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Skip Rate Methodology & Implementation guide

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Version Control

Version	Amendments	Date
1.0	First Publication	16th December 2024



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Executive Summary

Introduction

As part of NESO's commitment to transparency and addressing the issue of skip rates, we aim to provide greater clarity. To support this, NESO asked LCP Delta to review and create a new method for defining and measuring skip rates. NESO's Skip Rate Dataset is based on LCP Delta's suggested method, with additional exclusions for units that are behind system constraints and could not have been instructed.

This document explains the full methodology of the data published from 16 December 2024. As we receive feedback from ENCC and the industry, the method will be updated to better reflect ENCC Operations and address the questions which are received. This document assumes you understand physical & dynamic parameters and how the Balancing Mechanism (BM) operates.

A tool has been created using the follows the steps outlined in this document. The tool analyses data from the previous day, and the results will be published on the data portal the following day.

The data can be accessed on the data portal [here](#) and any queries on this data set should be directed to box.NC.customer@nationalenergyso.com

How are skips assessed

The method aims to assess skips by considering the volume of accepted actions for each 5-minute period which we will refer to as **imbalance requirement**. Bids and offers are treated independently. The method compares any accepted actions to all the options that were available based on their price, from most economically attractive to least economically attractive. We refer to the list of all available options as the **feasible merit stack**.

As actions can be taken for different reasons other than just price, this method applies 5 stages of exclusions. The intention of these exclusions is to progressively remove units that were not feasibly available to ENCC balancing engineers in real time. Stage 0 is the starting point and considers BM units based on price alone. Each subsequent stage removes units that may not have been accessible to balancing engineers in real time. The exclusions are



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applied sequentially, i.e. units that are excluded at stage 1 will remain excluded in all later stages.

To calculate the skip rate, the method considers how much offer and bid volume was accepted and calculates the cheapest way this volume could have been dispatched. This final list of units is referred to as the **Volume Adjusted In-Merit Stack**.

There are two skip rates being calculated (All BM and Post System Action (PSA)) each with different **Volume Adjusted In-Merit Stacks**. Each time you move through the stages for All BM the volume considered is equal to the **imbalance requirement** so as units are excluded, other units are considered. For PSA the **imbalance requirement** may be reduced at stage 2 and again at stage 3 when any system tagged acceptances are removed. In both calculations, the skipped volume remains the same. System Tagged Units are treated as follows:

- Any actions taken for system reasons are removed from the acceptance stack in both examples.
- Then for All BM, these system flagged accepted actions are incorporated back into the **Volume Adjusted In-Merit Stack**. It is assumed that these actions had to be taken for system reasons so cannot cause a skip. These are maintained in the stack for all following stages.
- For PSA these actions remain excluded from both the **Acceptance Stack** and the **Volume Adjusted In-Merit Stack**.

Stage 1 - At stage 1 we remove accepted and feasible wind offers

Stage 2 - At stage 2 we remove feasible volume from very long notice units where they are inaccessible to balancing engineers in real time. We also remove units behind active constraints where the BOA direction would worsen the constraint (e.g. offers on Peterhead behind SCOTEX). We consider all constraint flows and limits on the system and 'artificially' system tag acceptances that are deemed to have been sent for system reasons.

Stage 3 - There may be units that are not 'Artificially' System tagged from stage 2 but are system tagged in the Elexon Bid Offer Accept Level Facts table. These units are treated the same way as the 'Artificially' system tagged units at stage 2.

Stage 4 - At stage 4 we remove the actions that would cause an unwind of an action already taken (e.g. Offers on a unit that has already accepted Bids).



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Stage 5 – At stage 5 we remove feasible volume from long notice units where they are inaccessible to balancing engineers in real time. In addition, we remove infeasible pumped storage actions that go from a positive value through zero to a negative or vice versa (e.g. +300MW to -300MW on DINO). This is done because these units need to remain at 0 for some time before switching between import and export.

Implementation

Data Sources

To ensure replicability of this analysis it was decided that the primary source of data would be Elexon’s BMRS API. The data used is as follows:

- SEL, SIL, MZT, MNZT, NDZ from [APIs: Details – API Developer Portal](#)
- PN, MIL, MEL from [APIs: Details – API Developer Portal](#)
- BOD from [APIs: Details – API Developer Portal](#)
- BOALF from [APIs: Details – API Developer Portal](#)
- Fuel Type is determined by internal data sources supplemented with Elexon Fuel Types where required
- Constraint flows, limits, and units that sit behind each constraint. This is not published.

