

Skips Behind Active Thermal Constraints

Methodology and Implementation
Guide

Contents

Introduction.....	4
How are skips assessed.....	5
Data Sources.....	5
Data Preparation	6
Overview of Methodology.....	7
Stage 1: Determining Constraint Activity	7
Stage 2: Exclusions.....	7
Stage 3: Assessing Dispatch and Identifying Skips.....	8
Handling Overlapping Constraints	10
Nested constraints.....	10
Crossing constraints	10
Marginal Unit Treatment	11
Limitations and Considerations.....	13
Publication Datasets	14
Skip Rate Calculation	14
Monthly BM Unit-level Data	14
Monthly Constraint-level Data	15
Constraint-level Volume Attribution.....	15
Definitions.....	15



Version Control

Version	Amendments	Date
1.0	First Publication	15 th October 2026



Introduction

As part of NESO's commitment to improving operational transparency and addressing skip rates, we aim to provide greater insight into dispatch decisions made behind active **thermal constraints**.

The GB electricity transmission network carries power from generators to consumers across hundreds of high-voltage circuits. Each circuit has a physical limit on the amount of power it can safely carry. These limits are called thermal constraints, and a significant proportion of operational actions are undertaken to manage these thermal constraints, making it vital that the rationale used to determine which units are dispatched is transparent and clearly communicated to stakeholders.

When generation and demand patterns would push power flows beyond a circuit's safe limit, NESO — the National Energy System Operator — intervenes. It instructs generators behind the constraint to change their output, keeping the network within safe operating limits. These instructions are called balancing actions, and the process of selecting which generators to instruct is called **dispatch**.

Ideally, where managing thermal constraints, NESO would always dispatch the cheapest available generators which could solve that constraint first. In practice, factors beyond price — such as a generator's location on the network, how quickly it can respond, and operational risk — mean this is not always possible. When a cheaper generator was available and could have helped manage the constraint, but was not used in favour of a more expensive generator, that volume is said to have been skipped. The proportion of available volume that was skipped is called the **skip rate**.

Through engagement with industry, NESO has heard concerns that the existing energy skip rate methodology does not explicitly assess dispatch decisions behind individual thermal constraints. Stakeholders have highlighted that this limits their understanding of how generators are utilised when constraints are active, and to distinguish constraint-related skips from those caused by other factors.

In response, NESO has developed this methodology to analyse dispatch decisions and skips that occur behind active thermal constraints. It uses the same core logic and assumptions as the existing energy skip rate method, applied specifically to constraint management actions. The methodology produces two monthly datasets:

1. **A unit-level dataset** showing monthly skip rates for each Balancing Mechanism Unit (BMU) — a registered generating unit, storage asset, or demand unit that participates in the Balancing Mechanism.
2. **A constraint-level dataset** showing monthly skip rates for each named constraint boundary.

This document sets out the methodology in full: including the data used, how constraints are identified, how dispatch decisions are assessed, and how results are aggregated for publications. Due to the nature of the underlying data, results cannot be published on a day-plus-one basis. Instead, the data is published monthly once the preceding month is complete. The published



datasets can be assessed at [Skip Rates | National Energy System Operator](#), and any questions or feedback on the methodology or outputs can be directed to .box.SkipRates@neso.energy.

How are skips assessed

The method aims to assess skips by considering the volume of thermal constraint actions accepted in each 5-minute period. This volume is referred to as the **constraint requirement**, defined using the accepted System bids and offers.

Bids and offers are treated separately. Bids are assessed for export constraints, while offers are assessed for import constraints. For each active constraint, the method compares the actions accepted by NESO with all feasible options available behind that constraint. These options are ordered by price, from the most to the least economically attractive, to form the **Feasible Merit Stack**.

Because dispatch decisions are influenced by factors other than price, the method applies a series of exclusions. These exclusions progressively remove volumes that were not available to ENCC balancing engineers in real time.

