PSU Resources Workaround – Reference Card

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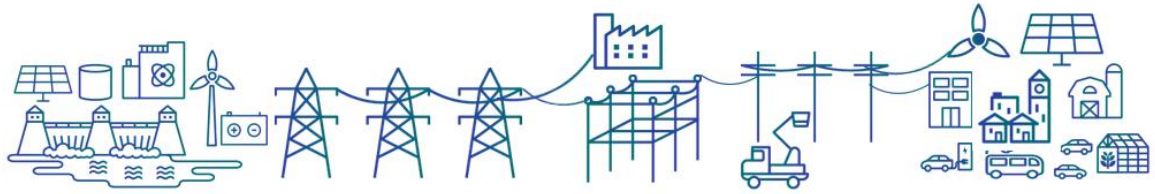
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Day-Ahead Market & Real-Time Scenarios

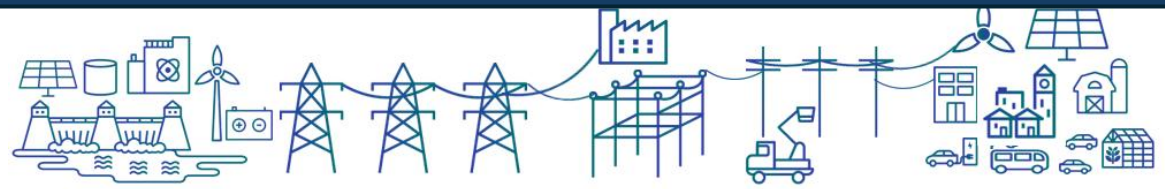
The IESO is currently reviewing several issues identified since the launch of the renewed market, specifically related to the ramping and scheduling of pseudo-unit resources (PSU). As part of this process, the IESO is exploring feasible interim workarounds while permanent system solutions are being developed.

Day-Ahead Market Issue(s) Identified

- **Issue 1:** PSU Derates or Constraints applied to CT or ST below Dispatch Scheduling and Optimization engine (DSO) calculated MLP, results in the PSU being dispatched to 0 MW.

Real-Time Market Issue(s) Identified

- **Issue 1:** Derates on the ST get allocated pro-rata amongst all PSUs at a station including ones that are U/A from an outage slip.
- **Issue 2:** PSU Derates or Constraints applied on CT or ST below DSO calculated MLP, results in the PSU being dispatched to 0 MW.
- **Issue 3:** ST ramping up to MLP after associated CT.
- **Issue 4:** CT Derate on Duct Firing (DF) Range.
- **Issue 5:** IESO DSO does not calculate non-linear 2x1 or 3x1 ST MLP resulting in infeasible OR schedules



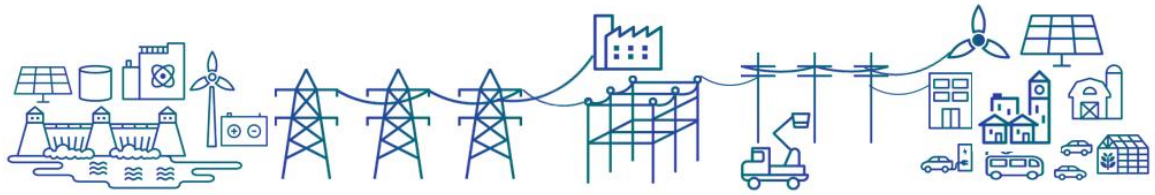
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Day-Ahead Market & Real-Time Scenarios

The following are sample scenarios for day-ahead and real-time that illustrate the identified issues. These scenarios are intended to clarify the nature of the scheduling problems and provide guidelines on actions (steps) to mitigate the impact.

Important considerations for the scenarios:

- Where applicable, it is noted that **two different outage slips are to be submitted, one for the Combustion Turbine (CT) and one for the Steam Turbine (ST).**
- When submitting the outage slips, Market Participants (MP) must ensure there is a **comment in the outage slip which indicates the new max capacity for the PSU**. The MP may provide additional time slice information (if needed) and the IESO may set the high operating limit at those specific times.
- The **"DSO calculated Minimum Loading Point (MLP)"** is referred to throughout the reference card, this is a linear calculation where the **1x1 MLP that was submitted by the MP in their daily dispatch data is multiplied by the number of CTs at the facility.**



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Day-Ahead Market Scenario

Issue 1: PSU Derates or Constraints applied to CT or ST below Dispatch Scheduling and Optimization engine (DSO) calculated MLP, results in the PSU being dispatched to 0 MW.

