# Proposed Values for Uninstructed Imbalances for the Year 2017

## Report to the Regulatory Authorities

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EIRGRID SONI

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# 1. Executive Summary

Uninstructed Imbalances apply in the Single Electricity Market (SEM) when the Actual Output of a Generator Unit deviates from its Dispatch Quantity in a Trading Period. This report to the Regulatory Authorities (RAs) sets out the proposed 2017 values, up to the end of the current SEM but not including the Integrated-Single Electricity Market (I-SEM), for the five parameters used in the calculation of Uninstructed Imbalances, accompanied by relevant justification and background.

It is the Transmission System Operators' (TSOs') opinion that these parameter values provide adequate economic signals at present and that no change is currently warranted. As such, the TSOs propose that the parameter values for 2017 remain unchanged for the current SEM. Corresponding values for the new I-SEM will be proposed separately in 2017.

## 2. TSC Obligations

Paragraph 4.142 of the Single Electricity Market (SEM) Trading and Settlement Code (version 18.0) requires the TSOs to make a report to the RAs at least 4 months before the start of the Year[1] proposing values for the five parameters outlined below used in the calculation of Uninstructed Imbalances for that Year.

The parameters are:

1. Engineering Tolerance, ENGTOL
2. MW Tolerance, MWTOL
3. System per Unit Regulation parameter, UREG
4. Discount for Over Generation, DOG
5. Premium for Under Generation, PUG

This document is the TSOs' joint submission under Paragraph 4.142.

[1] "Year" defined as per Trading and Settlement Code (Version 18.0) glossary: "means a period commencing at 00:00h on 1 January and ending at 24:00h on the next occurring 31 December".

## 3. Uninstructed Imbalance Parameters

All dispatchable generation is required to follow instructions from the control centres within practical limits to ensure the safe and secure operation of the power system. Failure to do so will lead to increased constraint costs as the TSOs would be required to re-dispatch other generation at short notice to account for the mismatch in actual and instructed generation and could, at worst, lead to system blackout. Thus, economic signals to ensure that dispatchable generation follows instructions within acceptable practical limits are required. In SEM, the Uninstructed Imbalance mechanism, as set out in the Trading and Settlement Code, provides such signals.

The Uninstructed Imbalance mechanism should provide economic signals that:

- are sufficient to ensure generators follow dispatch instructions
- are cost related – where possible
- are not unreasonably punitive
- avoid perverse incentives

A change to one individual parameter would require revision of the other parameters used in the Uninstructed Imbalance mechanism to ensure the correct economic signals are maintained. For example, any change to the tolerance band would necessitate a review and likely further change to the adjustment factors applicable outside of the tolerance band in order to recover the costs to the system of the Uninstructed Imbalance and to maintain the necessary incentive to comply with Dispatch Instructions.

# 4. MW Tolerance (MWTOL) and Engineering Tolerance (ENGTOL)

## 4.1 Basis for Parameters

The TSOs have a duty to operate the power system in a safe, secure and economic manner for the benefit of all consumers. Maintaining the demand/supply balance, and thus system frequency, within strict limits is crucial to the management of power system security. The importance of maintaining system frequency close to 50 Hz is demonstrated by the use of system frequency as a power quality metric around the world. Frequency control is maintained by carrying reserves of spare capacity on the system.

As the power system of Ireland and Northern Ireland does not have AC interconnection with other power systems, frequency control is more challenging than for a large interconnected system[2]. Deviation of a Generator Unit from its Dispatch Instruction will have a direct impact on system frequency and on the reserve available to the TSOs for frequency control. This effect is amplified on smaller power systems. Thus, all Generator Units are required to follow Dispatch Instructions from the control centres.

In operation, even at constant steady state frequency, a Generator Unit instructed to a given MW value is unlikely to be able to maintain its output at exactly the dispatched MW level for any period of time. This may be due to tolerances in machine design, precision of measurements, the provision of reactive power, varying instantaneous calorific quality of fuel input and deviations in general thermodynamic conditions. However, over a period of time the average output of the Generator Unit should be manageable within a small tolerance.