The method then determines the lowest-cost combination of feasible volumes that could have met the constraint requirement. This is referred to as the **In-Merit Stack**. Any volume included in this stack that was available but not accepted is classified as **skipped volume**.

Data Sources

The methodology uses the following data:

Data	Description	Source
BOALF (ELEXON)	Bid-Offer Acceptance Level data – records every instruction issued by NESO to BMUs.	Bid-Offer Acceptance Level Data
BOD	Bid-Offer Data – the prices submitted by BMUs at each bid-offer pair level.	Bid-Offer Data
PN, MIL, MEL	Physical Notification, Maximum Import Level, and Maximum Export Level – establish each unit's expected operating point and capability envelope.	Physical Parameters
SEL, SIL, MZT, MNZT, NDZ	Stable Export Limit, Stable Import Limit, Minimum Zero Time, Minimum Non-zero Time, Notice to Deviate from Zero – establish each unit's	Dynamic Parameters

	expected operating level and minimum periods and notification time	
Fuel Type	Characterises each unit's technology type	determined by internal data sources supplemented with Elexon Fuel Types where required.
Constraint Flows & Limits	Constraint boundary definitions from the Balancing Mechanism, providing constraint names, limits, and associated BMUs at five-minute resolution.	Internal
Constraint Action Tagging Data	Balancing Actions and Reasons – identifies constraint system-tagged acceptances (voltage, stability, thermal)	Internal
Constraint Definition	Lookup table mapping constraints to BMUs.	Internal
Intertrip	Information on the arming and disarming of units contracted under Constraint Management Intertrip Service, CMIS	Internal
MFR	Mandatory Frequency Reserve – identifies units instructed to counter frequency changes	Internal
Quick & Slow Reserve	Contracted services used to balance energy supply and demand, and respond to system disturbances	Enduring Auction Capability (EAC) auction results National Energy System Operator

Data Preparation

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

- Average PN, SEL, SIL, MNZT, MZT and NDZ
- Maximum MEL
- Minimum MIL
- Feasible Volume

The Bid Offer Accept Level Facts table and PN data from Elexon are interpolated to determine the values for this data at the start and end of each minute. Each unit's BOA Level is compared with its PN to calculate accepted volume. Bid Offer Data is used to calculate which Bid Offer Pair IDs, and therefore prices, are associated with Accepted Volume.

Overview of Methodology

The methodology assesses dispatch decisions in five-minute intervals. For each interval where a thermal constraint is active, it asks a simple question: did NESO use the cheapest available generators to manage this constraint? The answer is calculated in the three stages, defined below.

Stage 1: Determining Constraint Activity

Before calculating skip rates, the methodology identifies the thermal constraints that are active in each 5-minute interval. A constraint is classified as active using the following indicators and processing rule:

1. **Limit violation:** A constraint is identified as active when the power that would have flowed across the boundary, had NESO not taken balancing actions, exceeds the constraint limit after applying a buffer tolerance.
2. **Constraint tagging.** A constraint is also identified as active when constraint-tagging data shows that one or more BMUs were dispatched to manage that constraint during the relevant settlement period. This data is produced using a combination of control room reporting and automated tagging logic.
3. **Gap smoothing.** Once periods of constraint activity have been identified, inactive gaps of up to 60 minutes between two active periods are treated as part of the same continuous constraint event. This prevents short operational interruptions from fragmenting what is, in practice, a single event.

Only intervals where a constraint is active are included in the skip rate calculation. Intervals where no constraint is active are excluded entirely.

Stage 2: Exclusions

Before building merit stacks, several categories of volume are removed to reflect the options genuinely available to NESO engineers at the time of dispatch.

Exclusion	Reason
Wind and solar offer volume	NESO cannot instruct intermittent generators to increase output above their Physical Notification (PN). Their offer volume is not a real option.