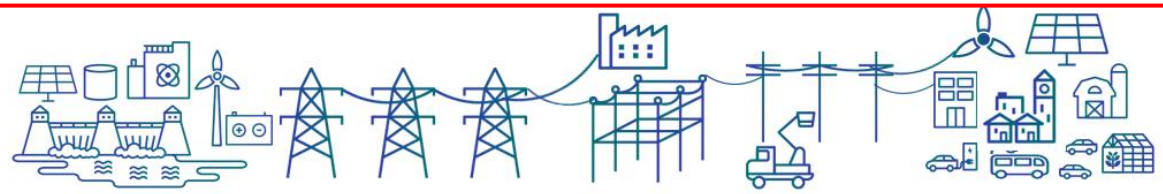
Description: Any derate on the physical units associated with a PSU (CT or ST) to below the DSO calculated MLP, will result in the PSU being dispatched to 0 MW. The DSO calculates a MLP for each PSU at a station, when a derate is applied to the physical ST unit, the DSO will allocate the constraint pro-rata according to the amount of energy offered to each ST portion of a PSU. The calculation of maximum constraints on PSUs is outlined in the Market Renewal Program: Day-Ahead Market Calculation Engine Detailed Design Document Section 3-12.3.4 CT Maximum Constraints and Section 3.12.3.6 ST Maximum Constraints.

Scenario A: a CT planned outage ~~or derate~~ in the day ahead timeframe is submitted, accompanied by a derate slip on the associated ST unit to reflect the reduced capability on the ST, (this scenario also includes seasonal derate). Derating the ST below the highest unit configuration DSO calculated MLP results in a DAM schedule of 0 MW.

Step 1: Submit the appropriate ST derate value using the **'Planned'** priority code (if possible) or **'Urgent'** (if submitting derates past the normal planning timeframe) in the outage program. Inform the IESO of the maximum capacity of ~~each~~ the remaining PSU at the station during the outage~~/derate~~ timeframe, this information will be relayed to the IESO via a **comment on the outage/derate slip.**

Step 2: The IESO will ensure the outage slip is not considered by the DAM calculation engine to prevent a schedule to 0 MW and will instead apply a high operating limit against all PSUs at the station. This high limit will be for the maximum capability, and duration provided by the participant to the IESO through the "Planned" outage slip.

Note: The derate slip is required for reporting purposes, IESO action will ensure correct dispatching based on the information in the slip



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Real-Time Market Scenarios

Issue 1: Derates on the ST get allocated pro-rata amongst all PSUs at a station including ones that are U/A from an outage slip.

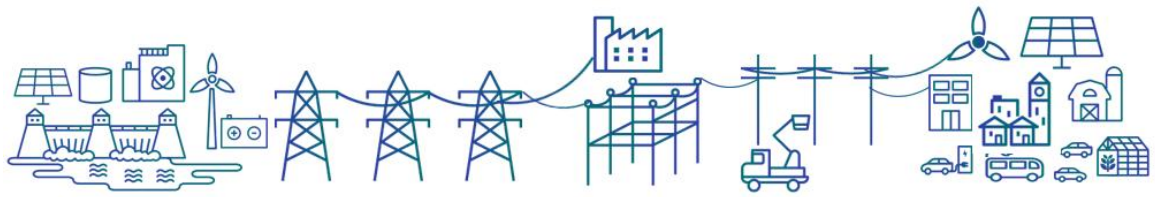
Description: The DSO allocates the constraint pro-rata according to the amount of energy offered to each ST portion of a PSU and does not consider the outage slip. So, when an outage slip is submitted on the CT, and a proportional derate is submitted on the ST, its reduced capacity is automatically allocated amongst all offered PSUs, including the out of service one, which results in a reduced operating range to all the available PSUs. The calculation of maximum constraints on a PSUs is outlined in the Market Renewal Program: Real-Time Calculation Engine Detailed Design Document Sections 3.10.3.4 CT Maximum Constraints and Section 3.10.3.6 ST Maximum Constraints.

Scenario A: CT is forced U/A, and the ST capability needs to be reduced.

Step 1: Submit an outage slip on the CT using the **'Forced'** priority code, and an associated ST derate slip using the **'Urgent'** priority code. Inform the IESO of the maximum capacity of each PSU in service at the station, this should be via a **comment on the outage/derate slip.**

Step 2: The IESO will ensure the ST outage slip is not considered by the DSO and will instead apply a high operating limit against the remaining PSUs at the station. This high limit will be for the maximum capability, and duration provided by you to the IESO through either the outage slip or verbally to the IESO control room.

Step 3: For **future hours, adjust your offers** to align with the PSU expected output, unless the max offer would be below DSO calculated MLP. The IESO will approve mandatory window offer changes in these instances.



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Real-Time Market Scenarios

Issue 2: PSU Derates or Constraints applied on CT or ST below DSO calculated MLP, results in the PSU being dispatched to 0 MW.

