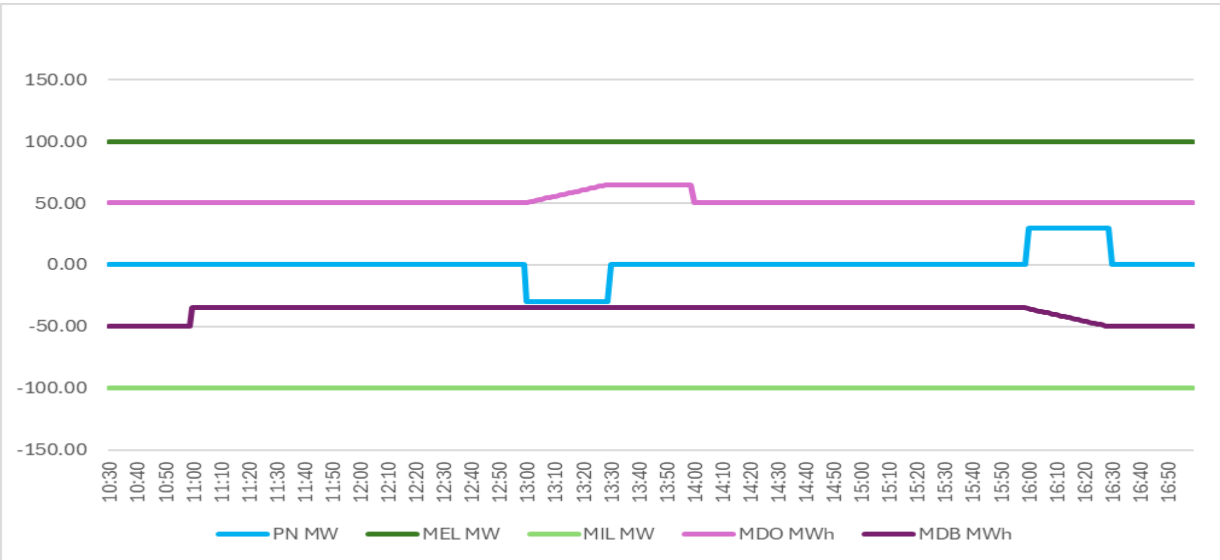
Physical Notifications (PNs)

The protection period for PNs is defined as:

4 settlement periods plus any additional time required to get the unit to required SoC prior to PN delivery and through the delivery of the PN. Any less than that 4SPs of protection will be insufficient to submit a PN in time to restore the unit to the correct SoC. For PN's there is no requirement to protect volumes once the PN has been delivered. Where a charge PN is in place, the MDB values represent the PN being delivered for the duration of the committed delivery window; conversely, a discharge PN is reflected through changes in the MDO values.