	When wholesale prices are negative, this exclusion is overridden.
BMUs not behind an active constraint	These units are assessed separately in the energy skip rate method.
Long-notice units (MZT, MNZT, or NDZ $\geq$ 31 mins)	This method assesses real-time or near-real-time actions only. Units requiring more than 30 minutes' notice are not practical options.
Acceptances not tagged for system reasons	These actions were taken to meet an energy imbalance, not to manage a thermal constraint. System tagging is identified via the Balancing Actions and Reasons (BAAR) dataset.
Acceptances for voltage or inertia	This method covers thermal constraints only. Voltage and inertia constraints are excluded.
Actions that would unwind an existing action	For example, a bid on a unit with an accepted offer is excluded. The unit must first unwind the accepted offer before the equivalent bid volume can be accessed.
Pumped storage mode switches	These units need time at zero output when switching between generation and pumping. Actions requiring a mode switch are not immediately available.
Units on Mandatory Frequency Response (MFR)	These units are held at a specific output to deliver frequency response contracts. Their volume is not available for constraint management.
Bids on units armed for intertrip	These units are paid to remain available under intertrip contracts. Bidding them off would reduce the value of the service and add cost.
Units with Quick and Slow reserve contracts	These units are paid to reserve a portion of their capacity for contingency response. Instructing them would reduce the reserve volume available to manage system disturbances.

Stage 3: Assessing Dispatch and Identifying Skips.

The method calculates the skip rate in the following steps:

Step 1 – Identify Feasible Volume

For each Balancing Mechanism Unit (BMU) behind an active constraint, the methodology calculates how much volume the unit could deliver in the current five-minute interval. Input data is prepared by interpolating Physical Notification (PN) and Bid-Offer Acceptance Level (BOALF) data to the start and end of each minute, then computing five-minute averages and extremes:

- Average PN, Stable Export Limit (SEL), Stable Import Limit (SIL), Minimum Zero Time (MZT), Minimum Non-Zero Time (MNZT), and Notice to Deviate from Zero (NDZ).
- Maximum of minutely Maximum Export Level (MEL) within a 5-minute period.
- Minimum of minutely Minimum Import Level (MIL) within a 5-minute period.

From these, the feasible volume at each bid-offer pair is derived. Each unit's acceptance level is compared with its PN to determine accepted volume, and Bid-Offer Data (BOD) is used to identify which bid-offer pair – and therefore which price – is associated with that volume.

Step 2 – Calculate the Constraint Requirement

Sum the total system-tagged accepted volume across all BMUs behind the constraint in the current interval. Only acceptances tagged as having been taken for system (thermal constraint management) reasons are included. Acceptances tagged for voltage, inertia, or energy purposes are excluded. This total is the constraint volume requirement: the quantity NESO actually moved to manage the constraint. For nested constraints, only BMUs exclusive to the inner constraint contribute to its volume requirement, because shared BMUs may have been dispatched for the outer constraint. For crossing constraints, all BMUs behind the constraint contribute.

Step 3 – Build the Merit Stack and identify In-merit Volume

Rank all feasible volume behind the constraint by price, cheapest first. Fill the merit stack up to the constraint requirement. All volume within this stack is in-merit – it represents the cheapest set of actions that could have resolved the constraint.

Pricing direction: bid and offer prices are ordered according to their cost to NESO. Bids (export constraints) are ranked in descending price order because higher-priced bids are cheaper for NESO to accept. For example, a £100/MWh bid is ranked ahead of a -£10/MWh bid. Offers (import constraints) are ranked in ascending order, with the lowest-priced offer ranked first.

The marginal unit is the most expensive action in the stack. Any feasible volume that is more expensive than the marginal unit is out-of-merit and excluded from the skip rate calculation.

Step 4 – Identify Skipped Volume

Compare the in-merit stack against what NESO actually accepted. In-merit volume that was not accepted is classified as skipped. The skip rate for the interval is:

$$\text{Skip rate (\%)} = (\text{Total Skipped volume} \div \text{In-merit volume}) \times 100$$

A skip rate of 0% means NESO accepted all the cheapest available options. A higher rate indicates that cheaper volume was available but not used.