Definitions

Acceptance Stack	This stack contains the units that were issued BOAs and serves to assess the volume instructed within a specified 5-minute interval. This is used alongside the Feasible Merit Stack to evaluate the proportion of this volume that was in merit.
Feasible Merit Stack	This is the comprehensive list of all the units that could have been instructed. The feasible volume that accepted units could have delivered is included in the Feasible Merit Stack.
Imbalance Requirement	This pertains to the total volume of bids or offers accepted within a specific 5-minute period after all exclusions have been made for a given stage.
Volume Adjusted Merit Stack	This denotes the final list of units representing the most cost-effective means to meet the imbalance requirement. The portion of the volume from this stack that was accepted is



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	deemed to be 'accepted in merit', while the volume not accepted from this stack is referred to as 'skipped' volume.
Import Constraint	This refers to the limitation on the amount of volume that can be imported into a specific boundary.
Export Constraint	This refers to the limitation on the amount of volume that can be exported out of a specific boundary.
Constraint Limit	This is a restriction required to control flow in and out of the boundary to ensure the safety and reliability of the system. To ensure a margin of safety, we apply a reduction factor to the original constraint limit as below: <ul style="list-style-type: none"> • 0.95 * Limit (applicable to positive export constraint limits and negative import constraint limits) • 1.05 * Limit (applicable to positive import constraint limits or negative export constraint limits)
Adjusted Flow or PN of a constraint	This metric retroactively analyses the impact that BOAs have had on a constraint. It represents the transfer that would have occurred if NESO had not issued BOAs for the constraint.
Unwind	<ul style="list-style-type: none"> • Feasible volume from a negative pair ID on a unit which has been sent an offer volume in a given 5-minute period • Feasible volume from a positive pair ID on a unit which has been sent a bid volume in a given 5-minute period • Where a BOA has been sent, we will never consider the option of bringing the BOA back to its PN by instructing it through the bid price of a positive pair id or an offer price of a negative pair id. <p><i>Unwinds should be treated the same as any other feasible volume for stages 1 – 3 inclusive.</i></p> <p><i>Unwinds are also considered when calculating which units can fill available head room / foot room for a constraint in stages 2 & 3.</i></p>
Skipped Volume	This refers to the amount of offer or bid volume in MWh that is deemed available to balancing engineers and in-cost merit but not accepted during the dispatch process.
Long Notice	MZT >= 31mins MNZT >= 31mins NDZ >= 31mins
Very Long Notice	MZT > 12hours MNZT > 12hours NDZ >= 89mins

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Skip Rate – All BM	<p>This metric refers to the proportion of bid or offer volume in-cost merit and not accepted to the total amount of accepted volume for a given 5-minute period.</p> <p>This is calculated as:</p> $\frac{\text{Total Skipped Volume, MWh}}{\text{Total Imbalance Requirement, MWh}} \times 100\%$
Skip Rate – Post System Actions	<p>This metric refers to the proportion of bid or offer volume in-cost merit and not accepted to the total amount of accepted volume for a given 5-minute period.</p> <p>This is calculated as:</p> $\frac{\text{Total Skipped Volume, MWh}}{\text{Total Imbalance Requirement, MWh} - \text{System Tagged Volume, MWh}} \times 100\%$

Preparation of Data

Before applying exclusions and calculating the Volume Adjusted In-Merit Stack, the Acceptance Stack and Feasible Merit Stack, the input data is prepared. Based off the values at the start and end of every minute, the following is calculated for each 5-minute period:

- Average PN, SEL, SIL, MNZT, MZT and NDZ
- Maximum MEL
- Minimum MIL
- Feasible Volume that can be delivered (these values change through the exclusion stages to ensure feasibility)

The list of all units, their prices, and their feasible volumes form the Feasible Merit Stack.

We interpolate the **Bid Offer Accept Level Facts table** and **PN** data from Elexon to determine the values for this data at the start and end of each minute. We compare the unit's BOA Level with its PN to calculate how much volume was accepted from each BM Unit. We use Bid Offer Data to work out which Bid Offer Pair ID is associated with Accepted Volume. This provides us with the corresponding price. The units that have been accepted form the Acceptance Stack.

For a given 5-minute period, the Imbalance Requirement for offers is defined as the total Volume of offers that were instructed, in MWh. The Imbalance Requirement for bids is defined as the total Volume of bids that were instructed, with unit MWh.



