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Slow Reserve: Crossover Guidance for BM and non-BM units

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Document Purpose

This document is intended to verify the Slow Reserve Crossover operations, the associated rules and provides example scenarios. There is an assumption that the agreed Crossovers rules for QR will be mirrored across Slow Reserve. This document should test those assumptions and then seek to agree any differences.

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Introduction

Service Contract and Window Definitions

The following definitions align with the terminology outlined in the Slow Reserve Service Terms, Procurement Rules and Service Design documentation:

Term	Definition
Service Window (SR Window)	Each consecutive thirty (30) minute period commencing at 23.00 hours. This is equivalent to each Settlement Period in

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	an EFA day and was historically also referred to as the Service Window in SR/QR service designs.
SR Contract	Contract(s) for the delivery of Slow Reserve from an Auction Unit either formed through the daily auction (Firm Service) or upon utilisation by NESO of the Optional Service.
Contracted Service Period	An SR Window which is the subject of an SR Contract as procured through the daily auction (Firm Service)
Service Window Block	SR Auction bids for a continuous period of not less than two (2) hours in duration comprising consecutive SR Windows with identical MW.

Slow Reserve has a Firm requirement for four (4) or more continuous Service Windows that, when bid in to auction, constitute a Service Window Block. The Service Window Block will therefore constitute four (4) or more contiguous Service Windows each of 30-minutes, and of consistent MWs across the Service Window Block.

Any Service Window Block accepted at auction, will form four (4) or more (as appropriate) individual Contracted Service Windows, each of 30-minutes.

NESO requirement for Crossovers

In any given Service Window NESO may require SR units, where contracted or declared available for the Optional service, to deliver (if instructed) at least to their Minimum Activation Period (MAP) for non-BM units or Minimum Non-Zero Time (MNZT) for BM units.

If an instruction is issued near the end of a Contracted Service Period, the SR unit is required to continue to run for up to **29 mins** (as determined through its MAP) into the next Service Window. The unit must be able to deliver this output into the next Service Window at or above the MW value in the first Service Window, as described throughout the sections below.

A Crossover instruction is an instruction issued (in accordance with the SR Service Terms) by NESO in a Contracted/Optional Service Window to deliver SR where, to meet

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the unit's MAP, the instruction would cross the boundary into a subsequent Service Window. Where instructed, the unit must continue to deliver SR across the boundary as described below. This period of the subsequent Service Window is defined as the "**Cross-Over Period**".

Crossover instructions can be issued to a unit which is either contracted for Slow Reserve or has declared available for the Optional service (non-BM) **but would not** be issued if the unit is contracted for a different Balancing Service (other than Slow Reserve in the opposite direction) in the subsequent Service Window.

Slow Reserve Service Windows align with 30-minute Settlement Periods (SP) in a service day (23:00 to 23:00) and, for the Firm service, require a 2-hour minimum commitment (4 contiguous SPs). The Optional Service has no minimum commitment period and may consist of only a single discrete Service Window.

A crossover period therefore occurs after any Contracted Service Period, whether Firm or Optional.

Please Note:

- A Slow Reserve MAP cannot exceed 30-minutes and includes all ramping.
- We refer in this document to SR Windows, Service Windows, SR Contracts, Contracted Service Periods, and Service Window Blocks. Please refer to the definitions above for clarity.
- Example Crossovers in this document reference SW 1 (Service Window 1) and SW 2 (Service Window 2), however these are purely for illustration purposes and the Crossover requirement applies to all relevant Service Windows, as described above, within an operational day.

Document Guidance

The following sections detail the Crossover rules that providers are expected to follow to comply with the relevant terms and conditions of the Slow Reserve service:

- 1. Section 1 – applies to non-BM participation**
- 2. Section 2 – applies to BM participation**

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Non-BM Crossovers

When do non-BM Crossovers apply?

Where an instruction is issued by NESO towards the end of a Contracted Service Period (Firm or Optional), and the unit would not be able to conclude its Minimum Activation Period by the end of that Service Window in which the instruction was issued, the unit is expected to continue its delivery into the next Service Window up to the end of its Minimum Activation Period – unless contracted for a different Balancing Service (other than Slow Reserve in the opposite direction) in the next Service Window.

