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# Operational Constraints Update

## 30/04/2020

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### ***Key Updates***

- *Section 3.4.2: Inclusion of S\_NBMIN\_MINNI3, requirement that at least one of Coolkeragh 30, Kilroot 1 or Kilroot 2 is on at all times. Operational Constraint active from 25 April.*

### **Disclaimer**

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## 1. Introduction

To enable the efficient and secure operation of the power system, EirGrid and SONI schedule and dispatch units so as to adhere to their respective Operating Security Standards<sup>1</sup>. These standards ensure that the all-island transmission system is operated in a secure and reliable manner.

The process by which the TSOs schedule and dispatch the power system is outlined in the 'Balancing Market Principles Statement'<sup>2</sup>. This includes a description of how the operational constraints outlined in this document are applied.

### 1.1 Document Objective

The objective of the Operational Constraints Update is to present the key system and generator constraints which are included in the scheduling process. The most common operational constraints that are modelled are:

- North – South tie-line export / import constraint: MWR type
- Moyle import / export constraint: MW type
- Requirement to keep a minimum number of units on in an area: NB type
- Requirement to limit the output of the generators in an area to limit short circuit levels or overloads: MW type or NB type
- Requirement for a minimum output from the generators in an area to support the voltage or to avoid overloads: MW type or NB type

This document comprises of: (i) **Operating Reserve Requirements**, and (ii) **System Constraints**.

### 1.2 List of Terms

| Transmission Constraint Group (TCG) Type |   |
|--|---|
| MW                                       | Limit MW output of unit or units assigned to a TCG                                |
| MWR                                      | Limits (the total MW + Primary Reserve - the area demand) from assigned resources |
| NB                                       | Limit to the status (On/Off) of the unit or units assigned to a TCG               |

| Limit Flag |   |
|------------|---|
| E          | Equality Constraint (generation = load)                               |
| X          | Export Constraint - limit output of a group of units $\leq$ max limit |
| N          | Import Constraint - limit output of a group of units $\geq$ min limit |
| B          | In-between Constraint; $\geq$ min and $\leq$ max                      |

<sup>1</sup>

<http://www.soni.ltd.uk/media/documents/Operations/SONI%20Operating%20Security%20Standards%20v1.pdf>

<http://www.eirgridgroup.com/site-files/library/EirGrid/Operating-Security-Standards-December-2011.pdf>

<sup>2</sup> <https://www.sem-o.com/documents/EirGrid-and-SONI-Balancing-Market-Principles-Statement-V2.0.pdf>

## 2. Operating Reserve Requirements

The following tables show the operating reserve requirements on an all-island basis and in each jurisdiction.

| Category                            | All Island Requirement % Largest In-Feed | Ireland Minimum <sup>1</sup> (MW) | Northern Ireland Minimum (MW) |
|-------------------------------------|--|-----------------------------------|-------------------------------|
| POR                                 | 75% <sup>3</sup> (S_PRM_TOT)             | 155/ 150 (S_PRM_ROI)              | 50 (S_PRM_NI)                 |
| Regulating Sources POR <sup>2</sup> |  | 135/ 75 (S_PRM_ROI)               | 50 (S_PRM_NI)                 |
| SOR                                 | 75% <sup>4</sup> (S_SEC_TOT)             | 155/ 150 (S_SEC_ROI)              | 50 (S_SEC_NI)                 |
| TOR1                                | 100% (S_TR1_TOT)                         | 155/ 150 (S_TR1_ROI)              | 50 (S_TR1_NI)                 |
| TOR2                                | 100% (S_TR2_TOT)                         | 155/ 150 (S_TR2_ROI)              | 50 (S_TR2_NI)                 |

1. Ireland Lower values apply for when there is at least one pump storage unit in pump mode.
2. Minimum values of POR in each jurisdiction must be supplied from regulating sources
3. At times more than 75% POR is held All Island (up to 80%) in order to maintain system security standards based on transient security analysis (this will remain under review by the TSOs).
4. At times more than 75% SOR is held All Island (up to 100%) in order to maintain system security standards based on real-time transient security analysis (this will remain under review by the TSOs).