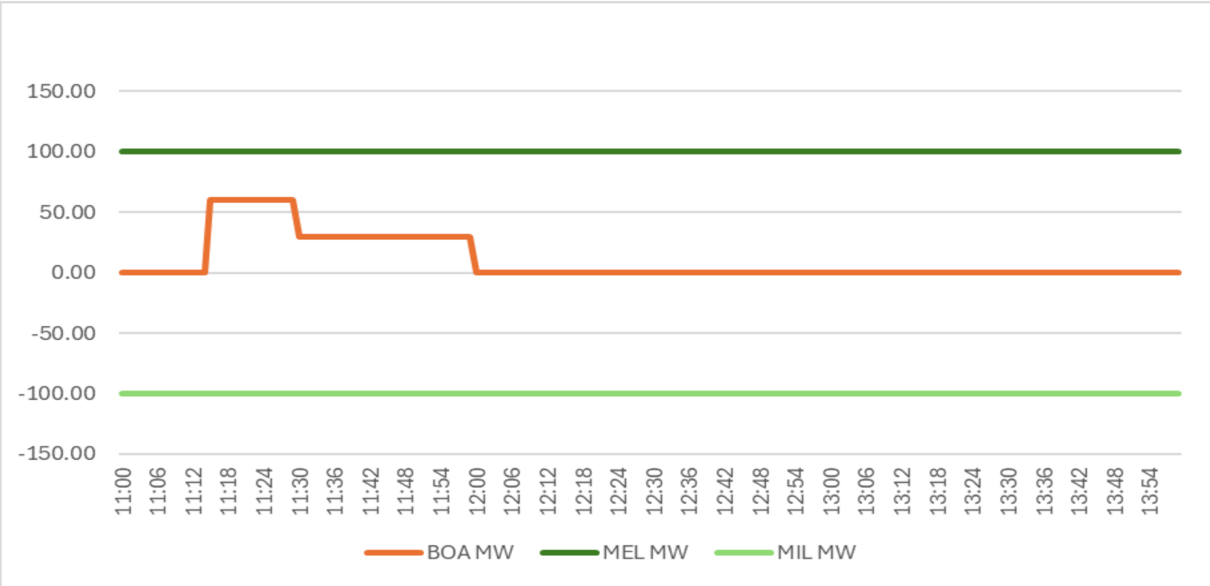
Example
A unit has a 30 MW (15MWh) charge PN in **SP15 (13:00 – 13:30)**. The Protected Period for this PN would be from **SP11 to SP15** inclusive. This can be broken down into the 4 SPs prior to delivery (i.e. **SP11 to SP14** inclusive, plus any additional trading/recovery time as required, where MDB is reduced to protect volume) and the SP of PN delivery (**SP15**). In **SP15**, the MDB volume has been protected in the 4 SPs prior but must be delivered in **SP15** and to do so, the MDB volume remains protected to avoid NESO issuing a BOA at the start of **SP15** and causing non-delivery of the PN. Note that no protection is needed in the 2 SPs following PN delivery because the MDB at the end of the PN delivery period correctly reflects the available energy volume having assumed that the full PN is delivered. In this example, the MDB is -35MWh throughout **SP11 to SP15** inclusive to reflect the 15MWh that must be protected and note that as the charge PN is delivered in **SP15** the MDO value increases linearly as the physical State of Energy of the asset changes (see graph below).

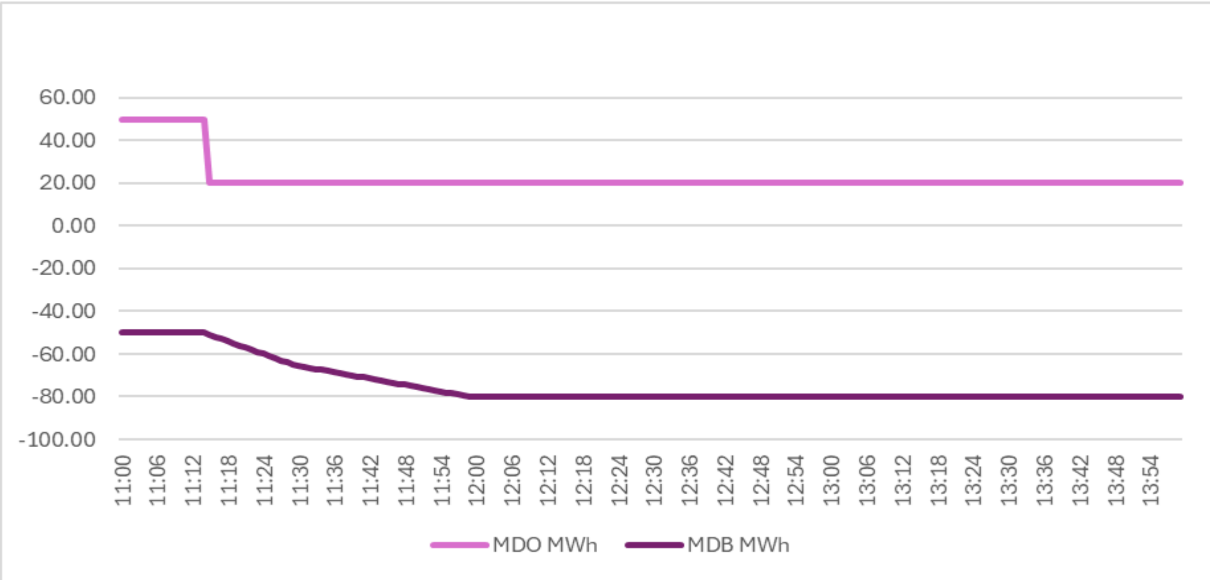
Similarly, If the unit has a 30 MW (15MWh) discharge PN in **SP21 (16:00 -16:30)**, the Protected Period for this PN would be from **SP17 to SP21** inclusive. The MDO reduces from 65MWh to 50MWh to protect the 15MWh PN to be delivered in **SP21.** As the discharge PN is delivered the MDB increases linearly from -35MWh to -50MWh as the physical State of Energy of the asset changes.