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Creating the Volume Adjusted In-Merit Merit Stack

At every stage, the Feasible Merit Stack and Volume Adjusted In-Merit Stacks are created after excluding units based on the stage's exclusion criteria. The exclusions are applied sequentially, i.e. units that are excluded at stage 1 will remain excluded in all later stages.

For each 5-minute period, we order the Feasible Merit Stack from most economically attractive to least economically attractive. Feasible volume from units up to and including the imbalance requirement are considered, with more expensive units excluded. This forms the Volume Adjusted Merit Stack. A tie-breaker rule is applied if there are multiple units at the same price – this is explained later. This works as follows:

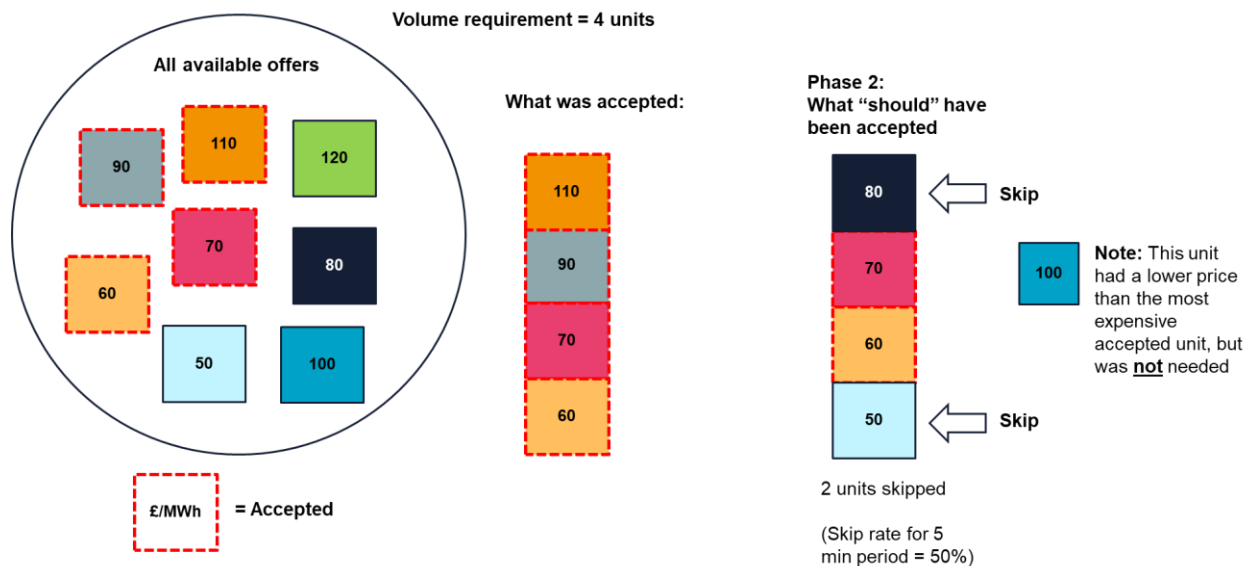
1. Volume Adjusted Merit Stack
 - a. Offer
 - i. Define the imbalance requirement as the sum of all offer volume (MWh) for a given 5-minute period.
 - ii. Order the Feasible Merit Stack by price ascending.
 - iii. Calculate the cumulative volume delivered by BMUs for each row by summing feasible volume for all units up to and including the current unit. This reflects the total volume available at or cheaper than the current row's price level.
 - iv. Match the cumulative volume to the stack at the point where the marginal unit meets the imbalance requirement. The price at this point is the marginal price.
 - b. Bid
 - i. Define the imbalance requirement as the sum of all bid volume (MWh) for a given 5-minute period.
 - ii. Order the Feasible Merit Stack by price descending.
 - iii. Calculate the cumulative volume delivered by BMUs for each row by summing feasible volume for all units up to and including the current unit. This reflects the total volume available at or cheaper than the current row's price level.



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- iv. Match the cumulative volume to the stack at the point where the marginal unit meets the imbalance requirement. The price at this point is the marginal price.

The above process is performed for each stage of exclusions. The image below shows a simple visual example of this.



Exclusions Methodology

1. Stage 0

i. Input data

- To create the input data, we consider all units that received Bid Offer Acceptances and all units that could have received Bid Offer Acceptances. For each 5-minute period we consider the unit's average PN, SEL, SIL, NDZ, MNZT, MZT, and their minimum MIL, and their maximum MEL.
- At stage 0, in LCP Delta's method the 'feasible volume' a unit can deliver does not consider whether the final position of the unit is 'stable' (does not leave the unit between 0 and SIL or 0 and SEL). This is corrected at stage 2.