### 2.1 Operating Reserve Definitions

| Category          | Delivered By | Maintained Until |
|-------------------|--------------|------------------|
| Primary (POR)     | 5 seconds    | 15 seconds       |
| Secondary (SOR)   | 15 seconds   | 90 seconds       |
| Tertiary 1 (TOR1) | 90 seconds   | 5 minutes        |
| Tertiary 2 (TOR2) | 5 minutes    | 20 minutes       |

### 2.2 Source of Reserve

|                                     | Ireland  | Northern Ireland  |
|-------------------------------------|--|---|
| Regulating Reserve                  | Synchronised Generating Units  | Synchronised Generating Units   |
| Non or Partially Regulating Reserve | Turlough Hill Units when in pumping mode<br>23 MW of Response from DSUs<br>EWIC Interconnector (up to 75 MW) <sup>3</sup>              | 10 MW of battery response<br>2 MW of Response from DSUs<br>Moyle Interconnector (up to 75 MW)   |
| Negative Ramping Reserve            | 100MW<br><br>(Defined as the MW output of a conventional generator above its minimum load which can be delivered at or above 5 MW/min) | 50MW<br><br>(Defined as the MW output of a conventional generator above its minimum load which can be delivered at or above 5 MW/min) |

<sup>3</sup> On trial with NGET

## 3. System Constraints

### 3.1 Tie Line Limits

Tie line flows in both directions have physical limits, the maximum flow that can be sustained without breaching system security rules (line overloads, voltage limits, system stability etc.) after a credible transmission or generation event. The limits are referred to as the Total Transfer Capacity (TTC) comprising of two values: N-S and S-N. For more information on Inter-Area Flow (North-South Tie Line) Constraints follow link:

[https://www.sem-o.com/documents/general-publications/Information\\_Note\\_on\\_Inter-Area\\_Flow\\_Constraints.pdf](https://www.sem-o.com/documents/general-publications/Information_Note_on_Inter-Area_Flow_Constraints.pdf)

### 3.2 Non-Synchronous Generation

To ensure the secure, stable operation of the power system, it is necessary to limit the level of non-synchronous generation of the system. The System Non-Synchronous Penetration (SNSP) is a measure of the non-synchronous generation on the system at an instant in time i.e. the non-synchronous generation and net interconnector imports as a percentage of the demand and net interconnector exports (where "Demand" includes pump storage consumption when in pumping mode).

### 3.3 Adverse Weather and Increased System Risk

During periods of adverse weather or where there is an increased system risk (e.g. high impact generator or interconnector testing), the TSOs may implement measures to mitigate the consequences of this risk. Such measures may include but not limited to scheduling additional reserve and running units out of merit.

There are no changes to operational constraints at present associated with the Covid-19 pandemic. It is of critical importance that the security of the power system is maintained during the Covid-19 pandemic period.

As such The TSOs are aware that Covid-19 may have implications for market participants during the pandemic period.

Should market participants identify operational risks related to Covid-19 they should inform the TSO as soon as possible via their normal point of contact. Should this instigate a significant change to scheduling and dispatch the TSOs will update this weekly constraints document to reflect this in a revised publication as soon as possible.

Any changes to operational constraints will be notified through the Weekly Operational Constraints Process.

### 3.4 Permanent System Constraint Tables

The following tables set out the system constraints:

- Active System Wide Constraints;
- Active Northern Ireland Constraints, and
- Active Ireland Constraints.

Note that the limits specified in each table represent the normal intact transmission network limit. These limits may vary from time to time due to changing system conditions.

### 3.4.1 Active System Wide Constraints

| Name   | TCG Type | Limit Type | Limit   | Resources   | Description   |
|--|----------|------------|---|---|---|
| <b>Inter-Area Flow</b><br><b>(S_MWR_ROI)</b>                   | MWR      | X:<=       | 400 MW<br>(There is a margin of 20MW on this limit for system safety) | Ireland and Northern Ireland Power Systems          | Ensures that the total MW transferred from Ireland to Northern Ireland does not exceed the operational limits of the North-South tie line. It takes into account the rescue/reserve flows that could occur immediately post fault inclusive of operating reserve requirements.<br><br>This is required to ensure the operational limits of the existing North South tie line are respected. |
| <b>Inter-Area Flow</b><br><b>(S_MWR_NI)</b>                    | MWR      | X:<=       | 450 MW<br>(There is a margin of 20MW on this limit for system safety) | Ireland and Northern Ireland Power Systems          | Ensures that the total MW transferred from Northern Ireland to Ireland does not exceed the limitations of the North-South tie line. It takes into account the rescue/reserve flows that could occur immediately post fault inclusive of operating reserve requirements.<br><br>This is required to ensure the limits of the existing North South tie line are respected.                    |
| <b>Non-Synchronous Generation</b><br><b>(S_SNSP_TOT)</b>       |          | X:<=       | 65%   | Wind, PV, Moyle Interconnector, EWIC Interconnector | Ensures that the SNSP is kept below 65%.  |
| <b>Operational Limit for RoCoF</b><br><b>(S_RoCoF)</b>         |          | X:<=       | 0.5 Hz/s  | Ireland and Northern Ireland Power Systems          | Ensures that RoCoF does not exceed 0.5 Hz/s.  |
| <b>Operational Limit for Inertia</b><br><b>(S_INERTIA_TOT)</b> |          | N:>=       | 23,000MWs   | Ireland and Northern Ireland Power Systems          | Ensures that all island Inertia does not fall below 23,000 MWs.   |

