Delegated Technical Limits –
A Guide to Indicative Curtailment Assessments

Contents

1. Background and Context

As the country decarbonises, Northern Powergrid along with all other Distribution Network Operators (DNOs) are seeing an increase in the number of generator connection applications across our regions. We are aware that our customers may be facing long delays and increased costs because of constraints on the national electricity transmission network that require major reinforcement works to resolve.

We are committed to working with National Grid Electricity Transmission (NGET), National Grid Electricity System Operator (NGESO) and those customers directly impacted to explore all possible solutions and to remain open and transparent. This document relates to Delegated Technical Limits which is part of the wider landscape of works accelerating connections despite transmission constraints.

The application of a Delegated Technical Limit (referred to hereafter as a "Technical Limit") to a Grid Supply Point (GSP) will allow us, the DNO, to manage customers otherwise dependent on the completion of transmission works in an agile way within a limit set by NGESO to keep power flows over the Transmission/Distribution boundary within the assigned Technical Limit.

Connecting customers that are "shovel ready" ahead of those not yet ready to connect will temporarily use the capacity that these projects are reserving but will not utilise until they connect. When these projects do connect to the system and begin operating, those customers that have benefitted from the unutilised capacity will see a reduction in network headroom and they may need to temporarily reduce their export to keep the GSP in question within its Technical Limit.

This will be a form of uncompensated curtailment and this document sets out how we have calculated an indicative level of curtailment.

2. Introduction to Indicative Curtailment Assessments

Northern Powergrid share the results of Indicative Curtailment Assessments to assist connectees get a sense of the potential level of curtailment. Indicative Curtailment Assessment results are provided to make a better-informed decision on whether or not to proceed with their connection under the Technical Limits programme.

Our Indicative Curtailment Assessment makes assumptions about generators not yet connected to our network along with measurements of recent network behaviour to determine whether the overall export is expected to exceed the Technical Limit requiring a connection to be curtailed. This assessment is undertaken for each half hour of a full year.

The indicative measure of curtailment is dependent upon:

- The Technical Limit at the GSP, which is updated annually
- Historical net power flow at the GSP
- The nature of generators yet to connect and ahead in the queue (type and assumed profile)
- Whether or not individual generators in the queue progress to full operation whilst Technical Limits are in place
- The position in the queue, of the generator being considered

A number of different scenarios (detailed later) are considered in our Indicative Curtailment

Assessments to enable connectees to understand the impact of sensitivities affecting curtailments.

It is explicitly noted that historical data is no guarantee of future performance and curtailment assessment results are provided on an indicative basis only.

3. Indicative Curtailment Assessment Methodology

Our Indicative Curtailment Assessment considers every half hour in the year based on the methodology shown in figure 1.

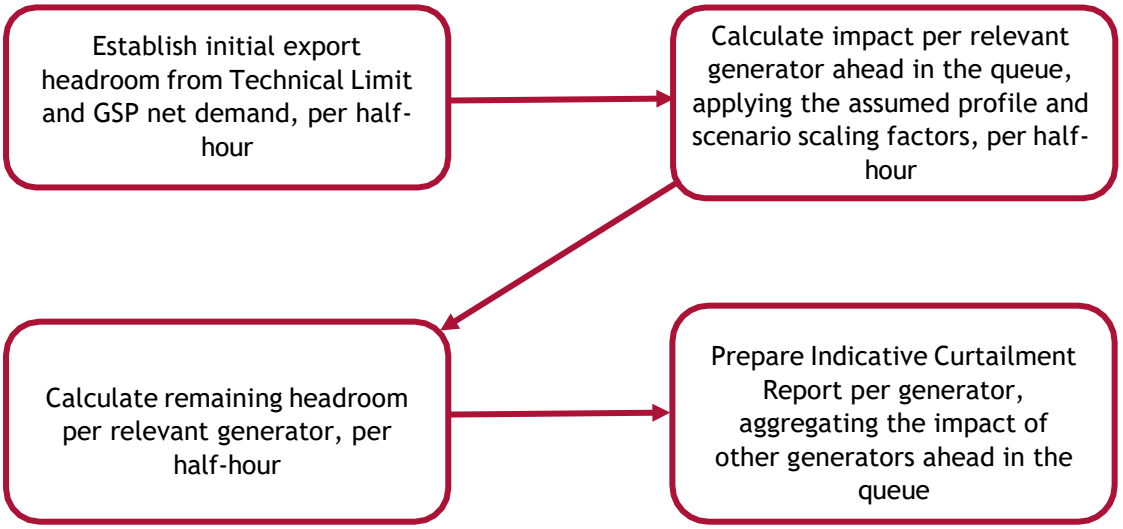


Figure 1: Indicative Curtailment Assessment methodology.