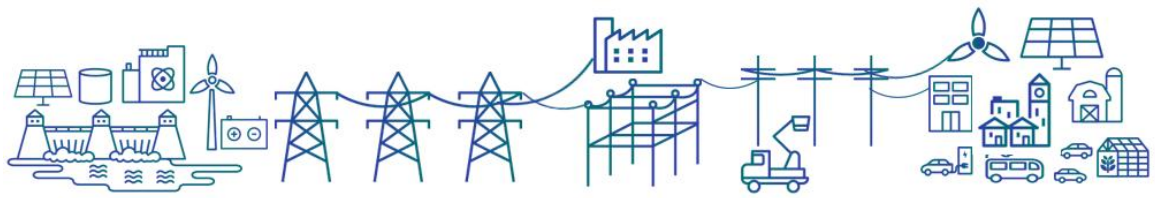
Description: Any derate on the physical units associated with a PSU (CT or ST) to below the DSO calculated MLP, will result in the PSU being dispatched to 0 MW. The DSO calculates a MLP for each PSU at a station, when a derate is applied to the physical Steam Turbine (ST) unit, the DSO will allocate the constraint pro-rata according to the amount of energy offered to each ST portion of a PSU. The calculation of maximum constraints on PSUs is outlined in the Market Renewal Program: Real-Time Calculation Engine Detailed Design Document Sections 3.10.3.4 CT Maximum Constraints and Section 3.10.3.6 ST Maximum Constraints.

Scenario A: One CT gets forced U/A reducing the capability on the ST. Since derating the ST to below the highest unit configuration DSO calculated MLP results in a dispatch to 0 MW on all remaining PSUs.

Step1: Submit the appropriate ST derate value using the **'Urgent'** priority code in the outage program. **Inform the IESO of the maximum capacity of each PSU** in service at the station, this should be via a **comment on the outage/derate slip.**

Step 2: The IESO will ensure the outage slip is not considered by the market tools to prevent the dispatch to 0 MW and will instead apply a high operating limit against the remaining PSU/s at the station. This high limit will be for the maximum capability, and duration provided by the Participant to the IESO through either the outage slip or verbally to the IESO control room.

Note: The derate slip is required for reporting purposes, IESO action will ensure correct dispatching based on the information in the slip



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Real-Time Market Scenarios

Issue 2: PSU Derates or Constraints applied on CT or ST below DSO calculated MLP, results in the PSU being dispatched to 0 MW.

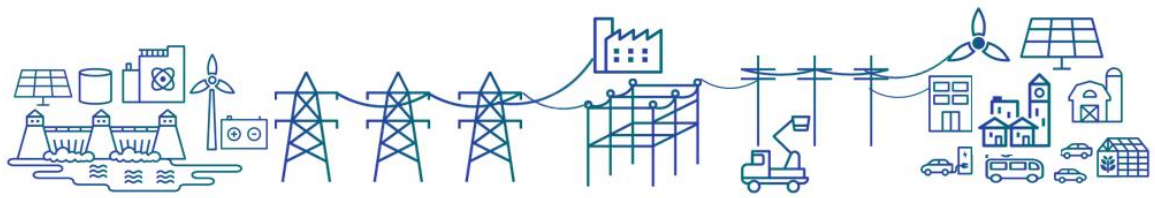
Scenario B: PSU capability is reduced, based on physical CT & ST limitation (i.e. ambient temperature derates).

Step1: Submit derate slips on the CT & ST using the **'Urgent'** priority code. ~~**Inform the IESO of the maximum capacity of each PSU** in service at the station, this should be via a **comment on the outage/derate slips**~~

~~**Step 2:** The IESO will for current hour ensure the outage slip is not considered by the DSO to prevent the dispatch to 0 MW and will instead apply a high operating limit against all PSU/s at the station. This high limit will be for the maximum capability, and duration provided by the Participant to the IESO through either the outage slip or verbally to the IESO control room.~~

Note: **The derate slip is required for reporting purposes~~, IESO action will ensure correct dispatching based on the information in the slip~~**

Step 2~~3~~: For future hours, adjust your offers to align with the PSU expected output unless the max offer would be below DSO calculated MLP. The IESO will approve mandatory window offer changes in these instances.