BOAs

There is no requirement for any protection period/volume for BOA's. Once an instruction is accepted, the provider must redeclare MDO/MDB to incorporate the impact of the instruction, including any associated unwind volumes as in the example below.





Example

A 60MW BOA sent from 11:15 to 11:30 (15MWh) reduces MDO from 50MWh to 35MWh; and increases MDB from -50MWh to -65MWh as the battery discharges and the SoC changes. A subsequent 30MW BOA from 11:30 to 12:00 (15MWh) further discharges the battery, reducing MDO from 35MWh to 20MWh; and increasing MDB from -65MWh to -80MWh. As the remaining **MDO at the end of the two BOAs is 20MWh, the declared MDO at the point of instruction acceptance must be set to 20MWh**, rather than a ramping down value, to ensure the BOAs are protected and deliverable.

Protecting power range with MEL/MIL Declarations

- MEL/MIL must reflect reduced capability when response contracts are held. This ensures that NESO do not issue any BOAs that inadvertently sterilise response capability.
- MEL/MIL are used to protect the MW power range and MDO/MDB and used to show available energy volume in MWh.

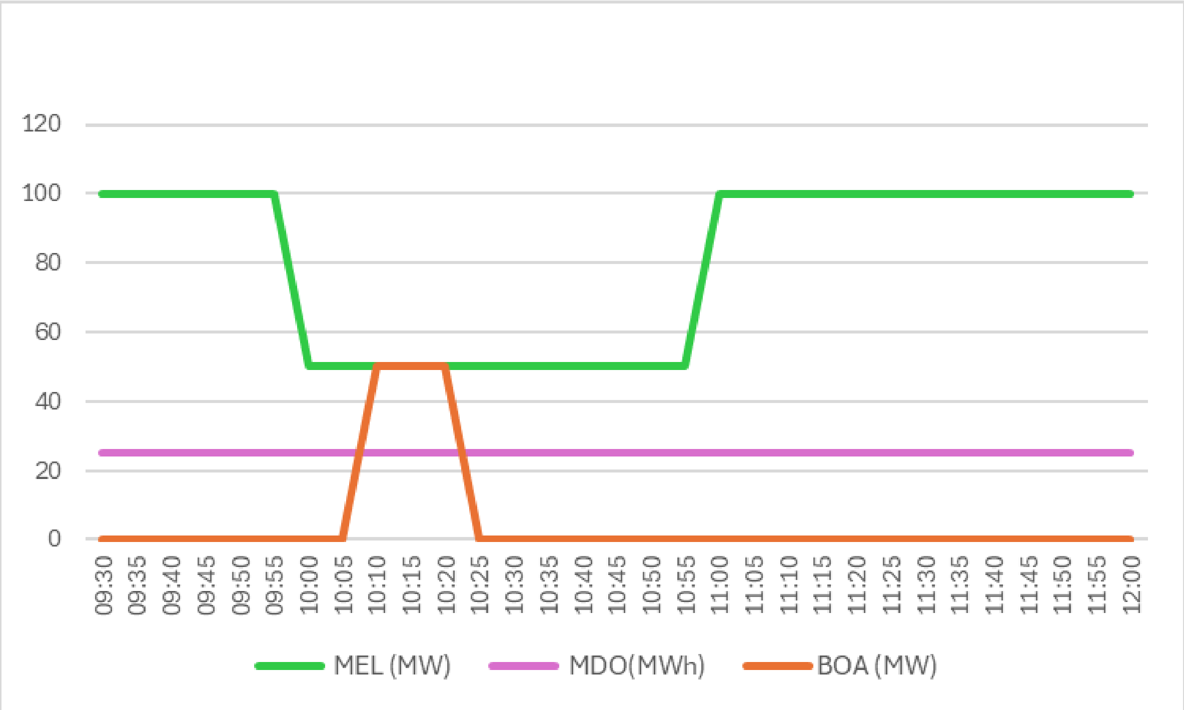
Example:

- Unit MEL = 100 MW
- Response contract = 50 MW
- Declared MEL =50 MW
- MDO = 25MWh

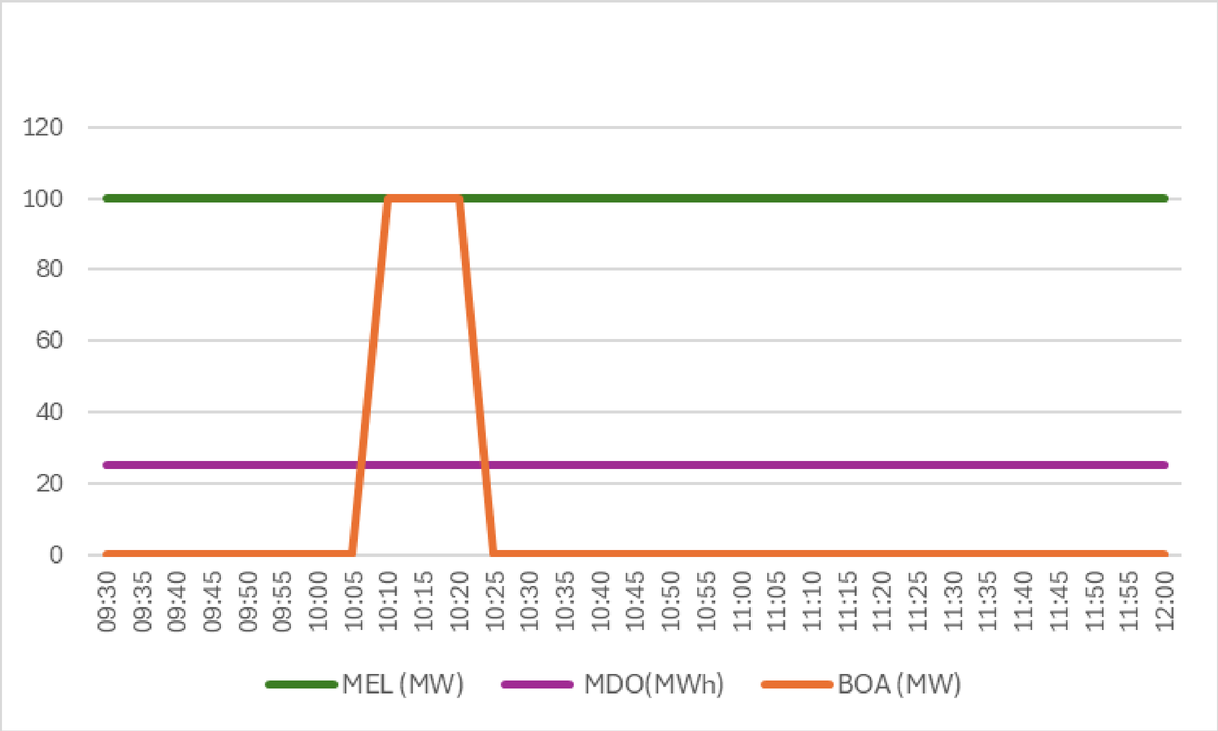
The use of MEL/MIL in this way is unchanged from practice prior to GC0166 implementation.

Note: MEL/MIL redeclarations to indicate plant failure is still required.