4. Curtailment Formulas

Conventionally, a reverse power flow (i.e. from the Distribution Network back up to the Transmission Network) is represented as a negative number. This convention has been adopted throughout.

To establish the initial export headroom, for every half-hour in the year:

$$Initial\ Headroom = Technical\ Limit - Net\ GSP\ Demand$$

(This number is negative where headroom exists.)

For each generator, for every half-hour in the year:

$$Estimated\ Export = Export\ Capacity \times Profile\ Scaling\ Factor \times Scenario\ Scaling\ Factor$$

The impact of each generator in the queue is then added in series to calculate the headroom for a generator in a given queue position, for every half-hour in the year to calculate the remaining headroom:

$$Headroom_{Position\ X} = Initial\ Headroom + \sum_{Position\ 1}^{Position\ X} Estimated\ Export$$

If the headroom becomes positive for a given queue position in a given half-hour, the generation in that queue position is considered curtailed for that half-hour. The generator that triggers curtailment

may be able to realise at least some of their assumed export during the half hour. All other generators in later queue positions will be 100% curtailed in that half-hour for the purposes of this assessment.

5. Assumed Generator Profiles

Where a generator is connected, we assume that its impact is already reflected in the net power flow over the Transmission/Distribution boundary at the GSP. No further scaling or estimations of output are applied to these generators.

When calculating indicative levels of curtailment, we assume generic profiles for generators not yet connected. These profiles are as follows, and shown in figure 2:

- **Peaking plants** (e.g. Short Term Operating Reserve (STOR)) are assumed to export 100% of their export agreement, in peak hours only
- **BESS schemes** are assumed to export 100% of their export agreement in peak hours, and import 100% of their import agreement in the middle of the day (solar maximum)
- **All other dispatchable generation (Waste/CHP and Hydro)** is assumed to export 100% of their export agreement all the time
- **Solar PV generation** is scaled on a time-of-day and day-of-year basis using aggregated data from solar farms already connected to the network, to create a generic solar farm profile
- **Wind generation** is scaled to 75% of their contracted export in winter, 70% of their contracted export in spring and autumn, and 65% of their contracted export in summer

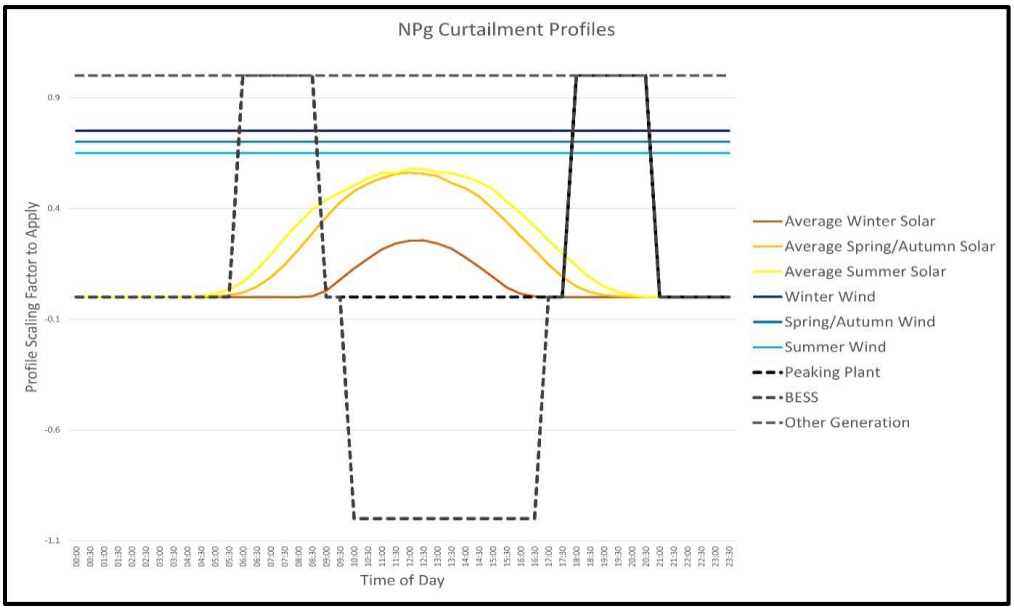


Figure 2: Assumed generator profiles. (Note that the solar generation is an average taken from individual daily data, and each day will vary from the profile shown).