To account for these practical limits, the Uninstructed Imbalance mechanism in the SEM includes a tolerance band. When the system is operating at Nominal System Frequency, this tolerance band is defined as the maximum of (a) the MW Tolerance and (b) the Engineering Tolerance multiplied by the Dispatch Quantity. When the system frequency deviates from the Nominal System Frequency, it is expected that Generator Units vary their output to compensate – this is known as frequency regulation. The impact of frequency regulation on the Uninstructed Imbalance mechanism is addressed in Section 5.

## 4.2 Proposed Values

### MW Tolerance MWTOL

The MW Tolerance is a MW value that defines the minimum MW tolerance at Nominal System Frequency within which a Generator Unit is deemed to be complying with its Dispatch Instruction. The MW Tolerance for Generators varies worldwide, with the majority ranging from 1 MW to approximately 10 MW, when such a tolerance is used. These values are dependent on a number of factors including the size of the power system, the settlement mechanism for the deviation, the timeframe across which the deviation is calculated and the prices applicable for deviation outside of the tolerance band. As such, a direct comparison of these values is not appropriate.

A value of 1 MW has been used for the MW Tolerance in SEM to date and was also applied in the settlement of the electricity market in Ireland prior to the start of the SEM. Although the Trading and Settlement Code allows the MW Tolerance parameter value to vary on a

[2] O'Sullivan, J., Power, M., Flynn, M., O'Malley, M., 1999. Modelling of frequency control in an island system. In: IEEE Power Engineering Society 1999 Winter Meeting. Vol. 1. pp. 574–579.

Trading Day basis, the TSOs are of the opinion that there are insufficient grounds to justify introducing a varying value, which would increase the complexity of the Uninstructed Imbalance mechanism.

### Engineering Tolerance ENGTOL

The Engineering Tolerance, a percentage value, defines the percentage tolerance around the Dispatch Quantity at Nominal System Frequency within which a Generator Unit is deemed to be complying with its Dispatch Instruction. Worldwide, there is a range of percentage values used, from 1% upwards, with the majority in the region of 1% to 2%[3].
As for the MW Tolerance, these values are dependent on a number of factors pertinent to each particular power system and market structure. A value of 1% has been used since the beginning of the SEM and, similarly to the MW Tolerance, this value was also implemented in the electricity market in Ireland prior to the SEM.

For these parameter values, at Nominal System Frequency, the tolerance band for a Generator Unit is the maximum of (a) 1 MW and (b) 1% of the Dispatch Quantity. The TSOs believe that this minimum tolerance band continues to be reflective of the acceptable practical limits within which dispatchable generation is required to follow its instructions.

[3] http://www.ieso.ca/imoweb/pubs/interpretBulletins/ib_IMO_MKRI_0001.pdf

# 5. System per Unit Regulation Parameter (UREG)

## 5.1 Basis for Parameter

It is expected that, as a result of governor action, a Generator Unit's output will vary in response to fluctuations in the system frequency (known as frequency regulation). This can result in Uninstructed Imbalances. However, to recognise that frequency regulation is correct behaviour, the Uninstructed Imbalance mechanism widens the tolerance band when the frequency deviates from nominal to ensure that the DOG and PUG parameters do not apply to imbalances that arise as a result of frequency regulation.

## 5.2 Proposed Value

The Generator Units on the island of Ireland normally have a governor droop setting of 4%. The coordination of Droop settings ensures that Generator Units share the requirement for regulation in proportion to their size. Therefore, at the start of the SEM, this was the value adopted for UREG. As the technical characteristics of the Generator Units on the system have not changed, no change to this parameter value is necessary.

# 6. Discount for Over-Generation (DOG) and Premium for Under-Generation (PUG)

## 6.1 Basis for Parameters

Generator Units should normally remain within the tolerance band, as discussed in Section 4. If a Generator Unit moves outside the tolerance band, additional constraint costs are incurred due to the requirement for corrective action to be taken by the TSOs to avoid compromised system security. It is therefore appropriate to provide economic signals to incentivise Generator Units to remain within the tolerance band.

