System Non-Synchronous Penetration

Definition and Formulation

Operational Policy – 27 August 2018

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Introduction

With increasing level of installed non-synchronous generation capacity i.e. wind and solar, and further interconnection to the All-Island power system, it is necessary to measure and limit the System Non-Synchronous Penetration (SNSP) to ensure safe and prudent operation of the system. The purpose of this document is to clarify the definition of SNSP.

The definition of SNSP is based on the results of the Facilitation of Renewables (FoR) studies. If future studies show a change in the SNSP definition is required, this policy will be updated accordingly.

Context

The FoR studies identified a number of issues associated with operating the power system with high penetrations of non-synchronous sources (e.g. wind generation and interconnector imports). These issues include frequency stability, transient stability and voltage stability, following the loss of a large infeed or following a transmission fault. The SNSP metric was developed, based on analysis of the results of the studies, to provide a single constraint that captures the range of issues. Although the metric is an approximation, it is deemed a prudent constraint to apply in real-time operation.

In the FoR studies, interconnector import cases and export cases were considered but wheeling flows (import on one interconnector and export on the other) were not explicitly studied. Nevertheless, for the current level of interconnection, it is believed that wheeling flows will not materially impact on system security. Therefore interconnector flows are netted prior to use in the SNSP calculation. This may be reviewed in future as further interconnectors connect to the system.

System Non-Synchronous Penetration Definition

SNSP is a measure of the non-synchronous generation on the system at an instant in time. It is the ratio of the real-time MW contribution from non-synchronous generation and net HVDC imports to demand plus net HVDC exports. The equation to express SNSP as a percentage is thus formulated as follows:

$$\text{SNSP}(\%) = \frac{\text{Non} - \text{Synchronous Generation} + \text{Net Interconnector Imports}}{\text{Demand} + \text{Net Interconnector Exports}} \text{ x } 100$$

Where:

- Non-Synchronous Generation = Total Large Scale Non-Synchronous Generation + Representation of Total Small Scale Non-Synchronous Generation
    - Total Large Scale Non-Synchronous Generation = Total wind and PV generation on the All-Island system (and all additional non-synchronous generation, e.g. tidal)
    - Representation of Total Small Scale Non-Synchronous Generation is calculated as follows:

      SSG_{Rep} = (Installed Capacity of Small Scale Wind Generation * Ratio of Availability to Installed Capacity of Large Scale Wind Generation * 0.6) + (Installed Capacity of Small Scale PV Generation * Ratio of Availability to Installed Capacity of Large Scale PV Generation)
- Net Interconnector Imports/Exports = The net flow of Moyle and EWIC, where flows are measured at the SEM end i.e. Moyle MW flow is measured at Ballycronan More and EWIC MW flow is measured at Portan (e.g. at full export EWIC is 530 MW)
- Demand is measured in generated[1] terms and for the purposes of SNSP includes Turlough Hill pump demand. It is calculated as follows for real-time calculations:
    - Demand = All-Island System Generation (including non-synchronous generation) + Net Imports – Net Exports
    - Where All-Island System Generation[2] represents the generation required to meet the System Demand and any Turlough Hill pump demand

[1] Generated Power = Exported Power + Generator House Load

[2] This is an All-Island equivalent of the current EMS "System Generation". For example, if the demand was 3,000MW and there were two pumps on load at 73 MW each, the System Generation would be approx. 3,146MW.

Additional Notes:

- It is assumed that Turlough Hill is regarded as additional demand when pumping;
- Demand Side Units, when dispatched, result in an implicit reduction in Demand; and
- Aggregated Generating Units should be considered additional synchronous generation.

Settlement Implementation

DS3 System Services

Scalars are applied to DS3 System Service tariffs in order to incentivise flexibility, reliability, value for money and performance in the provision of the services.

The SNSP (%) metric, as described above, is an input into the calculation of the value of the Temporal Scarcity Scalar. The time-weighted average of the SNSP (%) value is calculated for each 30-minute settlement trading period. The Temporal Scarcity Scalar is then applied to the tariff of the services as described in Table 1.

Table 1: Temporal Scarcity Scalar Values (effective May 1st 2018)

Temporal Scarcity Scalar Values				
System Service	SNSP 0% - 50%	SNSP >50% & ≤60%	SNSP >60% & ≤70%	SNSP >70% & ≤75%
POR	1	1	4.7	6.3
SOR	1	1	4.7	6.3
TOR1	1	1	4.7	6.3
TOR2	1	1	4.7	6.3
RRS	1	1	4.7	6.3
RRD	1	1	4.7	6.3
RM1	1	1	4.7	6.3
RM3	1	1	4.7	6.3
RM8	1	1	4.7	6.3
SIR	1	1	4.7	6.3
SSRP	1	1	4.7	6.3
FFR	0	1	4.7	6.3
DRR	0	0	0	6.3
FPFAPR	0	0	0	6.3

The Temporal Scarcity Scalar is one of a number of scalars applicable to the payment to Providing Units for the provision of DS3 System Services. A Providing Unit's contractual Scaling Factor for the provision of a service is the product of the scalars applicable to that service.

Further information on DS3 System Services scalars can be found in the SEM Committee decision paper on tariffs and scalars[3], and the TSOs' scalar design recommendations paper[4].

[3] https://www.semcommittee.com/sites/semcommittee.com/files/media-files/SEM-17-080%20DS3%20SS%20SEMC%20Decision%20Paper%20Regulated%20Arrangements%20Tariffs%20and%20Scalars%20Final%20version.pdf

[4] http://www.eirgridgroup.com/site-files/library/EirGrid/OPI_INN_DS3-System-Services-Scalar-DesignFinal_231017.pdf