6. Scenarios Considered

Our Indicative Curtailment Assessments consider sensitivities of the following scenarios:

1. **Base scenario** - The profiles as described above are applied to all generators in the queue up to the generator being studied for a given curtailment assessment.

2. **Reduced Queue Scenario** - The profiles as described above are applied to all generators subject to transmission reinforcement (historically Appendix G Part 4 generators) in the queue up to the generator being studied for a given curtailment assessment, with all not-yet-connected generators not subject to restrictions (historically Appendix G Part 2 generators) scaled to zero export i.e. not connected.

3. **Lower Profile Scenario** - The profiles as described above are applied to all generators in the queue up to the generator being studied for a given curtailment assessment, but instead of assuming 100% export for generators other than solar or wind, 85% is assumed instead.

4. **Lower Profile and Reduced Queue Scenario** - The profiles as described above are applied to all generators subject to restrictions (historically Appendix G Part 4 generators) in the queue up to the generator being studied for a given curtailment assessment, with all not-yet-connected generators not subject to restrictions (historically Appendix G Part 2 generators) scaled to zero export, but instead of assuming 100% export for generators other than solar or wind, 85% is assumed instead.

7. Indicative Curtailment Assessment results

The outputs of our Indicative Curtailment Assessments include:

a. A table of both a count of potential half-hours curtailed, as a percentage; and a proportion of megawatt-hours potentially curtailed, as a percentage for all four listed scenarios. (table 1)
b. Graph for the base scenario to allow connectees to identify when curtailments may potentially occur. (figure 3)
c. Heat map of indicative curtailed half hours per year for the base scenario. (figure 4)

To allow connectees to examine further sensitives, we also provide:

a. An anonymised list of generators, technology type and rating in queue order.
b. Historical half-hourly net GSP power flows at the distribution/transmission boundary.
c. Technical Limit defined by NGESO.

This data is supplied without warranty or guarantee. It may contain anomalies or errors. It is supplied with the intent of allowing you, the customer, to carry out your own studies using your own generation profile and sensitivity factors from the same starting position. We will provide guidance on how to use this data on request.

Table 1: Template for table of indicative curtailment results for four scenarios.

	Base Scenario	Reduced Queue Scenario	Lower Profile Scenario	Reduced Queue and Lower Profile Scenario
Potential percentage half-hours curtailed				
Potential energy curtailed as % of maximum (continuous operation at contracted export)				

