Definition of Curtailment, Constraint and Energy Balancing for Non-Synchronous Renewable Generation Units

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EIRGRID AND SONI DEFINITION OF ENERGY BALANCING, CURTAILMENT AND CONSTRAINT FOR NON-SYNCHRONOUS RENEWABLE GENERATION UNITS

Following a series of consultations, decision paper SEM-13-010: Treatment of Curtailment in Tie-Break Situations noted the importance of a rule-set to differentiate between Constraint and Curtailment of wind generation units to allow each to be applied and compensated differently. That rule-set was published as an annex to SEM-13-010 named SEM-13-011: Definition of Curtailment and Constraint. It was subsequently decided that solar generation units would be treated in the same way as wind generation units.

In order to comply with the Clean Energy Package Regulation (EU) 2019/943 which requires TSOs to be able to operate renewable generation units without priority dispatch, updates are required to SEM-13-011 to add Energy Balancing actions to the rule-set.

Due to the specific characteristics and regulatory context for non-synchronous renewable generation units, the rule-set for determination and application of Energy Balancing, Constraint and Curtailment actions below applies to these unit types only. Energy and non-energy actions for dispatchable units are identified through an ex-post imbalance pricing process, as described in the 'Methodology for System Operator and Non-Marginal Flagging' published by the TSOs.

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Operational Rule for Determination of Energy Balancing, Constraint or Curtailment for Non-Synchronous Renewable Generation Units

Where applicable, market-based dispatch of controllable, non-synchronous renewable generation units without priority dispatch for any of the reasons below is taken on a merit order basis alongside dispatchable units.

Energy Balancing refers to the dispatch of controllable, non-synchronous renewable generation units without priority dispatch to meet the energy requirements of the system in real time.

Constraint of non-synchronous renewable generation refers to dispatch down due to localised network reasons, where only a subset of such generators can contribute to alleviating the problem.

Curtailment refers to the dispatch down of non-synchronous renewable generation for system-wide reasons, where the dispatch down of all such generators would alleviate the problem. There are different types of system security limits that necessitate Curtailment, for example the System Non-Synchronous Penetration (SNSP) limit.

In a situation where the sum of total generation and net interconnector flows exceed the demand to be served, and all units without priority dispatch (both dispatchable and controllable) have been dispatched down to the lowest level possible while maintaining system security, units with priority dispatch are then dispatched down according to the priority dispatch hierarchy. This is also implemented as a Curtailment action for non-synchronous renewable generation units with priority dispatch.

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Principles for Non-Market-Based Application, Relaxation, Rebalancing and Removal of Constraint and Curtailment

For **application** of Curtailment or Constraint across a group, setpoints are calculated for each unit within the group on a pro-rata basis with reference to that unit's nominal output.

Nominal output is what a unit's Active Power Output would be if it were not regulating for Frequency. Frequency Regulation is defined as the automatic adjustment of Active Power output by a Generation Unit, initiated by free governor action in response to continuous minor fluctuations of Frequency on the Power System. Frequency Regulation can cause a non-synchronous renewable generation unit's Active Power Output to vary slightly from its setpoint or Available Active Power.

When a unit is not regulating for frequency, nominal output is equal to its Actual Active Power Output. When the unit is regulating for frequency, nominal output is equal to the minimum of Available Active Power and any active setpoints.

When applying Curtailment or Constraint the grid controller first determines the necessary reduction in output across the relevant group based on system conditions, giving the group MW target.

Unit setpoints for non-market-based application of Curtailment or Constraint within a group are then calculated by the Wind Dispatch Tool as follows:

$$\text{Unit Setpoint} = \text{Group MW Target} \times \left(\frac{\text{Unit Reference Quantity}}{\text{Sum of Reference Quanities}} \right)$$

Relaxation is the lifting of Curtailment or Constraint across a group. Setpoints for relaxation of Curtailment or Constraint are calculated on a pro-rata basis with reference to the headroom, or MW difference, between each unit's nominal output and its maximum allowable output for relaxation (outlined below):

- For Curtailment, the maximum allowable output for relaxation is the minimum of (Available Active Power, Energy Balancing Setpoint, Constraint Setpoint), to the extent that each of these is active.
- For Constraint, the maximum allowable output for relaxation is the minimum of (Available Active Power, Energy Balancing Setpoint)*

**Note: Curtailment cannot be relaxed above a Constraint Setpoint, but a Constraint can be relaxed above a Curtailment Setpoint. Any lower Curtailment Setpoint will be lifted in line with the new Constraint Setpoint.*

When relaxing Curtailment or Constraint the grid controller first determines the allowable increase in output across the relevant group based on system conditions, giving the group MW target.

Unit setpoints for non-market-based relaxation of Curtailment or Constraint within a group are calculated by the Wind Dispatch Tool as follows:

$$\text{Unit Setpoint} = \text{Unit Output} + [\text{(Group MW Target - Group Output)}$$

Over time the Available Active Power or setpoint used as a reference for the calculation of Constraint or Curtailment Setpoints for each unit in a group may change. Rebalancing allows for an update to Constraint or Curtailment Setpoints to reflect the ability of each relevant unit to contribute to the Constraint or Curtailment target at that time. Rebalancing may result in higher setpoints for some units and lower setpoints for others. The group Constraint or Curtailment target remains the same before and after rebalancing.

For **rebalancing** of Curtailment or Constraint within a group, setpoints are calculated on a pro-rata basis with reference to each unit's maximum allowable output for rebalancing (outlined below):

- For Curtailment:
  - the maximum allowable output for rebalancing is the minimum of (Available Active Power, Energy Balancing Setpoint, Constraint Setpoint), to the extent that each of these is active.
  - Only units where the current Curtailment Setpoint is below any active Constraint Setpoint may be included in rebalancing of Curtailment.
- For Constraint:
  - The maximum allowable output for rebalancing is the minimum of (Available Active Power, Energy Balancing Setpoint, Curtailment Setpoint), to the extent that each of these is active.
  - Only units where the current Constraint Setpoint is below any active Curtailment Setpoint may be included in rebalancing of Constraint.

Rebalancing is initiated at the discretion of the grid controller to maintain system security.

Unit setpoints for rebalancing of Curtailment or Constraint within a group are calculated by the Wind Dispatch Tool as follows:

$$\text{Unit Setpoint} = \text{Group MW Target} \times \left(\frac{\text{Unit Reference Quantity}}{\text{Sum of Reference Quanities}}\right)$$

For **Removal** of Constraint or Curtailment, the selected action is removed but may also cause other actions to be removed, as set out below:

- For Removal of Constraint, all active Constraint and Curtailment are removed (noting that any active Energy Balancing Setpoint will remain in place).
- For Removal of Curtailment, the Curtailment instruction is removed (noting that any active Constraint or Energy Balancing Setpoint will remain in place).

Parallel Constraints

In order to manage constraints, non-synchronous renewable generation units are grouped together depending on their effectiveness to alleviate those constraints. An individual non-synchronous renewable generation unit may be part of more than one constraint group, each with a different group MW target and resulting unit Constraint Setpoints. This is described in detail in the Wind Dispatch Tool Constraint Group Overview published on the EirGrid and SONI websites.

In addition to the above principles, Constraint Setpoints for an individual unit arising from different Constraint groups may be considered in parallel with each other. In this approach Constraint Setpoints for a unit are calculated independently of Constraint Setpoints for that unit from other Constraint groups. Where the calculated Constraint Setpoint for a unit from a particular Constraint group is higher than an existing Constraint Setpoint for that unit from another Constraint group, the setpoint issued to the unit is the lower setpoint.