Slow Reserve requires a units' MAP to be no greater than 30 minutes.

Examples:

Crossovers apply in the below examples where the Minimum Activation Period does not conclude before the end of Service Window (SW) 1.

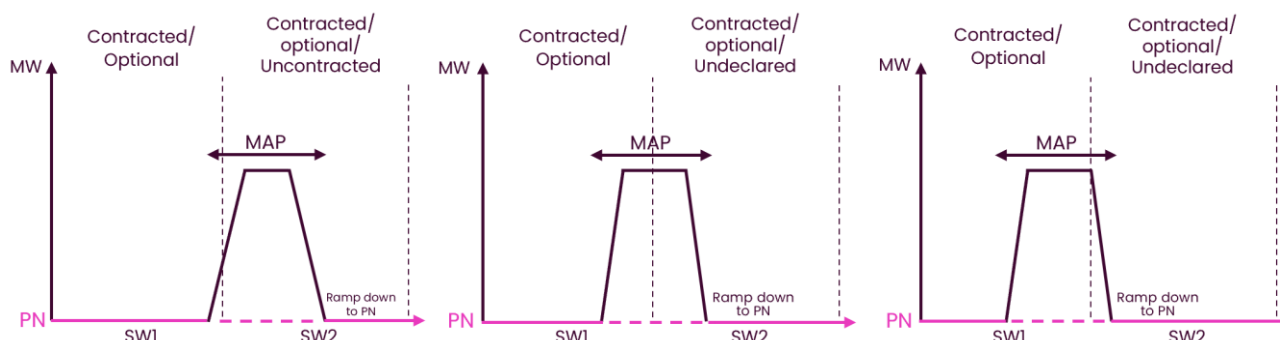


Figure 1 - Simple crossover behaviour

In the scenario where SW 2 is a Balancing Service other than SR (in either direction) (or the unit is declared unavailable), and if there was not sufficient time to create a SR instruction in SW 1 and honour the MAP, then no SR instruction would be created in SW 1. Using the same SW 2 scenario, where there is sufficient time to conclude the MAP within SW 1, then the unit will be ceased and returned to PN for the end of SW 1 following a cease instruction. Figure 2 illustrates where the MAP concludes at the end of SW 1, and therefore also illustrates the latest instruction time.

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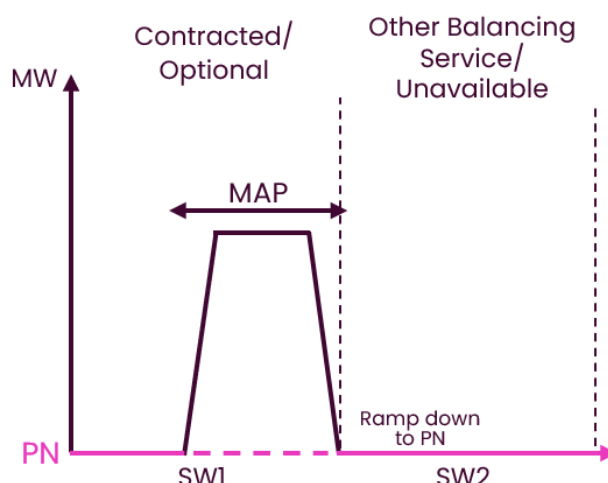


Figure 2 - No crossover required

If a Crossover is required, then output should be maintained to the end of the Service Window upon which one of the following scenarios ensues (as per Figure 3):

- If a unit were contracted for Slow Reserve (or declared available for the Optional service) for **10MW** in the first Service Window (SW 1) and only **1MW** (contracted or optional) in the subsequent Service Window (SW 2), then the unit must remain at the 10MW output into the second Service Window and then ramp down to the declared 1MW by the conclusion of the MAP [Blue Line, Figure 3].
- If the second Service Window (SW 2) was declared for **11MW** (contracted or optional), then the unit would ramp up to the new 11MW output immediately at the start of second Service Window and continue until ceased [Red Line, Figure 3].