Examples below highlight why this is still needed.
In the below example, a 100MW/100MWh unit has a 50MW response contract between 10:00 and 11:00. By submitting a reduced MEL, the power range is protected to ensure contracted frequency response volume can be delivered (i.e. no BOAs can be issued that will sterilise the response)



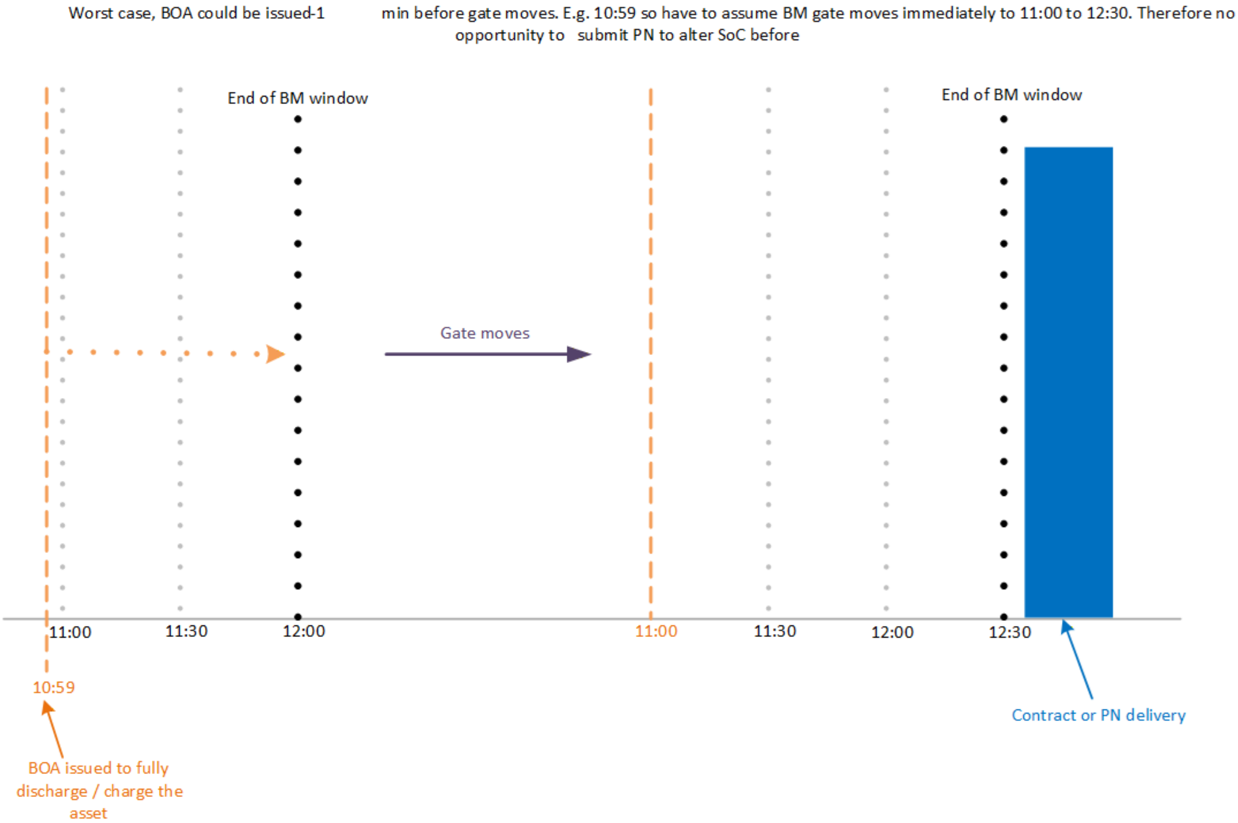
Without submitting the reduced MEL, there is a risk that the frequency response volume could be inadvertently sterilised via BOAs, as shown in the example below where the orange line shows a 25MWh BOA that could be issued if only MDO was used.



Note: The principles described above for MEL/MDO will apply to MIL/MDB as well.