### 3.4.2 Active Northern Ireland Constraints

| Name  | TCG Type | Limit Type | Limit                                     | Resources  | Description  |
|---|----------|------------|---|--|--|
| <b>System Stability</b><br>(S_NBMIN_MINNIU)                       | NB       | N:>=       | 3 Units at all times                      | B10, B31, B32, C30, K1, K2                                     | There must be at least 3 machines on-load at all times in Northern Ireland. Required for dynamic stability.  |
| <b>System Stability</b><br>(S_NBMIN_MINNI3)                       | NB       | N:>=       | 1 Unit at all times                       | C30, K1, K2  | There must be a least 1 machine on-load at all times in Northern Ireland. Required for dynamic stability.  |
| <b>Replacement Reserve</b><br>(S_REP_NI)<br>(S_MWMAX_NI_GT)       | MW       | X:<=       | 272 MW                                    | BGT1, BGT2, CGA, CGT8, EMPOWER, iPOWER, KGT1, KGT2, KGT3, KGT4 | Combined MW output of OCGTs and AGUs must be less than 272 MW (out of a total of 397 MW) in Northern Ireland at all times. 125 MW required for replacement reserve. The limit is subject to change based on the availability of the units and transmission constraints that may limit their output.  |
| <b>North West Generation</b><br>(S_NBMIN_CPS)                     | NB       | N:>=       | 0 or 1 Unit depending on NI system demand | C30  | Coolkeeragh C30 must be on load when the NI system demand is at or above 1,550 MW, CGT8 is unavailable and NI wind generation < 450 MW. This demand limit can be raised to 1,608 MW if CGT8 is available. For NI wind generation in excess of 450 MW there is no constraint. This operational constraint is required to ensure voltage stability in the northwest of Northern Ireland and to prevent possible system voltage collapse above the indicated system demand. |
| <b>Moyle Interconnector</b><br>(S_MWMIN_MOYLE)<br>(S_MWMAX_MOYLE) | MW       | B          | -380* < MW < 442<br><br>-                 | Moyle Interconnector <sup>4</sup>                              | It ensures that all flows do not exceed an import of 442MW to Northern Ireland and an export of 380MW* to Scotland (values taken from NI). This is required to ensure that the limits are respected.<br>*Note: Firm export limit on Moyle reduced to 80MW from 10 <sup>th</sup> November 2017. There is an agreed process between Moyle and NGET on releasing additional “non-firm” export capacity when GB system conditions allow.                                     |

<sup>4</sup> Combined Ramp Rate of EWIC and Moyle Interconnectors is limited to 10 MW/Min



### 3.4.3 Active Ireland Constraints

[A] Scenario A: In this scenario if PBA or PBB are operating in combined cycle mode they will be considered as constraint resources

[B] Scenario B: In this scenario if PBA or PBB are configured to synchronise in 10 minutes they will be considered as constraint resources

| Name   | TCG Type | Limit Type | Limit                                    | Resources  | Description  |
|--|----------|------------|--|--|--|
| System Stability<br>(S_NBMIN_ROImin)                   | NB       | N:>=       | 5 Units                                  | AD2, DB1, GI4, HNC, HN2, MP1, MP2, MP3, PBA [A], PBB [A], TB3, TB4, TYC, WG1 | There must be at least 5 machines on-load at all times in Ireland. Required for dynamic stability.<br><br>[A] See Scenario A   |
| Replacement Reserve<br>(S_REP_ROI)<br>(S_MWMAX_ROI_GT) | MW       | X:<=       | 698 MW<br>[B]                            | AT1, AT2, AT4, ED3, ED5, RP1, RP2, TP1, TP3. PBA [B], PBB [B]                | Combined MW output of OCGTs must be less than 698 MW (out of a total of 1023 MW) in Ireland at all times. 325 MW required for replacement reserve. The limit is subject to change based on the availability of the units and transmission constraints that may limit their output.<br><br>[B] See Scenario B |
| Dublin Generation<br>(S_NBMIN_DubNB2)                  | NB       | N:>=       | 1 Units                                  | DB1, HNC, HN2  | There must be at least 1 large generator on-load at all times in the Dublin area. Required for voltage control.  |
| Dublin Generation<br>(S_NBMIN_Dub_NB)                  | NB       | N:>=       | 2 Units                                  | DB1, HNC, HN2, PBA [B], PBB [B]  | There must be at least 2 large generators on-load at all times in the Dublin area. Required for voltage control. This assumes EWIC is operational.<br><br>Note that during an outage of EWIC there must be at least 3 large generators on-load at all times in the Dublin area.<br><br>[B] See Scenario B    |
| Dublin Generation<br>(S_NBMIN_DUB_L1)                  | NB       | N:>=       | 2 Units if Ireland System Demand >4000MW | DB1, HNC, PBA [B], PBB [B],  | Requirement for 2 units to be on load when Ireland System Demand is greater than 4000 MW. This operational constraint is required for load flow control in the Dublin area. This assumes EWIC is operational.<br><br>[B] See Scenario B  |