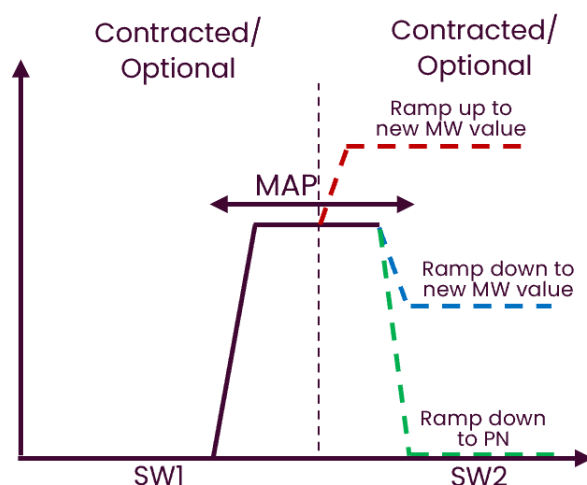


Figure 3 - Crossover to variable MWs

For the avoidance of doubt, if an instruction can be delivered within a Service Window (whilst honouring the MAP), then the instruction should be maintained at the same MW

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until the end of the Service Window and then ramp to the new MW level from the start of the next Service Window, where appropriate – see Figure 4.

For example, if a unit were contracted for SR (or declared Optionally available) for **10MW** in the first Service Window (SW 1) and:

- **11MW** in the subsequent Service Window (SW 2), and the Start Instruction was for a start time where the MAP is honoured within the first Service Window, then the unit will deliver to 10MW until the end of the first Service Window and then ramp up to the declared 11MW at the start of the subsequent Service Window [Red Line, Figure 4].
- **1MW** in the subsequent Service Window (SW 2), and the Start Instruction was for a start time where the MAP is honoured within the first Service Window, then the unit will deliver its 10MW until the end of the first Service Window and will ramp down to the declared 1MW for the start of subsequent Service Window [Blue Line, Figure 4].
- **Any MW** in the subsequent Service Window (SW 2), and the Start Instruction was for a start time where the MAP is honoured within the first Service Window, then the unit will deliver to 10MW until the end of the first Service Window. NESO may issue a Cease Instruction at any point in SW 1 or SW 2 and the unit should ramp to the PN as instruction. In the diagram below, the Cease Instruction has been sent for the start of SW 2 [Green Line, Figure 4].

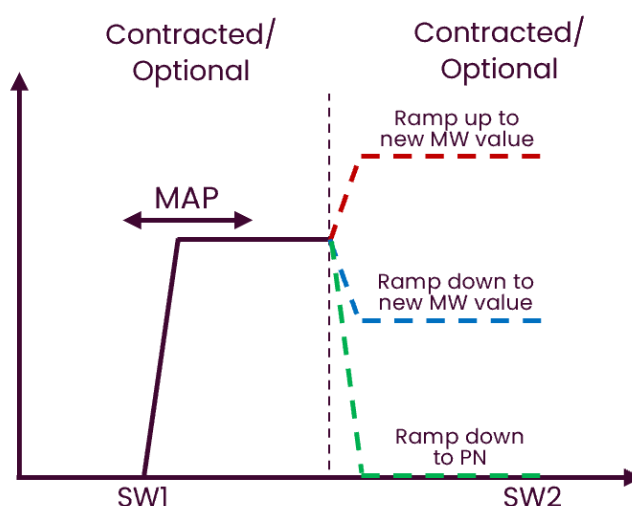


Figure 4 - MAP honoured crossover

If a unit were contracted for SR (or declared optionally available) for **10MW** in the first Service Window (SW 1) and **no declaration or not contracted for another Balancing Service** in Service Window (SW 2), and the Start Instruction was for a start time where

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the MAP is honoured within the first Service Window, then the unit will deliver 10MW until the end of the SW 1 and will ramp down to the PN from the start of SW 2 once ceased.