Core Assumption

The methodology assumes all BMUs behind a constraint have equal effectiveness in managing that constraint. In practice, a BMU's location on the network means it may be more or less effective at relieving a specific constraint. NESO considers these network effects when dispatching. This methodology does not account for them, which means some volume classified as "skipped" may have been bypassed for valid operational reasons.

Handling Overlapping Constraints

The GB transmission network has many thermal constraint boundaries. Many of these overlap — the same BMU can sit behind multiple constraints. When two or more overlapping constraints are simultaneously active in the same five-minute interval, the methodology must avoid counting the same volume more than once. Constraints that overlap geographically but are not active at the same time are processed independently and do not require special treatment.

Nested constraints

When one constraint's BMU population is entirely contained within another — for example, a local export boundary nested inside a wider regional boundary — the inner constraint is more tightly constrained. The methodology processes constraint groups from most constrained to least constrained.

The inner group is processed first: its merit stack is built, and in-merit volume is assigned to the cheapest units. Any volume that was not deemed in-merit at this nesting depth — that is, volume priced above the marginal unit — remains available and is carried forward to the outer group's merit stack. Volume that was classified as in-merit at the inner level is deducted from the unit's feasible volume and is not available to the outer group. This ensures each MWh is counted exactly once across all nesting levels.

Crossing constraints

When two constraints partially overlap — some BMUs are behind both, and some behind only one — the methodology splits the population into zones:

- Shared zone — BMUs behind both constraints.
- Exclusive zones — BMUs behind only one of the two constraints.

This is illustrated in the diagram below:

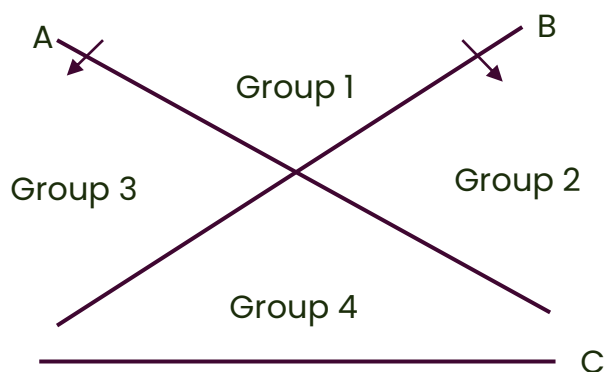


Figure 1: An example of two crossing export constraints.

The shared zone is processed first (it is more tightly constrained). Unused volume then carries forward to the exclusive zones. This structure can extend to three or more overlapping constraints, producing correspondingly more zones.

Consider the following example with two crossing constraints, A and B:

Zone	Contains	Constraint Group	Processing Order
$A \cap B$ (shared)	BMUs behind both A and B	1	1st (most constrained)
A only (exclusive)	BMUs behind A but not B	2	2nd
B only (exclusive)	BMUs behind B but not A	3	2nd
Outer (parent)	All BMUs behind A or B	4	3rd (least constrained)

The shared zone's merit stack is filled first. Carry-forward from the shared zone flows to each exclusive zone, then all remaining carry-forward flows to the outer zone. This ensures every MWh is assigned to exactly one zone and counted once.

Where the constraints are opposite types, i.e. import and export, each constraint is treated independently. Their feasible merit stacks are constructed only from units within each group.

In the above example, if constraint A were export and constraint B import, Group 3 would be processed independently using system offers, and group 2 using system bids. The feasible merit stack of Group 4 would depend on the constraint it sits behind. If behind an export constraint, the feasible merit stack is constructed from Groups 2 and 4; if behind an import constraint, it is constructed from Groups 3 and 4. Group 1's requirement is calculated as the net imbalance between accepted system bids and offers, and its feasible merit stack is constructed solely from units within Group 1.