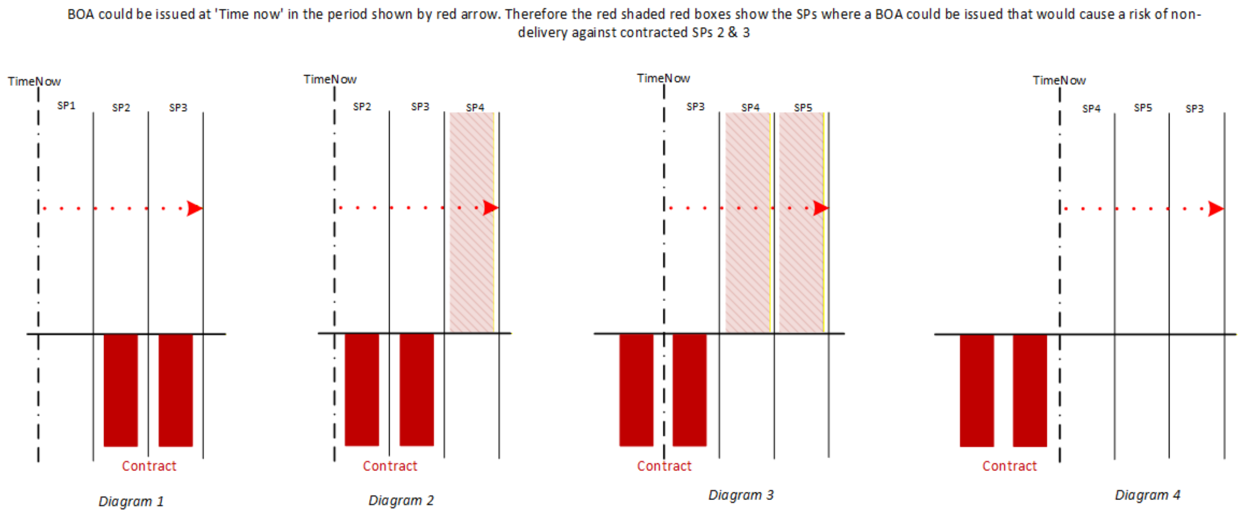
Reason for protecting volumes before contracted period or PN delivery

Example: a contract or PN starts at 12:30. In theory a BOA could be issued and accepted 1-min before the BM gate moves at 10:59. The BM gate moves at 11:00 and now covers 11:00 to 12:30 meaning no PN can be submitted before the contract or PN delivery SP and so no opportunity to adjust the asset SoC. Therefore the 10:30 to 11:00 SP should also be protected, and hence a minimum of 4 SPs protection is needed (10:30 to 12:30), plus any additional time required for trading.



Reason for protecting volume after contracted period for Reserve/Response

In the example below, a contract has been awarded in SP2 and SP3. This applies for both reserve and response. As the BM gate passes through the contracted window, without protecting 2 SPs after the contract period, there is a risk that NESO issue a future BOA that alters the SoC of the asset and results in the asset not being able to deliver the contract.



A BOA could be issued at 'Time now' for the period shown by the red arrow, in each of the diagrams above. The red shaded boxes therefore show the SPs where a BOA could be issued that would cause a risk of non-delivery against contracted SPs 2 & 3.

