



Guidance to Technical Limit Curtailment Assesmmments

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1. Background

As a result of this rapid expansion of the GB connections queue, many of our GSPs now have connections subject to transmission works. Historically, customers could not be connected until transmission network reinforcements had been completed, with some customers currently having connection dates more than 10 years away.

As part of the Energy Networks Association's (ENA) Strategic Connections Group (SCG), we have been working collaboratively with the Electricity System Operator (ESO), Transmission Owners (TOs) and the Distribution Network Operators (DNOs) to accelerate distribution connections through the establishment of Technical Limits on the Transmission and Distribution boundary. This allows Distribution Network Operators (DNO) to manage the flows at the interface points between the agreed limits and provide some customers with a flexible connection on a temporary basis, ahead of transmission reinforcement works being completed. These accelerated connections will need to be managed through Active Network Management (ANM) and will be subject to uncompensated curtailment.

This document outlines how SPEN calculates the indicative curtailment for accelerated connections under Technical Limits.

2. Introduction to Curtailment Assessments

SPEN provides an indication of the level of curtailment that the proposed connection may see under Technical Limits to aid customers in their decision making process. This is provided on an indicative basis only. The actual curtailment will be dependent upon the Technical Limits and the real-time net flows through the GSP, which in turn will depend on import/export flows from existing and future customers, and operational running arrangements of both the Distribution and Transmission networks. We encourage customers to do their own curtailment assessments to validate their business case.

Customers can decide on whether or not to proceed with their flexible connection. Where a customer decides not to pursue a flexible connection under Technical Limits, it does not impact on their requested access rights once the transmission reinforcement works are complete. However, it would mean these customers would not be able to connect until then.

The indicative curtailment figures are based on the following assumptions and considerations:

- The import and export Technical Limits at the GSP, which will be reviewed annually;
- Historical (12-month half-hourly) net power flow data at the GSP;
- Assumed typical import/export profiles (by technology type) for unconnected generators ahead in the queue and for the generator being considered;
- The queue position of the generator being considered;
- All distributed generators ahead in the queue proceed with their connection. No attrition is applied.
- An operational safety margin of 10% on the Technical Limits is considered for curtailment assessments.

The actual curtailment experienced post energisation will be uncompensated and may differ from the indicative level of curtailment provided considering the actual network operating conditions, demand variations and connected generation export variations at any given time.

3. Curtailment Assessment Methodology

In order to assess the indicative level of curtailment that a customer may experience under Technical Limits, we follow the following steps:

1. **Base GSP net demand data:** We prepare 12 months worth of GSP net demand data for each half-hour period.
2. **Consideration of the connections queue:** We apply assumed profiles per technology type to those generators who haven't yet connected and are ahead in the queue to the generator whose curtailment is being assessed. This is because their contributions are not already captured within the net flows at the GSP. These profiles are half-hourly representing 12-months of operation. Section 3.2 provides further details on the assumed profiles we have used.
3. **Resulting Power flow at the GSP:** Considering steps 1 and 2 above, it results in the forecast power flow at the GSP. This is then compared against the import and export Technical Limits at the GSP, applying a 10% operational safety margin, per half-hour. Section 3.1 provides the formulae used on the calculations.
4. **Provision of indicative curtailment:** Any exceedances of the limits are quantified. Our curtailment assessment results include the following:
 - Estimation of curtailment in megawatt-hours (MWh);
 - Estimated half-hours curtailed in percentage;