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2. Stage 1:

a. Removes Offers on Wind Units

i. **Methodology:**

- Remove Wind Offer volume from acceptances, including unwinds (i.e. across all bid-offer pairs).
- Remove wind offer volume (positive bid-offer pair IDs and potential bid unwinds) from merit stack.

3. Stage 2:

a. *Constraints exclusions*

- i. For all constraints, calculate the adjusted flow (PN) = Transfer - (Net impact of BOAs) **from accepted units. All bids and offers from units behind each constraint are considered.**
- ii. Constraints are considered active when they are within a 5% tolerance of the limit. For export constraints are considered active where the $PN > \text{limit} * 0.95$. Where this occurs, we artificially system tag the cheapest accepted bids that were required to take the constraint from PN to $\text{limit} * 0.95$. The full volume from the marginal unit is considered. To do this:
 - Sort accepted bids price descending.
 - Accepted Bid Volume up to and including a cumulative impact of adjusted flow – $\text{limit} * 0.95$ will be artificially system tagged. **The accepted volume from these units is forced into the Volume Adjusted Merit stack in the All BM method. It is not considered in the Acceptance Stack or Volume Adjusted In-Merit Stack in the PSA method.**
 - Accepted Bid Volume that would not have been needed to take adjusted flow below $\text{limit} * 0.95$ will be artificially energy tagged.
 - Remove feasible offer volumes from the merit stack for units behind the constraint.
- iii. For export constraint with headroom (where $\text{adjusted flow} < \text{limit} * 0.95$):
 - For units behind the constraint, sort offer volumes (from accepted and merit stack combined) by offer price ascending.
 - Keep offer volume from merit stack that takes the adjusted flow up to $\text{limit} * 0.95$.



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- Exclude feasible offer volume that will result in a flow that exceeds $\text{limit} * 0.95$.
- iv. Import constraints are considered active where the $\text{PN} < \text{limit} * 0.95$ for negative limits or where $\text{PN} < \text{limit} * 1.05$ for positive limits. Where this occurs, we artificially system tag the cheapest accepted offers that were required to take the constraint from PN to $\text{limit} * 0.95$. The full volume from the marginal unit is considered. To do this:
 - Sort accepted offers price ascending.
 - Accepted offer volume up to and including a cumulative impact of ($\text{limit} * 0.95$ for –ve limit OR $\text{limit} * 1.05$ for +ve limit) – adjusted flow will be artificially system tagged. **The accepted volume from these units is forced into the Volume Adjusted Merit stack in the All BM method. It is not considered in the Acceptance Stack or Volume Adjusted In-Merit Stack in the PSA method.**
 - Accepted offer Volume that would not have been needed to take adjusted flow above $\text{limit} * 0.95$ for –ve limit OR $\text{limit} * 1.05$ for +ve limit will be artificially energy tagged.
 - Remove feasible bid volumes behind the constraints as accepting them will violate the limit.
- v. For import constraint with foot room (where adjusted flow $> \text{limit} * 0.95$ for –ve limit OR adjusted flow $> \text{limit} * 1.05$ for +ve limit):
 - For units behind the constraint, sort accepted + potential bid volumes in bid price descending.
 - Include accepted and potential bid volume from merit order up to $\text{limit} * 0.95$.
 - Exclude feasible bid volume that will result in a flow that exceeds $\text{limit} * 0.95$.
- b. Remove volume infeasible or inaccessible to Balancing Engineers in real time
 - i. If a unit is between 0 and SEL or 0 and SIL due to PN or a BOA:
 - Where a unit is ramping from a BOA between 0 & SEL or 0 and SIL, the BOA volume delivered in the 5-minute period **is** considered. It is assumed the unit could not have delivered any further bid or offer volume on top of this BOA.



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- If the PN is between 0 and SEL or 0 and SIL, it is assumed that the unit could not have delivered bid or offer volume
 - ii. Applied to Feasible Merit Stack for units that have not been accepted (instructed units are not considered for this exclusion)
 - MNZT > 12 hours & PN == 0 all feasible volume removed
 - MZT > 12 hours & PN == 0 all feasible volume removed
 - NDZ >= 89 minutes & PN == 0 all feasible volume removed
4. Stage 3: Treatment of System Tagged Units
- a. For the All BM Skip rate where volumes in the accepted stack have been taken for system reasons, they are forced into the Volume Adjusted Merit stack. For units in the accepted stack:
 - i. Where an accepted unit has an Exelon System Flagged == True, the accepted volume from this unit will be forced into the Volume Adjusted Merit stack. Artificially System Tagged Actions from stage 2 continue to be forced into the Volume Adjusted Merit stack.