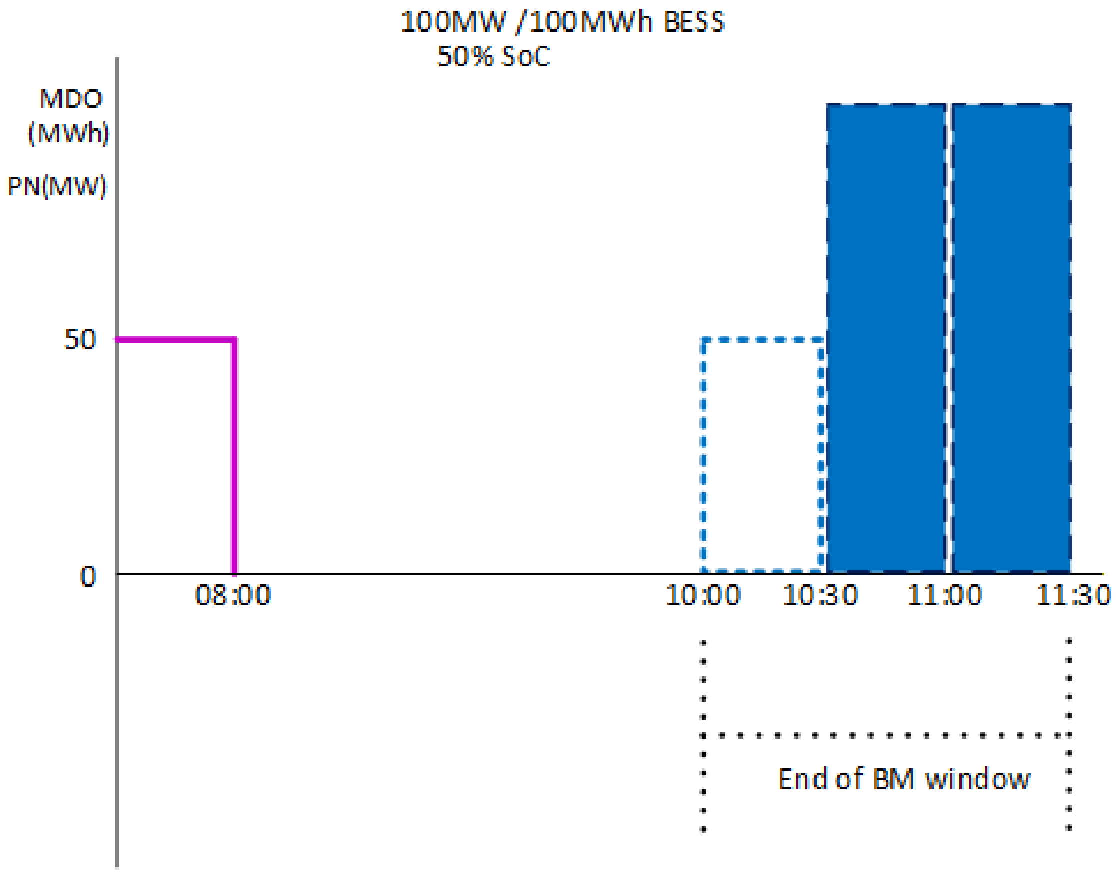
In diagram 1, future BOAs cannot be issued past the contract delivery period and so there is no risk of contracted volume being sterilised, provided the 4 SPs prior to the contract period have been protected as described in this document.

In diagram 2 and 3, future BOAs can be issued in SP4 and then SP4 & SP5 as the BM gate moves on. If no volume is protected in SP4 and SP5, any future BOA could result in the asset not having sufficient SoC to deliver the contract in SP2 and/or SP3.

In diagram 4, you can see that once the BM gate moves past the end of the contract period, the risk described in diagram 2 and 3 is no longer present and hence why only 2 SPs post contract period needs to be protected. At this point, if any reserve or response volume has not been fully utilised, it can be released back to NESO through a redeclaration of the MDO/MDB data.