| Name                                  | TCG Type | Limit Type | Limit  | Resources                              | Description   |
|---------------------------------------|----------|------------|--|--|---|
| Dublin Generation<br>(S_NBMIN_DUB_L2) | NB       | N:>=       | 3 Units if Ireland System Demand > 4700 MW   | DB1, HNC, HN2, PBA [B], PBB [B]        | Requirement for 3 units to be on load when Ireland System Demand is greater than 4700 MW. This operational constraint is required for load flow control in the Dublin area. This assumes EWIC is operational.<br><br>[B] See Scenario B   |
| South Generation<br>(S_NBMIN_STHLD1)  | NB       | N:>=       | 1 Unit if Ireland System Demand > 1500 MW  | AD2, AT1, AT2, AT4, SK3, SK4, WG1      | Requirement for at least one Unit to be on load when Ireland System Demand is greater than 1500 MW. This operational constraint is required for voltage stability in the South.   |
| South Generation<br>(S_NBMIN_STHLD2)  | NB       | N:>=       | 2 Units if Ireland System Demand > 2500 MW<br><br>3 Units if Ireland System Demand > 3500 MW | AD2, AT1, AT2, AT4, GI4, SK3, SK4, WG1 | Requirement for at least two Units, to be on load when Ireland System Demand is greater than 2500 MW.<br><br>Requirement for at least three Units, to be on load when Ireland System Demand is greater than 3500 MW.<br><br>This operational constraint is required for voltage stability in the South. |
| South Generation<br>(S_NBMIN_STHLD3)  | NB       | N:>=       | 1 Unit if Ireland System Demand > 2500 MW  | AD2, AT1, AT2, AT4, GI4, WG1           | Requirement for at least one Unit to be on load when Ireland System Demand is greater than 2500 MW. This operational constraint is required for voltage stability in the South.   |
| South Generation<br>(S_NBMIN_STHLD4)  | NB       | N:>=       | 1 Unit if Ireland System Demand > 3500 MW AND Ireland Wind < 500 MW                          | AD2, AT1, AT2, AT4, WG1                | Requirement for at least one Unit to be on load when Ireland System Demand is greater than 3500 MW AND Ireland Wind total is below 500 MW. This operational constraint is required for voltage stability in the South.  |
| South Generation<br>(S_NBMIN_STHLD5)  | NB       | N:>=       | 1 Unit if Ireland System Demand > 4200 MW  | AD2, GI4, WG1                          | Requirement for at least one Unit to be on load when Ireland System Demand is greater than 4200 MW. This operational constraint is required for voltage stability in the South.   |

| Name  | TCG Type | Limit Type | Limit                   | Resources                           | Description  |
|---|----------|------------|-------------------------|-------------------------------------|--|
| <b>Cork Generation</b><br>(S_MWMIN_CRK_MW)<br>(S_MWMAX_CRK_MW)  | MW       | B          | 0 MW<br><MW<<br>1100 MW | AD2, AT1, AT2,<br>AT4, WG1          | Generation restriction in the Cork area: this will be determined week ahead and available in the Weekly Operational Constraints Update.  |
| <b>South Generation</b><br>(S_MWMIN_STH_MW)<br>(S_MWMAX_STH_MW) | MW       | B          | 0 MW<br><MW<<br>1800 MW | AD2, AT1, AT2,<br>AT4, G14, WG1     | Generation restriction in the Southern Region: this will be determined week ahead and available in the Weekly Operational Constraints Update.  |
| <b>400 kV Network</b><br>(S_NBMIN_MP_NB)                        | NB       | N:>=       | 1 Unit                  | MP1, MP2, MP3,<br>TYC               | There must be at least one unit on load at all times; required to support the 400kV network.   |
| <b>EWIC Interconnector</b><br>(S_MWMIN_EWIC)<br>(S_MWMAX_EWIC)  | MW       | B          | -526<br><MW< 504        | EWIC<br>Interconnector <sup>5</sup> | It ensures that all flows do not exceed an import of 504MW to Ireland and an export of 526MW to GB (values taken from Portan). This is required to ensure that the limits are respected. |
| <b>South West Generation</b><br>(S_NBMAX_SW_NB)                 | NB       | N:>=       | 1 Unit                  | TB3, TB4                            | To support South West voltage, at times of low demand and very low wind generation output in the south-west, additional generation may be required                                       |

<sup>5</sup> Combined Ramp Rates on EWIC and Moyle Interconnectors are limited to 10 MW/Min