Frequency Response Actions

- The LCP Delta methodology removes units that are frequency tagged based on the Potential Alternative Actions dataset. The current implementation does not currently exclude these units as the information from this dataset is not available in real time. Future versions of the tool may take this into consideration.
5. Stage 4: Remove Unwinds from the Feasible Merit Stack
- a. Remove unwinds as defined at the top of this document from the Feasible Merit Stack.
 - b. Volume from BOAs that unwinds a previous BOA are **not excluded** from the acceptance stack
6. Stage 5: *Removes volumes that could not be accessed by the Balancing team in real time.*
- a. Applied to units that haven't been accepted, remove volumes from the Feasible Merit Stack



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- i. Where $MNZT \geq 31$ mins & $PN == 0$ the unit is assumed to have no feasible volume
 - ii. Where $MZT \geq 31$ mins & $PN == 0$ the unit is assumed to have no feasible volume
 - iii. Where $NDZ \geq 31$ minutes & $PN == 0$ the unit is assumed to have no feasible volume
- b. *Additional Consideration:*
- i. Applied to units that have been accepted in the accepted stack
 - For either $MNZT \geq 31$, $MZT \geq 31$ mins or $NDZ \geq 31$ mins with $PN = 0$
 - For offers, exclude accepted volume 0 to SEL from both accepted and merit stack
 - For bids, exclude accepted volume 0 to SIL from both accepted and merit stack
 - If the unit is between SEL and MEL, it must stay between SEL and MEL
 - If the unit is between SIL and MIL, it must stay between SIL and MIL
 - ii. Pumped Storage / Hydro units
 - If a hydro or pumped storage unit is importing, it cannot be instructed to export without first returning to 0. If a hydro or pumped storage unit is exporting, it cannot be instructed to import without first returning to 0.

For a marginal unit when creating the Volume Adjusted Merit Stack:

- When the feasible volume at the marginal price is greater than the remaining imbalance requirement at the marginal price, each feasible volume will receive in-merit volume proportional to the feasible volume.
 - E.g. if there is a remaining imbalance requirement of 100 MWh at the marginal price, but there is 200 MWh of feasible volume at the marginal price, then a unit with a single feasible volume of 50 MWh at the marginal price would have $(50/200) * 100$ MWh = 25 MWh of in-merit volume.



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Frequently Asked Questions

Question	Answer
Is the methodology a price based or cost-based assessment?	The methodology assesses each five minutes independently based on price and is not therefore based on cost over a period of combined five minutes.
Why is there bid and offer skip volume for the same unit?	The methodology independently assesses bid and offers.
Why are you not publishing more detail i.e. data behind the system constraint methodology	We are currently progressing this conversation with industry with an intent to publish more detail where we can. To do this we need to be sure a full assessment of the associated impacts of doing this has been completed and signed off by all stakeholders.
How do you treat deemed volumes?	We use the bid offer price data and do not calculate any additional volume above the 5 bid and 5 offer volume tranches. Effectively deemed bids and offers are excluded.
I have a query about the methodology or published data – where can I direct my query?	Please direct queries to box.nc.customer@nationalenergyso.com
Is there any output data which you are not intending to publish?	We have taken an approach to include disaggregated data to thirty minutes to allow our customers and the industry to challenge the datasets as provided. Therefore, the approach taken is in full transparency.
What will NESO be doing with the data which is being published?	NESO will be using the data being captured as part of an ongoing exercise in understanding the capabilities which need to be incorporated within the NESO to continue to drive down skip rates.
I am a new Balancing Mechanism Unit; will data be reported/included for my BM unit?	The basis for most of the data will come from ELEXON and therefore any new BM unit will be incorporated as standard.

Limitations of methodology have been set out by LCP Delta in their report:

- No ramp rate consideration
- State of charge



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- Ancillary services
- Pumped storage in “spin pump” and “spin gen” modes

In addition, there are further limitations to this methodology

- No notice to offer/ notice to bid consideration
- If a unit is ramping in a 5 min period as per PN, is BOAd to above SEL, feasible volume is considered to be 0
- Wind offers not considered for constraint exclusions although this should not happen frequently
- The unit which is marginal for artificially system tagged units reasons is fully attributed to a system action even where their full acceptance volume was not required.