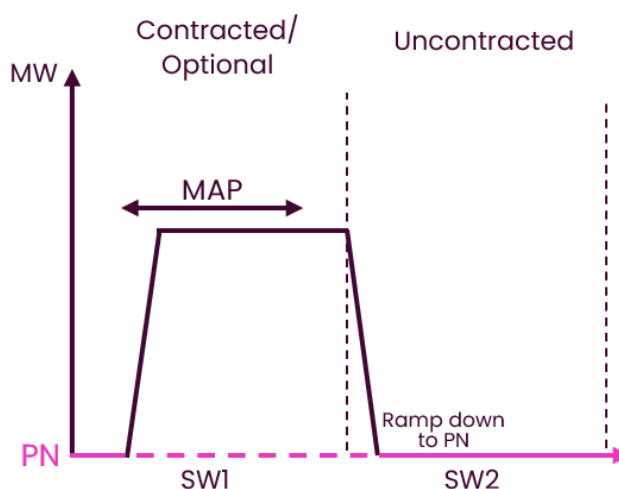


Figure 5 – Uncontracted Subsequent Service Window

Declarations

If contracted for SR (or declared available for the Optional service) in a Service Window (SW 1), a declaration (MW and Price) is always required for non-BM units to be instructed. For Crossover purposes, where a price is not submitted for the subsequent Service Window (SW 2), regardless of contract status, then the price from the SW 1 declaration will be carried forward. So, for SW 2, a Valid Declaration is required to allow for a Crossover instruction, and either of the following would be acceptable as a valid SW 2 declaration;

1. Blank declaration (no declaration) with no Price or MW (where the unit is not SR contracted or optionally available).
2. A price and **blank MWs**.
3. A price and MW value is acceptable (being either Contracted or Optionally available).

Note: zero (0) MW shall only be permissible:

1. To indicate a unit is not available for dispatch for technical (non-commercial) reasons.
2. To indicate where a unit holds a contract for 'another' balancing service other than Slow Reserve (in either direction) in a subsequent Service Window and is therefore unavailable for Crossover. See Scenario D for more detail.

Any failure to provide an acceptable declaration will prevent a Crossover instruction from being possible and therefore Availability Payment will be withheld for SW 1.

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Declared MWs must be of equal value to the contracted MW. Where they are not, the unit remains operationally available and all outlined Crossover rules apply. However, the unit will lose any availability fee for the Contracted Service Period where the unit does not meet its contracted obligations.

Recovery Period following Cease

Upon ceasing to FPN, if there is no change in delivery direction, the unit should, as a minimum, be allowed to recover as per its service declared Recovery Period before being instructed again for a Reserve Service in the same direction.

For example:

- Delivery of Positive Slow Reserve (PSR) -> Cease to PN -> Recovery Period -> Delivery of Positive Reserve (PxR)

Therefore, if the unit was delivering PSR in SW 1 with an 8-minute Recovery Period and is required to transition to a further positive service in SW 2, such as PxR (including PSR), it must be allowed to recover for the full 8-minutes.

However, if there is a change in delivery direction (e.g. PQR to Negative Quick Reserve (NQR)), then the preceding service declared Recovery Period will not apply and the unit can be instructed without any delay for a service in the opposite direction. E.g.:

- Delivery of PSR -> Cease to PN -> Delivery of NSR.

In this example, if the unit is transitioning to any negative service, it can proceed immediately without any delay.

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Non-BM Crossover Scenarios

The below examples describe some of the more common non-BM Crossover scenarios. Please also see **Appendix 1 & 2** for more details.

Scenario A:

- SW 1 = SR Contracted/Optional
- SW 2 = No Contract

Declarations

- If no declaration is provided, then the volume and price from SW 1 (the previous settlement period) will apply to the Crossover delivery period within SW 2.
 - Whilst no declaration is required in this scenario, as SW 2 is not subject to contract, nor available optionally, the provider could issue a declaration for price only for a Crossover instruction.

Delivery

Units in this scenario are expected to behave as outlined in Figure 1 and Figure 5, depending on the time of instruction in conjunction with the end of the window. See also instruction timing examples in Appendix 1.

Scenario B:

- SW 1 = SR Contracted/Optional
- SW 2 = SR Contracted/Optional

Declarations

- If no declaration is provided, then the volume and price from SW 1 (the previous settlement period) will apply to the Crossover delivery period within SW 2.
- For each SR Contract the unit must declare MWs equal to the contracted value.

Delivery

Units in this scenario are expected to behave as outlined in Figure 1, Figure 3, and Figure 4, as applicable to the time of instruction in context to the end of the window and any associated increase/decrease in the MW for SW 2. See also examples in Appendix 1 and change in MW examples in Appendix 2.