Marginal Unit Treatment

At the boundary of the merit stack, multiple BMUs may share the same price at the margin. When this happens, in-merit volume is allocated using the same tiebreaker rule as the existing energy skip rate method, using a **two-step pro-rata** rule:

- **Step 1: Proportional to accepted volume first** — Prioritise accepted volume. If any of the marginal units have accepted volume, in-merit volume is allocated proportionally to their accepted volumes. For example, if three units are at marginal price and two have accepted volume of 10 MWh and 3 MWh respectively, 10/13 and 3/13 of the available in-merit volume is assigned to them first. This reflects the principle that NESO's actual dispatch decisions should be honoured before hypothetical alternatives are considered.
- **Step 2: Proportional to feasible volume second** — Any in-merit volume not yet assigned is then distributed proportionally across all marginal units based on their remaining feasible

volume (feasible volume minus any in-merit volume already assigned). This ensures units with greater remaining capacity receive a proportionally larger share.

If the marginal unit is only partially in-merit — its feasible volume exceeds the remaining space in the stack — only the portion that fits within the constraint volume requirement is classified as in-merit. The remainder is out-of-merit and excluded from the skip rate. This tiebreaker approach is consistent with the existing energy skip rate method, ensuring comparable treatment of marginal units across both methodologies.

A marginal unit can also have a partial skip (some volume in-merit but not dispatched) or no skip at all

For example, the table below explains a scenario where all units shown are marginal at an average price of £10/MWh, and there is 17 MWh of constraints volume requirement left to allocate. The volume is assigned as follows:

BM Unit	Accepted Volume (MWh)	Feasible Volume (MWh)	In Merit Volume (MWh)
a	2	7	6.89
b	3	5	5.00
c	0	7	3.25
d	0	4	1.86

Note: At this stage, remaining feasible volume may be less than accepted volume if a unit is nested behind multiple constraints and has already been assigned in-merit volume in a previous group.

Limitations and Considerations

Users of this data should be aware of the following:

1. **Equal Effectiveness Assumption.** The methodology assumes all BMUs behind a constraint are equally effective at alleviating it. In practice, network location affects effectiveness. Some volume classified as skipped may have been bypassed for valid operational reasons that are not visible in the published data.
2. **No Network Modelling.** The methodology does not use Power Transfer Distribution Factors (PTDFs) or other network models. It relies on the BMU-to-constraint mapping provided in the Balancing Mechanism's constraint definitions.
3. **Historical, not Real-time.** Some exclusion data (notably intertrip arming) is only available with a lag of approximately one month. The publication reflects complete historical months only.
4. **Equal Volume Attribution for Shared Zones.** Where a BMU sits in a zone that is shared by multiple constraints, i.e., BMU is behind zone A $\cap$ B $\cap$ C, the BMU's merit stack results (skipped, in-merit, and accepted out-of-merit volumes) are split equally ($1/N$) across the N constraints it belongs to when rolling up to constraint-level rather than weighted by constraint characteristics. This is a simplification that ensures consistency between unit-level and constraint-level totals.

A weighted attribution using Power Transfer Distribution Factor (PTDF) would be more precise, but the methodology explicitly assumes equal generator effectiveness — making $1/N$ the only neutral option. The trade-off is attribution precision at the constraint level in exchange for guaranteed consistency: the sum of all constraint-level attributed volumes always equals the unit-level total.

5. **Skip Rate does not imply Inefficiency.** A non-zero skip rate does not necessarily indicate suboptimal dispatch. NESO considers factors beyond price — including network location, post-fault power flows, response speed, and operational risk — that this methodology does not capture.

Publication Datasets

Skip Rate Calculation

For each 5-minute period, the total in-merit volume assigned to each unit or constraint is summed, along with the skipped volume. The overall skip rate is calculated using Equation 1:

$$Skip\ Rate\ (\%) = \frac{Skipped\ Volume\ (MWh)}{In\ Merit\ Volume\ (MWh)} \times 100\%$$

Five-minute results are aggregated to monthly totals and published in two datasets.

