# Operational Constraints Update
# 21st October 2015

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| *Key Updates* | *Impact* |
|---|---|
| • *Active Ireland Constraints: Change to the System Demand value for the Dublin Generation PBC/HNC load based rule.*<br>• *Source of Reserve: Increase in Interruptible Load provision.*<br>• *Active System Wide Constraints: The Non-Synchronous Generation limit is currently being trialled at 55%.* | *Medium*<br>*Medium*<br>*Medium* |

strongly recommend that any party wishing to make a decision based on the content of this document should consult the TSO in advance.

## Contents

# 1. Introduction

To enable the efficient and secure operation of the system, generation is dispatched to certain levels to prevent equipment overloading, voltages outside limits or system instability.
The software used to model the system is the Reserve Constrained Unit Commitment (RCUC).

## 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 (i.e. in the RCUC software). 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
- Requirement to limit the output of stations due to fish spawning: MW type

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

## 1.2 List of Terms

| 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 <= max limit |
| N | Import Constraint - limit output of a group of units >= min limit |
| B | In-between Constraint; >= min and <= max |

## 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[1] (MW) | Northern Ireland Minimum (MW) |
|---|---|---|---|
| POR[2] | 75% | 110 / 75 | 50 |
| SOR | 75% | 110 / 75 | 50 |
| TOR 1 | 100% | 110 / 75 | 50 |
| TOR 2 | 100% | 110 / 75 | 50 |

1. Ireland Lower values apply from 00:00 - 07:00 inclusive
2. Minimum values of POR in each jurisdiction must be supplied by dynamic sources

### 2.1 Operating Reserve Definitions

| | 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 |
|---|---|---|
| Dynamic Reserve | Synchronised Generating Units | |
| Static Reserve | Turlough Hill Units when in pumping mode<br><br>Interruptible Load:<br>Standard provision: 58MW (07:00 – 00:00)<br><br>EWIC Interconnector (up to 100MW) | Moyle Interconnector (up to 50MW) |
| Negative Reserve<br><br>(Defined as the MW output of a conventional generator above its minimum load) | 100MW | 50MW |

# 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 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. When determining minimum system cost, RCUC respects the TTC values by not allowing the sum of the reserve holding in either jurisdiction and the tie line flow to exceed the TTC.

## 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 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.

### 3.3.1 Active System Wide Constraints

| Name | TCG Type | Limit Type | Limit | Resources | Description |
|---|---|---|---|---|---|
| **Inter-Area Flow** | MWR | X:<= | 400 MW (There is a margin of 20MW on this limit for system safety) | Ireland and Northern Ireland Power Systems | Ensures that the total MW transferred between Ireland and Northern 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. |
| **Inter-Area Flow** | MWR | X:<= | 450 MW (There is a margin of 20MW on this limit for system safety) | Ireland and Northern Ireland Power Systems | Ensures that the total MW transferred between Northern Ireland and 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. |
| **Non-Synchronous Generation** | | X:<= | 50% | Wind, MOYLE, EWIC | Ensures that the SNSP is kept below 50%. (This is currently being trialled at 55%). |
| **Operational Limit for RoCoF** | | X:<= | 0.5 Hz/s | Ireland and Northern Ireland Power Systems | Ensures that RoCoF does not exceed 0.5 Hz/s. |
| **Operational Limit for Inertia** | | N:>= | 20,000 MWs | Ireland and Northern Ireland Power Systems | Ensures that All Island Inertia does not fall below 20,000 MWs. |

### 3.3.2 Active Northern Ireland Constraints

| Name | TCG Type | Limit Type | Limit | Resources | Description |
|---|---|---|---|---|---|
| **System Stability** | NB | N:>= | 3 Units at all times | C30, B31, B32, B10, BPS4, BPS5, BPS6, K1, K2 | There must be at least 3 high-inertia machines on-load at all times in Northern Ireland. Required for dynamic stability. |
| **Replacement Reserve** | MW | X:<= | 211 MW | AGU IPOWER, CGT8, BGT1, BGT2, KGT1, KGT2, KGT3, KGT4 | Combined MW output of OCGTs must be less than 211MW (out of a total of 311MW) in Northern Ireland at all times.100MW Required for replacement reserve |
| **North West Generation** | NB | N:>= | 0 or 1 Unit depending on NI system demand | C30 | Coolkeeragh must be on load when the NI system demand exceeds 1000 MW. 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. |
| **Kilroot Generation** | NB | N:>= | 1 or 2 Units depending on NI system demand | K1, K2 | There must be at least one Kilroot unit on load when the NI system demand exceeds 1400 MW and 2 units are required above 1550 MW. This operational constraint is required to ensure voltage stability in the Belfast area and to prevent the requirement for an inter area flow reduction in a post fault scenario. |
| **Ballylumford Generation** | MW | X:<= | 1344 MW Dec - Feb, 1174 MW Mar - Nov | B31, B32, B10, BGT1, BGT2, B4, B5, B6 | The output from Ballylumford Power Station must be limited seasonally due to a circuit rating limitation.<br><br>The unused capacity from Moyle is transferred to Ballylumford, until Moyle returns to full availability. |

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|---|---|---|---|---|---|
| **Moyle Interconnector** | MW | B | -295 <MW <450<br><br>Current restriction is -200<MW <246 | Moyle Interconnector | This applies to all units registered as Moyle Interconnector units. It ensures that all flows do not exceed an import of 450MW to Northern Ireland and an export of 295MW to Scotland. This is required to ensure that the limits are respected.<br><br>Current restriction is due to one pole being unavailable and an operational limit to provide high frequency reserve. |