NESO expect to see declarations for the contracted MW and a price in SW 2. However, for the avoidance of doubt, if no SW 2 declaration is provided, the unit is considered uncontracted for SW 2 and the SW 1 declaration is carried forward. Crossover instruction will operate as described in scenario A and the unit won't receive Availability Payments, where appropriate, for SW 2 as it has not met its SW 2 contractual obligations.

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Scenario C:

- SW 1 = SR Contracted/Optional
- SW 2 = SR Optional

Delivery

Units in this scenario are expected to behave as outlined in Scenario B, subject to a valid declaration in SW 2. However, the MW declaration in SW 2 may or may not be the same as the preceding Contracted Service Period.

Scenario D:

- SW 1 = SR Contracted/Optional
- SW 2 = Response/Other Balancing Service/Declared 0MW for Slow Reserve

Delivery

As SW 2 is available for a different service other than Slow Reserve, it is not possible for the unit to transition straight from Slow Reserve into the next Service Window. Units in this scenario are expected to behave as outlined in Figure 2.

- The unit will declare 0MW for SR in SW 2 to ensure it is not instructed into a Service Window where it is contracted for a different Balancing Service. For the avoidance of doubt, two declarations would therefore be expected in SW 2 – one equating to 0MW for SR, and a separate declaration for the ‘other’ Balancing Service.
- The unit is ceased back to its PN by the end of SW 1 and no Crossover Instruction would be issued. The unit will therefore not be considered for instruction if it is unable to meet its MAP and cease by the end of SW 1.
- A cease instruction will be sent in accordance with the units Minimum Activation Period where applicable.
- The contracted service in SW 2 will follow its relevant service and contract terms. Non-BM SR service terms and parameters do not impact the “other” service.

Scenario E:

- SW 1 = No SR Contract/Optional
- SW 2 = SR Contracted/Optional

Delivery

If there is no declaration in SW 1, then unit cannot be instructed in SW 1 and therefore no Crossover instruction is issued. In the case of Optional (SW 1) to Contracted/Optional (SW 2), and where a valid Optional declaration has been made for SW 1, then the unit is expected to behave as outlined in Scenario B.

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BM Crossovers

Summary of BM Crossover Operation

Declarations:

For BM units, a declaration (MW and Price) is always available for every Service Window. If a unit fails to submit a declaration, MW and Price from the equivalent Settlement Period of previous days are used, as per BM default rules.

Declared MWs for each Contracted Service Period must be of equal value to the contracted MW. Where they are not, the unit remains operationally available and all outlined Crossover rules apply. However, the unit will lose any availability fee for the Contracted Service Period where the unit does not meet its contracted obligations.

Optional Declarations:

There is no optional service for BM participants. Therefore, a declaration is either for Slow Reserve (if a contract is held), or simply availability in the BM (if no contract is held), or a combination of Slow Reserve and available in the BM if the unit's declarations are greater than the contracted MW for Slow Reserve.

Dynamic Parameters:

BM units must ensure their dynamic parameters allow dispatch into the start of SW 2 (based on their MNZT and relevant headroom/footroom) if there is a SR contract in SW 1. The BM unit is expected to declare MW values such that there is sufficient headroom in SW 2 in order to carry on delivering at the same MW.

Instruction:

BM units shall be instructed via BOAs and will follow the units submitted Dynamic Parameters. OBP will not consider Crossover logic within the dispatch of BM units and will instruct purely based on unit capabilities, as declared through its Dynamic Parameters.

Delivery:

Unlike non-BM operation, BM Crossovers simply follow the profile of the BOA instruction, which is based on a unit's declaration and Dynamic Parameters for both SW 1 and SW 2. Units are expected to deliver per the profile of its instruction, regardless of whether it crosses from one Service Window to another.

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BM Crossover Scenarios

The below examples describe some of the more common crossover scenarios. Note, unlike non-BM, there is no Optional service for BM and is therefore not considered. Please see **Appendix 1 & 2** for more details on crossovers.

Scenario F:

- SW 1: SR Contract
- SW 2: No Contract

Declaration

- BM units are obliged to submit Dynamic Parameters which are in line with their SR contract for SW 1.
- BM units must also submit Dynamic Parameters that enable them to be dispatched in SW 2.
- If a unit fails to meet these obligations, it can still be dispatched under BM rules but will fail its delivery settlement check and will receive no availability payment(s) for the relevant SW.