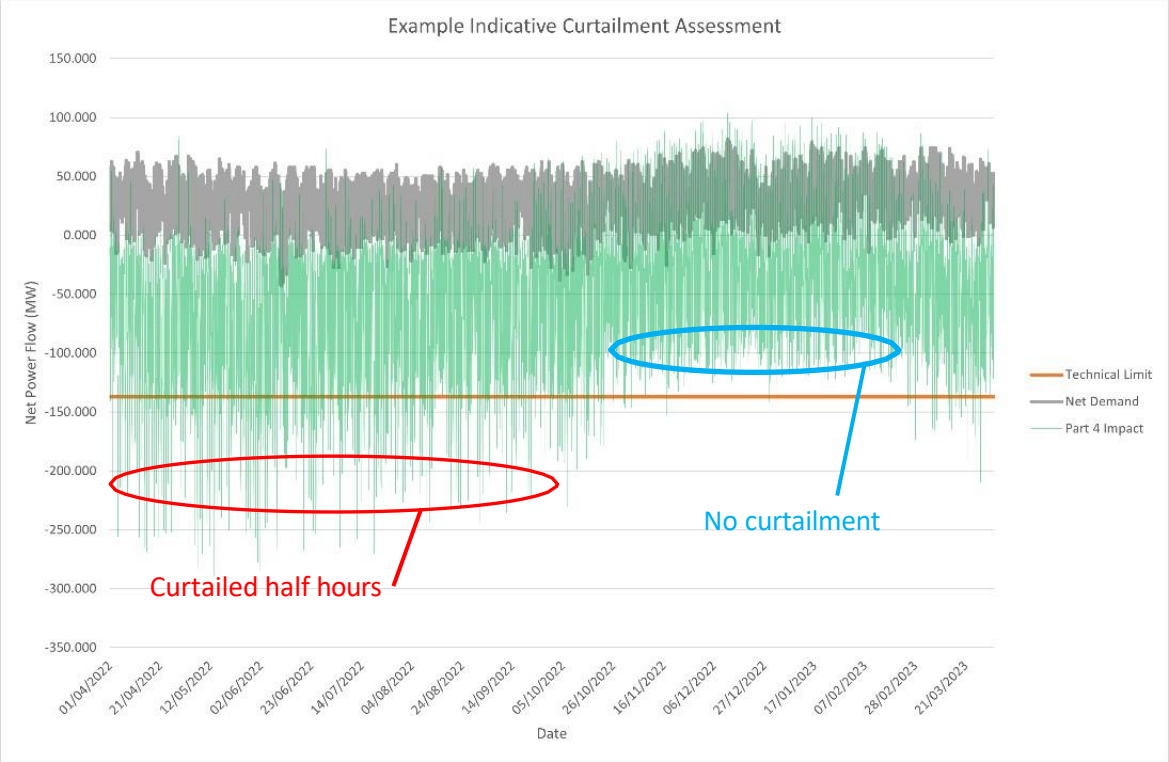


Figure 3: Example of charted results showing time of year our Indicative Curtailment Assessment has shown potential curtailment. The orange line is the Technical Limit. When the green trace is below the orange line, a measure of curtailment is indicated. The grey trace indicates the measured net demand at the GSP.