### 3.3.3 Active Ireland Constraints

| Name | TCG Type | Limit Type | Limit | Resources | Description |
|---|---|---|---|---|---|
| **System Stability** | NB | N:>= | 5 Units | AD1, AD2, DB1, GI4, HNC, HN2, MP1, MP2, MP3, PBC, TB3, TB4, TYC, WG1 | There must be at least 5 high-inertia machines on-load at all times in Ireland. Required for dynamic stability. |
| **Replacement Reserve** | MW | X:<= | 493 MW | AT11, AT12, AT14, ED3, ED5, MRC, NW5, RP1, RP2, TP1, TP3 | Combined MW output of OCGTs must be less than 493MW (out of a total of 793MW) in Ireland at all times. Required for replacement reserve. The MW values are subject to change as availability of the units change. |
| **Dublin Generation** | NB | N:>= | 2 Units | DB1, HNC, HN2, PBC | 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. |
| **Dublin Generation** | NB | N:>= | 1 Unit if Ireland System Demand >4000 MW | PBC, HNC | Requirement for PBC or HNC to be on load when the Ireland System Demand is greater than 4000 MW. This operational constraint is required for load flow control in the Dublin area. |
| **Dublin Generation** | NB | N:>= | 1 Unit if Ireland System Demand > 4600 MW | PBC | Requirement for PBC to be on load when Ireland System Demand is greater than 4600 MW. This operational constraint is required for load flow control in the Dublin area. |
| **Dublin North Generation** | NB | N:>= | 1 Unit | PBC, HNC, HN2 | Requirement for generation in North Dublin (for load flow and voltage control). |
| **Dublin South Generation** | NB | N:>= | 1 Unit | PBC, DB1 | Requirement for generation in South Dublin (for load flow and voltage control). |

| | | | | | |
|---|---|---|---|---|---|
| **South Generation** | NB | N:>= | 1 Unit if Ireland System Demand > 1500 MW | AD1, AD2, AT11, AT12, AT14, MRC, 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. |
| | NB | N:>= | 2 Units if Ireland System Demand > 2500 MW | AD1, AD2, AT11, AT12, AT14, GI4, MRC, SK3, SK4, WG1 | Requirement for at least two Units to be on load when Ireland System Demand is greater than 2500 MW. This operational constraint is required for voltage stability in the South. |
| | NB | N:>= | 3 Units if Ireland System Demand > 3500 MW | AD1, AD2, AT11, AT12, AT14, GI4, MRC, SK3, SK4, WG1 | Requirement for at least three Units to be on load when Ireland System Demand is greater than 3500 MW. This operational constraint is required for voltage stability in the South.<br><br>Note that when Ireland wind is less than 500 MW one of these Units must be AD1, AD2, AT11, AT12, AT14, MRC, WG1. |
| | NB | N:>= | 3 Units if Ireland System Demand > 4200 MW | AD1, AD2, AT11, AT12, AT14, GI4, MRC, SK3, SK4, WG1 | Requirement for at least three Units to be on load when Ireland System Demand is greater than 4200 MW. This operational constraint is required for voltage stability in the South.<br><br>Note that when Ireland wind is less than 500 MW one of these Units must be AD1, AD2, AT11, AT12, AT14, MRC, WG1.<br><br>When Ireland System Demand is greater than 4200 MW one of these Units must be AD1, AD2, GI4, WG1 |

| | | | | | |
|---|---|---|---|---|---|
| **Cork Generation** | MW | B | 0 MW <MW< 1100 MW | AD1, AD2, AT11, AT12, AT14, WG1 | Generation restriction in the Cork area determined week ahead by Grid Operations NearTime. |
| **South Generation** | MW | B | 0 MW <MW< 1800 MW | AD1, AD2, AT11, AT12, AT14, GI4, MRC, WG1 | Generation restriction in the Southern Region. This will be determined week ahead by Grid Operations NearTime. |
| **Moneypoint** | NB | N:>= | 1 Unit | MP1, MP2, MP3 | There must be at least one Moneypoint unit on load at all times. Required to support the 400kV network. |
| **Hydro Smolt Protocol** | NB | N/A | Varies | ER1, ER2, ER3, ER4, LE1, LE2, LE3 | Over the spring and early summer period as the water temperature in the rivers and lakes change, the hydro stations have to be dispatched in a very specific way to allow fish to move safely. This affects the generators in Erne and Lee. |
| **EWIC Interconnector** | MW | B | -526 <MW< 504<br><br>Current restriction is -300<MW <504 | EWIC Interconnector | This applies to all units registered as EWIC Interconnector units. It ensures that all flows do not exceed an import of 504MW to Ireland and an export of 526MW to UK (values taken from Portan). This is required to ensure that the limits are respected.<br><br>Current restriction is due to a high frequency limit on the island. |
| **Turlough Hill Generation** | MW | B | >0 MW by day, <0 MW by night | TH1, TH2, TH3, TH4 | To ensure required MW running of Turlough Hill. |

## 4. DS3 Operational Capability Metric Outlook

A briefing paper which informs industry stakeholders of how operational capability metrics for Ireland and Northern Ireland power system are expected to change out to 2020 is located here. In particular, it highlights the likely changes to System Non Synchronous Penetration (SNSP[1]) metric.

[1] SNSP is a real-time measure of the percentage of generation that comes from non-synchronous sources, such as wind and HVDC interconnector imports, relative to the system demand.