Scenario G:

- SW 1: SR Contract
- SW 2: SR Contract

Declaration

- BM units are obliged to submit Dynamic Parameters which are in line with their SR contracts for SW 1 and SW 2.
- If a unit fails to meet these obligations, it can still be dispatched under BM rules but will fail its delivery settlement check and will receive no availability payment(s) for the relevant SW.

Scenario H:

- SW 1: SR Contract
- SW 2: QR (or other Balancing Service) Contract

Whilst SW 2 is a different Service, BM dispatch will operate to the Dynamic Parameters as provided for the unit. Given this, whilst the SW1 BOA instruction may be returned to PN by

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the end of SW1, it is also valid that the unit may receive a BOA instruction that starts in SW1 and continues into SW2, conforming to the active Dynamic Parameters of the unit.

If the unit is later instructed in SW2, then the BOA instruction will conform to the Dynamic Parameters for that “Other” Balancing Service in SW 2 (which will be expected to conform to the Service and Contract terms of the “Other” Balancing Service). Slow Reserve service terms and parameters in SW1 do not impact the “Other” Service in SW2.

Scenario I:

- SW 1: No Contract
- SW 2: SR Contract

If there is no declaration in SW 1, then unit cannot be instructed in SW 1 and therefore no Crossover instruction is issued.

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Appendix 1: Examples of Instruction Timings and Crossover Rules

Scenario:

- 30-min MAP,
- Prequalified Capacity = 15MW
- 15-min Time to Full Delivery => Ramp Up Rate = 1MW/min
- 15-min Cease Time => Ramp Down Rate = 1MW/min
- SW2 Contracted/Uncontracted/Optional

Instruction Start	Unit behaviour
10:30	Assume SW1 = declared 15MW, the unit is expected to ramp from 10:30 to full output by 10:45 (1MW/min), when it could receive a cease instruction to ramp back to PN for 11:00 at the earliest. Alternatively, if not ceased at 10:45 the unit can continue to deliver and will therefore be subject to Crossover. For example, the unit ramps to full delivery by 10:45 (as above), stays at this level until 10:59 then may be ceased (with a Cease start time of 10:59) ramping down to PN by 11:14 or there is no cease and at 11:00 it ramps to the new MW level from 11:00 at 1MW/min until it reaches the new MW level.
10:40	Assuming SW1 = declared 10MW, the unit ramps to full delivery by 10:50 (1MW/min Ramp Rate); • If SW 2 is at a higher MW (15MW), it ramps to the higher MW from 11:00 at 1MW/min, and reaches the SW2 level by 11:05. • If SW 2 is at a lower MW (3MW), it remains at SW1 MW until 11:03 and then ramps (1MW/min) to the lower MW by 11:10 (to honour 30 min MAP). • If the unit has no declared value in SW 2 then it remains at SW1 MW until 11:00 and then ramps to PN by 11:10 (with a cease start time at 11:00). • Note: If SW2 does have a declared Available Power, NESO may cease the unit at 11:00, and the unit would therefore ramp down from 11:00 (SW1 MW level) to reach PN at 11:10.
10:50	Assuming SW1 = declared 10MW, the unit ramps to full delivery by 11:00 (1MW/min Ramp Rate); • If SW 2 is at a higher MW (15MW), it ramps to the higher MW from 11:00 at 1MW/min, and reaches the SW2 level by 11:05 • If SW 2 is at a lower MW (3MW), it remains at SW1 MW until 11:13 and then ramps (1MW/min) to the lower MW by 11:20 (to honour 30 min MAP) • If the unit has no declared value in SW 2 then it remains at SW1 MW until 11:10 and then ramps to PN by 11:20 (with a cease start time at 11:10). • Note: If SW2 does have a declared Available Power, NESO may cease the unit at 11:10, and the unit would therefore ramp down from 11:10 (SW1 MW level) to reach PN at 11:20.