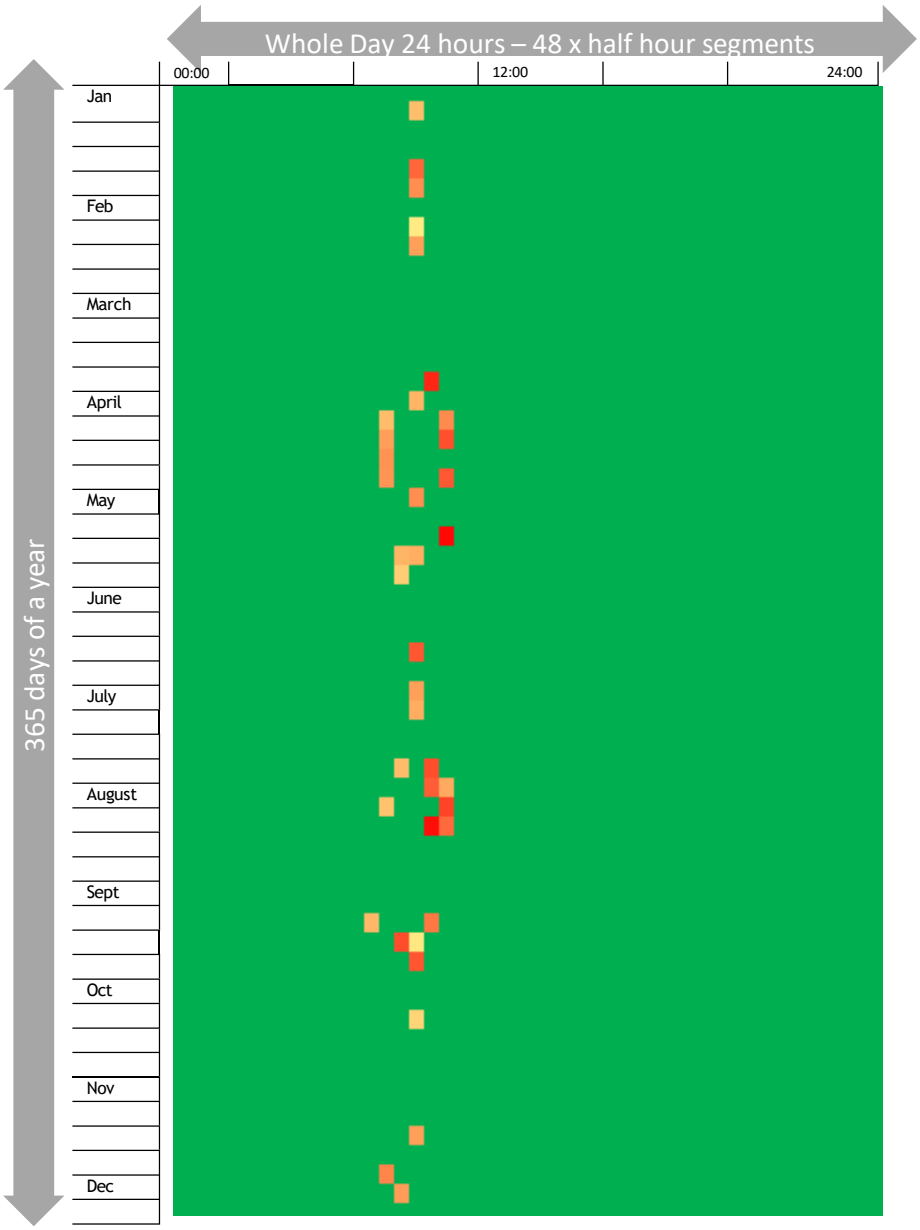


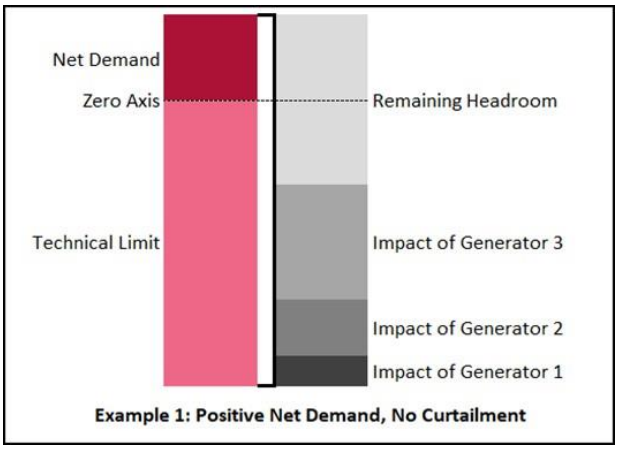
Figure 4: Example of heat map showing indicative half hours when curtailment may potentially occur over the year.

8. Examples

Under Technical Limits, the generation headroom available at a GSP, at any time, corresponds to the difference between the export Technical Limit and the observed net demand at the GSP. This headroom will generally be larger than the Technical Limit in a given half-hour, but at some GSPs that see reverse power flows already this headroom may be smaller than the Technical Limit.

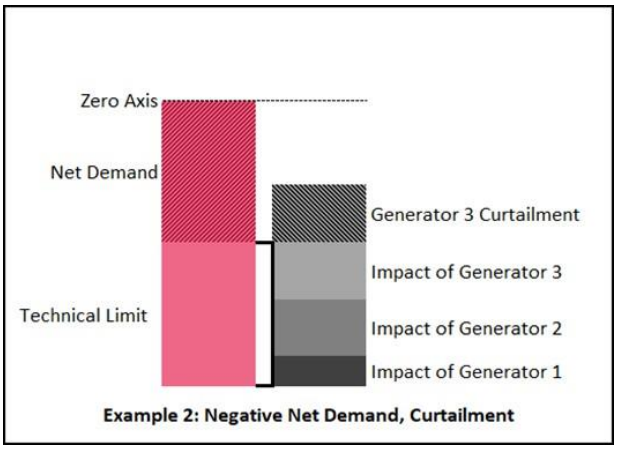
In our assessment, as in practice, headroom is assigned to connections subject to transmission reinforcement according to their order in the queue. Should a connection not be able to realise their contracted export, we classify that half-hour as being curtailed.

The following charts are provided to visualise the assessment and allocation of headroom for a single half-hour. These are prepared using generic data and are not necessarily representative of actual conditions on the network.



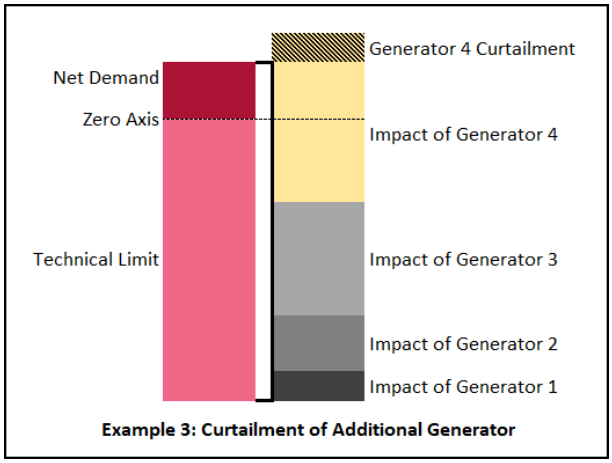
Example 1: Positive Net Demand, No Curtailment

1) No curtailment example - This chart represents one half hour when the net demand is positive, the Technical Limit is negative, and the cumulative impact of all three generators in the queue fit within the initial headroom. Every generator can realise their full export in this half hour.



Example 2: Negative Net Demand, Curtailment

2) Curtailment example - This chart represents the half hour when the GSP Net Demand in the above example has become negative i.e. is being driven into a reverse power flow by an existing generator embedded in the network. This results in Generator 3 in the earlier example experiencing curtailment as there is less initial headroom.



Example 3: Curtailment of Additional Generator

3) Additional generator example - This chart represents the addition of another generator, Generator 4 – this generator is experiencing some curtailment even with a positive GSP Net Demand. Note that this generator would have experienced no curtailment in example 1, and would have been 100% curtailed in example 2.