Monthly BM Unit-level Data

One row per BMU per month per direction (bid/offer). Columns:

Column	Description
month	Calendar month (e.g. 2025-01). Only complete months are published.
bmu	The BMU identifier.
bid_offer	"Bid" (export direction) or "Offer" (import direction).
fuel_type	The BMU's registered fuel type.
in_merit_volume_mwh	Total in-merit volume for the BMU across all constraints in the month (MWh).
skipped_volume_mwh	Total skipped volume for the BMU across all constraints in the month (MWh).
skip_rate	Skip rate as a percentage (0–100), rounded to one decimal place.



Monthly Constraint-level Data

One row per named constraint per month. Columns:

Column	Description
month	Calendar month. Only complete months are published.
constraint	The constraint name, or "Other" for constraints not individually published.
in_merit_volume_mwh	Total in-merit volume attributed to the constraint in the month (MWh).
skipped_volume_mwh	Total skipped volume attributed to the constraint in the month (MWh).
skip_rate	Skip rate as a percentage (0–100), rounded to one decimal place.

Constraint-level Volume Attribution

Nineteen constraint boundaries are published individually. These are the boundaries already visible on the NESO Day-Ahead Constraint Flows and Limits portal. All remaining constraints are aggregated into a single "Other" category.

Where there are multiple constraint boundaries overlapping simultaneously (see **Handling Overlapping Constraints** above), the zone's volume is split equally between the constituent constraints. For example, a shared zone that falls within three constraint boundaries contributes one-third of its in-merit, skipped, and accepted out-of-merit volumes to each constraint. This equal-split approach ensures that summing volumes across all constraint rows produces the same system-wide total as the unit-level dataset.

Definitions

Active Constraint	A constraint that is actively being managed by the ENCC. It is affecting dispatch decisions.
Adjusted Flow	This represents the power that would have travelled across a constraint, had no BOAs been sent.
Constraint Limit	This is a restriction required to control flow in or out of the boundary to ensure the safety and reliability of the system. To ensure a margin of safety, we apply a safety factor to the original constraint limit as below:

	• 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)
Export Constraint	Limits the power that can flow out of a region. Often regions with low demand and high generation.
Import Constraint	Limits the power that can flow into a region. Often regions with high demand and low generation.
Feasible Merit Stack	The list of all units and volume that could have been instructed, including those that were instructed. This does not contain volume that has been excluded.
In-Merit Stack	This denotes the final list of units representing the most cost-effective means to meet the constraint volume requirement. The portion of the volume from this stack that was accepted is deemed to be 'accepted in merit', while the volume not accepted from this stack is referred to as 'skipped' volume.
Constraint Group	The boundary of a group is the largest shape that can be drawn on a map without crossing any active constraints. The BMUs within this boundary form a group.
Constraint Volume Requirement	The total volume of system bids or offers accepted within a specific 5-minute period and group after all exclusions are applied.
Marginal Unit	The unit (or units) sitting at the highest price boundary of the in-merit stack.
Skip rate	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. This is calculated as: $\frac{\text{Total Skipped Volume, MWh}}{\text{Total In-merit Volume, MWh}} \times 100\%$
Nesting Depth	The number of active constraints whose BMUs fully encloses this constraint's group. • Depth 0 = outermost constraint (no larger constraint contains it). • Higher depth = more tightly constrained. Merit stacks are processed from highest depth (innermost) to lowest (outermost).



Carry-forward	After processing an inner constraint's merit stack, any feasible volume from its BMUs that was not assigned as in-merit is passed to the next outer constraint's merit stack. Each unit's feasible volume is reduced by its in-merit allocation before being passed up.
Power Transfer Distribution Factor	A coefficient measuring how much a generator's output change affects flow on a specific constraint boundary.