Over-generation outside of tolerance by a Generator Unit results in a need for the TSOs to instruct other Generator Units down from their dispatched levels to lower levels in order to balance supply and demand. Significant over-generation can necessitate dispatching a Generator Unit off load to compensate. Under-generation outside of tolerance by a Generator Unit results in the need to instruct other Generator Units up from their dispatched levels to higher levels. In the event of unexpected or large under-generation by a Generator Unit the TSOs must act in a quick and decisive manner to restore appropriate system balance and reserve targets. This will generally necessitate dispatching on quick-start generation.

From a system security standpoint, over- or under-generation is undesirable as it can result in unnecessary ramping and cycling of Units, increasing the likelihood for Unit trips and / or increasing wear and tear of Generator Units.

## 6.2 Proposed Values

Prior to the start of the SEM, a study[4] was carried out by the TSOs to evaluate the costs incurred on the system due to Uninstructed Imbalances. Generally, a Generator Unit that over-generates should be entitled to no more than the average costs of the resources dispatched down to displace the over-generated volumes. In contrast, a Generator Unit that under-generates should, generally speaking, pay back at least the average costs of the resources dispatched up and on to replace the under-generated volumes.

The conclusions of the study into the costs involved in Uninstructed Imbalances suggested that a value of 0.2 for both DOG and PUG provided an appropriate signal to Generator Units to comply with Dispatch Instructions within the proposed tolerance band while ensuring that there is recovery of the additional constraint costs incurred. The TSOs believe that based on operational experience to date these values of 0.2 for both DOG and PUG, which have been in place since 2007, are providing sufficient economic signals to cause Generator Units to follow Dispatch Instructions whenever possible, while being cost related and not overly punitive.

In respect of Interconnectors under test, the TSOs are proposing that DOG and PUG values continue to be set to zero for 2017 (up to the end of the current SEM). Until such a time as the market design provides for an Interconnector test profile to be submitted, it would be

[4] Proposed values for Uninstructed Imbalances for the First Trading Year: **AIP/SEM/07/430**

unduly penal to allow DOG and PUG values to be applied in this case. This has been previously described in the TSOs' published paper SEM-12-001a[5].

[5] See System Operators published paper SEM-12-001a https://www.semcommittee.com/sites/semcommittee.com/files/media-files/SEM-12-001a%20TSO%20Paper%20on%20Updated%20Operational%20Parameters%202012.pdf

# 7. I-SEM Parameters

Paragraph 4.142 of the SEM Trading and Settlement Code requires the TSOs to make a report to the RAs at least 4 months before the start of the Year proposing values for the Uninstructed Imbalance parameters for the coming calendar Year. The new I-SEM design is due to go live on the 1st of October 2017. Based on this timeline, the TSOs have submitted proposed Uninstructed Imbalance parameters for the period of the 1st of January 2017 to the 30th of September 2017. From the 1st of October 2017 the new market design under I-SEM will come into effect and the Uninstructed Imbalance parameters will need to be reviewed in light of the new market design. This review, and the submission of proposed values in advance of I-SEM go-live, will be carried out through the parameter setting process being developed as part of the I-SEM Market Rules Working Group.

## 8. Conclusion

It is the TSOs' opinion, based on operational experience since the start of SEM in November 2007, that the Uninstructed Imbalance parameters are providing adequate economic signals at present and that no change is currently warranted to these parameter values for the remainder of the SEM. Appropriate Uninstructed Imbalance parameters for I-SEM will have to be calculated based on the new market design but this is outside the scope of this paper.

The proposed values for the parameters used in the calculation of Uninstructed Imbalances for the remainder of the SEM are set out in the table below:

| | Parameter | Proposed Value |
|---|---|---|
| 1 | Engineering Tolerance, ENGTOL (where 0 ≤ ENGTOL ≤ 1) | 0.01 |
| 2 | MW Tolerance for each Trading Day t, MWTOLt (where 0 ≤ MWTOLt) | 1 |
| 3 | System per Unit Regulation parameter, UREG | 0.04 |
| 4 | Discount for Over Generation for each Generator Unit u, in each Trading Period h, DOGuh (such that 0 ≤ DOGuh ≤ 1) | 0.2 |
| 5 | Premium for Under Generation for each Generator Unit u in each Trading Period h, PUGuh (such that 0 ≤ PUGuh ≤ 1) | 0.2 |