Reason for not protecting volume beyond contracted period for PN

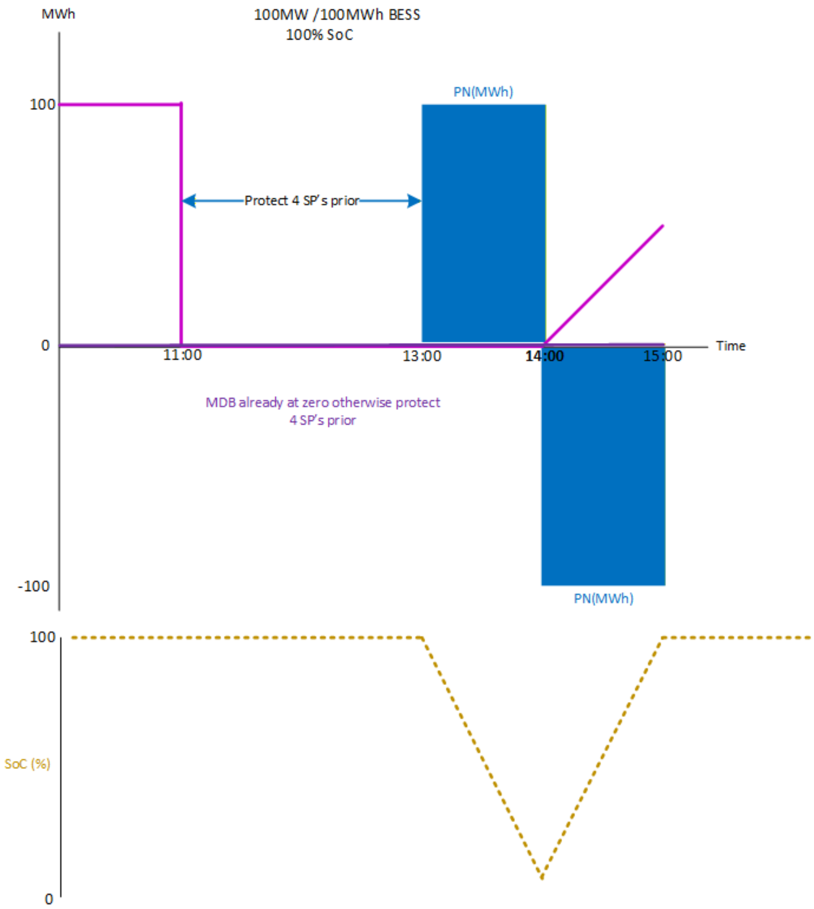
The example below shows that no protection is needed in the 2 SPs following PN delivery. This is because the initial submission of MDO has assumed the full PN is delivered and thus correctly reflects the available energy volume at the end of the PN delivery period. Therefore, future BOAs cannot cause non-delivery of the PN as there is insufficient energy volume available to do so.



Ad-hoc Scenarios

1. **Cases where there is insufficient volume to buy out a PN**

   A key principle of MDO/MDB data is that it must ensure all future commitments can be delivered. There will be occasions where, due to energy volume being protected for future commitments, the submitted MDO/MDB figures will prevent NESO from issuing a BOA to buy out some or all of a non-zero PN. NESO is comfortable that this will not have a detrimental impact to safe, secure & economic system operations, given the likelihood of the BMU(s) in question being the only available option to meet the requirement of the BOA, is very low. Should that case occur, NESO still has the ability to instruct a BMU to zero (from a non-zero PN) using an Emergency Instruction, as described in Grid Code BC2.9. An example of this scenario is shown below.



In the above example, NESO could not issue a BOA to buy out the full discharge PN volume from 13:00 to 14:00, unless NESO issued a future BOA to buy out the full charge PN volume from 14:00 to 15:00 first, triggering an update to MDB which would allow the full discharge PN to be bought out (assuming the future BOA was issued before 13:00). The OBP optimisers will not consider this combination and so this would typically only be done by exception.

If this approach was not possible, an Emergency Instruction would be issued as described above (an EI would trigger MDO/MDB to be redeclared).

2. **Commissioning Units**

   MDO/MDB volumes will always be capped by MEL/MIL but during commissioning it would be prudent to set MDO=MDB=0 to avoid any unwanted BOAs, in addition to the normal approach of using MEL/MIL to reflect actual output as the commissioning schedule changes. Existing guidance for commissioning units can be found here.

Useful Documents

1. EDL Message Specification
2. Data Validation, Consistency & Defaulting Rules
3. Reserve services | National Energy System Operator
4. Frequency response services | National Energy System Operator
5. SoE Monitoring Guidance

Glossary

Acronyms	Definition
BMU	Balancing Mechanism Unit
BOA	Bid Offer Acceptance
DRL	Dynamic Regulation Low
EDL	Electronic Dispatch and Logging
EFA	Electricity Forward Agreement
EI	Emergency Instruction
MDB	Maximum Delivery Bid
MDO	Maximum Delivery Offer
MEL	Maximum Export Limit
MIL	Maximum Import Limit
OBP	Open Balancing Platform
PN	Physical Notification
SoC	State of Charge
SoE	State of Energy
SP	Settlement Period