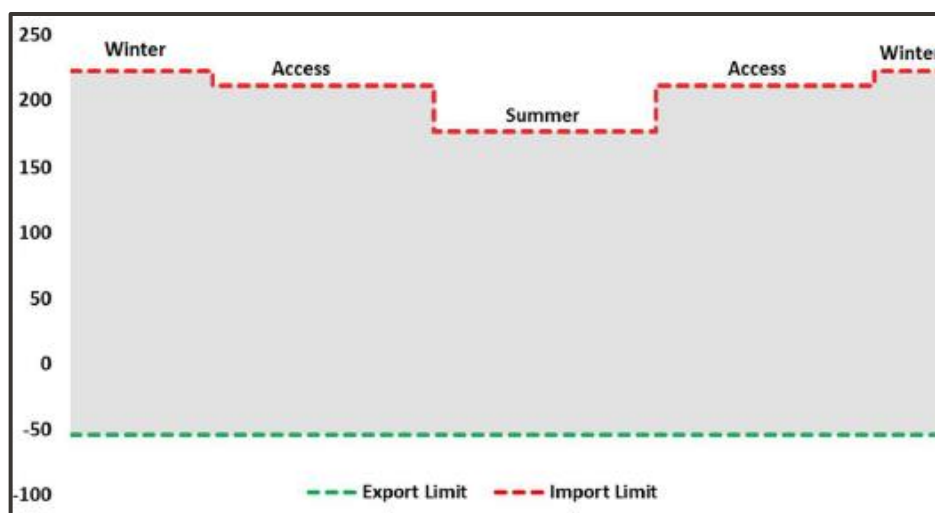


Figure 1: Typical GSP technical limits

3.1. Calculation Formulas

The forecast flows at the GSP have been calculated as follow, for every half-hour period in the year:

$$\begin{aligned}
 & \text{Forecast Export Power Flow}_{GSP} \\
 &= \text{GSP Net PowerFlow Data} - \sum_{\text{Position 1}}^{\text{Position n}} \text{Estimated Export} \\
 & \quad - \text{Customer Estimated Export}
 \end{aligned}$$

$$\begin{aligned}
 & \text{Forecast Import Power Flow}_{GSP} \\
 &= \text{GSP Net PowerFlow Data} + \sum_{\text{Position 1}}^{\text{Position n}} |\text{Estimated Import}| \\
 & \quad + |\text{Customer Estimated Import}|
 \end{aligned}$$

Where,

- *Estimated Export* is the sum of export from generators ahead in the queue;
- *Estimated Import* is the sum of import from BESS ahead in the queue;
- *Customer Estimated Export* is the customer whose export curtailment is being assessed.
- *Customer Estimated Import* is the customer whose import curtailment is being assessed.

The estimated curtailment is calculated as follows:

If the *Forecast Export Power Flow_{GSP}* is smaller than the *Export Technical Limit* (the *Export Technical Limit* is a negative number) times the *Operational Safety Margin*, the *Customer Estimated Export* will be curtailed by the *Estimated Export Curtailment* value. However, if the *Forecast Export Power Flow_{GSP}* is greater than the *Export Technical Limit* times the *Operational Safety Margin*, the *Customer Estimated Export* will not be curtailed.

If the *Forecast Import Power Flow_{GSP}* is larger than the *Import Technical Limit* (the *Import Technical Limit* is a positive number) times the *Operational Safety Margin*, the *Customer Estimated Import* will be curtailed by the *Estimated Import Curtailment* value. However, if the *Forecast Import Power Flow_{GSP}* is smaller than the *Import Technical Limit* times the *Operational Safety Margin*, the *Customer Estimated Import* will not be curtailed.

$$\begin{aligned}
 & \text{Estimated Export Curtailment} \\
 &= \text{Min} \{ |\text{Forecast Export Power Flow}_{GSP} - \text{Export Technical Limit} \\
 & \quad * \text{Operational Safety Margin}|, |\text{Customer Estimated Export}| \}
 \end{aligned}$$

$$\begin{aligned}
 \text{Estimated Import Curtailment} &= \text{Min} \{ | \text{Forecast Import Power Flow}_{GSP} - \text{Import Technical Limit} \\
 &\quad * \text{Operational Safety Margin} |, | \text{Customer Estimated Import} | \}
 \end{aligned}$$

Where,

- *Operational Safety Margin* = 0.9

The total curtailment in megawatt-hours (MWh) is the summation of every half hour estimated curtailment in the year as follows:

$$\text{Total Export Curtailment (MWh)} = \frac{\sum_1^{17520} \text{Estimated Export Curtailment}}{2}$$

$$\text{Total Import Curtailment (MWh)} = \frac{\sum_1^{17520} \text{Estimated Import Curtailment}}{2}$$

3.2. Assumed Profiles

When calculating the indicative level of curtailment, we assume profiles for any contracted unconnected generators as well as for the generator whose curtailment is being assessed. This assumed profiles are based on historic usage data of connections to our distribution network with similar technology types as follows:

- **Wind:** based on the historical usage data from wind generators already connected to the SPEN distribution networks.
- **Solar PV:** based on the historical usage data from PV generators already connected to the SPEN distribution networks.
- **Hydro:** based on the historical usage data from hydro generators already connected to the SPEN distribution networks.
- **BESS:** based on the historical usage data from BESS already connected to the SPEN distribution networks.
- **Other generation types (i.e. gas, waste/CHP):** assumed to export 100% of their agreed capacity at all the time.

The assumed profiles will be reviewed annually.