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10:59	Assuming SW1 = declared 10MW, the unit ramps to full delivery by 11:09 (1MW/min Ramp Rate); • If SW 2 is at a higher MW (15MW), it continues to ramp to the higher MW by 11:14 • If SW 2 is at a lower MW (3MW), it remains at SW1 MW until 11:22 and then ramps (1MW/min) to the lower MW by 11:29 (to honour 30 min MAP) • If the unit has no declared value in SW 2 then it remains at SW1 MW until 11:19 and then ramps to PN by 11:29 (with a cease start time at 11:19). • Note: If SW2 does have a declared Available Power, NESO may cease the unit at 11:19, and the unit would therefore ramp down from 11:19 (SW1 MW level) to reach PN at 11:29.
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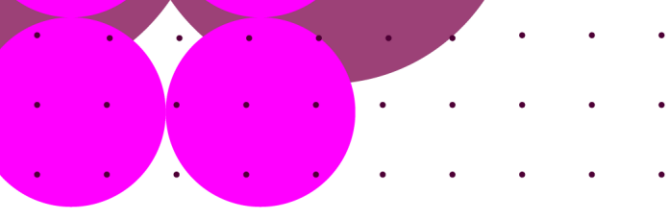
In the above table the Time to Full Delivery is 15 minutes, however the unit could declare parameters in the pre-qualification process that support a sub 15-minute ramp. If Time to Full Delivery is declared at 45 seconds with the Service Capacity MW as 30MW then the calculated ramp would be 40MW/min. A unit sent an instruction with a start time of 10:05 (start and cease time will always be to a whole minute), would be expected to be at 30MW by 10:05:45. If in this example only 20MW had been declared for the Service Window then the unit (using the same 40MW/min ramp) would be expected to be at the 20MW from PN by 10:05:30.

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Appendix 2: Crossover Rules for Example Scenarios

The table below covers the behaviour expected for crossovers across various scenarios.

Case 1: SW 1 Valid Availability Declaration → SW 2 Valid Availability Declaration		
SW 1 40MW	SW 2 – 40 MW (same)	Unit continues at same level until cease.
SW 1 40MW	SW 2 – 50 MW (higher)	Unit ramps to higher MW from start of SW 2 until ceased.
SW 1 40MW	SW 2 – 30 MW (lower)	If MAP is satisfied, ramp to lower MW from start of SW 2. If MAP is not satisfied, then continue at 40MW and ramp to 30MW with MAP (which includes ramp down) satisfied.
Case 2: SW 1 Valid Availability Declaration → SW 2 No Valid Availability Declaration		
SW 1 40MW	SW 2 – No submissions	If MAP is satisfied, then the unit will continue at 40MW to the end of SW 1 and ramp to PN from the start of SW 2, unless ceased prior to the end of SW 1. If MAP not satisfied, then the unit will continue at 40MW and ramp to PN when MAP (which includes ramp down) satisfied
Case 3: SW 1 Valid Availability Declaration → SW 2 Price only declaration		
SW 1 40MW	SW 2 – Price only declaration	The unit has submitted a price only declaration without a MW. If MAP is satisfied, then the unit will continue at 40MW to the end of SW 1 and ramp to PN from the start of SW 2, unless ceased prior to the end of SW 1. If MAP is not satisfied, then the unit will continue at 40MW and ramp to PN when MAP (which includes ramp down) satisfied. The price paid for utilisation of energy for SW 2 will be that from SW 2. The API allows the submission of price only and a provider could use this to submit a price only for SW 2 when they did not have a contract and to meet their SW 1 obligations.
Case 4: SW1 Valid Availability Declaration → Declaration for another NESO Balancing Service (other than Slow Reserve)		
SW 1 40MW	SW 2 – A contract for another NESO Balancing Service	An instruction will only be issued if MAP can be satisfied in SW 1. To support this, the provider should declare 0MW availability for SR in SW 2 when contracted for another NESO balancing service other than Slow Reserve.
Case 5: SW1 Valid Availability Declaration → 0MW Declaration not due to being contracted for another NESO Balancing Service		
SW 1 40MW	SW 2 – 0 MW Declared	The unit has explicitly declared 0MW for SW 2 for Slow Reserve, so an instruction will only be issued if MAP can be satisfied in SW 1 and no crossovers will be applicable for SW 2. The unit has not met the terms of its SW 1 requirement.



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