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Real-Time Market Scenarios

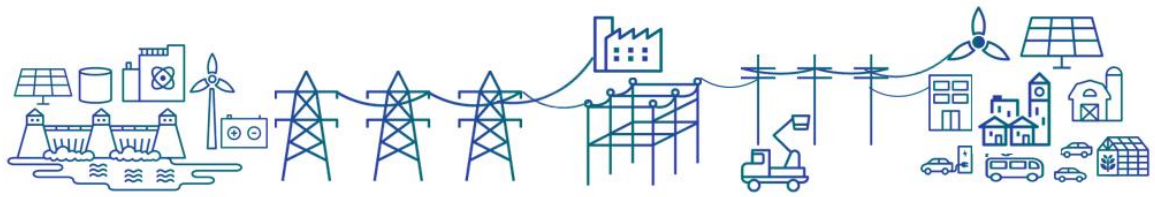
Issue 2: PSU Derates or Constraints applied on CT or ST below DSO calculated MLP, results in the PSU being dispatched to 0 MW.

Scenario C: A Combustion Turbine (CT) is derated to below its MLP

Step 1: Submit a derate slip on the CT using the **'Urgent'** priority code and contact the IESO control room.

Step 2: For each impacted hour, the IESO will implement one of two options based on market and system conditions at the time.

1. **Allow the derate to be processed by the DSO**, doing so will dispatch the PSU to 0 MW, but you will be verbally instructed by the IESO to continue ramping to your derated value.
2. **Prevent the submitted derate from being processed by the market tools**, and the PSU will be dispatched up to MLP as per the submitted ramp rates. The IESO will acknowledge that your unit may be out of compliance with the dispatch.



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Real-Time Market Scenarios

Issue 3: ST ramping up to MLP after associated CT.

Description: When ST synchronizes later than the PSU's CT, the DSO will use the ST's physical unit MW output to determine which ramp rate applies to the PSU. Instead, the DSO should use the PSU (CT+ST) MW output when determining the appropriate ramp rate to use. This issue can result in the PSU dispatches that ramp the PSU quicker than feasible. Since derates below MLP effect the dispatch, this can create scheduling issues during ramp up.

Scenario A: ST synchronizes after CT and is dispatched up too quickly.

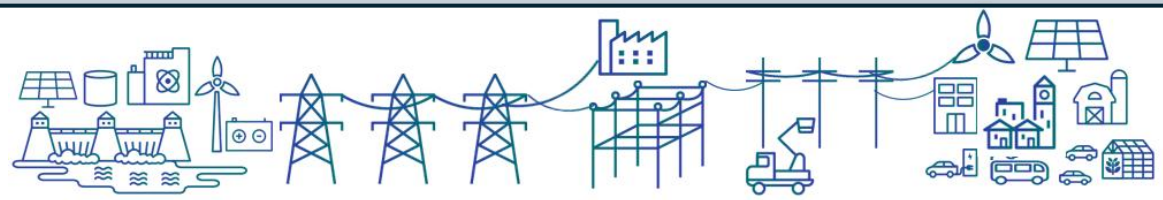
Step 1: Reject any infeasible energy dispatch and contact the IESO control room.

Step 2: Submit the applicable derate slip using the **'Urgent'** priority code, and follow dispatch as directed by the IESO control room.

Step 3: The IESO will implement one of two options based on market and system conditions at the time:

1. **Allow the submitted derate to be processed by the DSO**, doing so may dispatch the PSU to 0 MW, but the IESO will verbally instruct you to continue ramping to your MLP value .
2. **Prevent the submitted derate from being processed by the DSO** and instruct the PSU to continue ramping up as per their capability, with the understanding that they may be outside of their compliance deadband.

Step 4: For future hours, adjust your offers to align with the PSU expected output unless the max offer would be below DSO calculated MLP. The IESO will approve mandatory window offer changes in these instances.



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Real-Time Market Scenarios

Issue 4: CT Derate on Duct Firing (DF) Range.

Description: Derates on the CT do not impact the DF range on the associated PSU. Thereby, if a derate to a CT requires a reduction in the capability of the ST's DF range , this is not captured by the DSO.

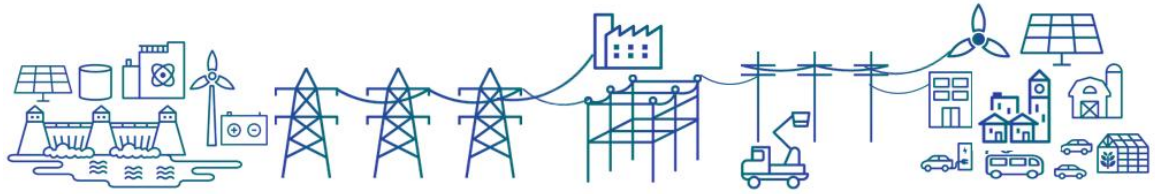
Scenario A: The full duct firing range on the ST needs to be reduced.

Step 1: Reflect ST capability **through max offers** on the PSU

Step 2: Reject any infeasible energy/OR dispatch and contact the IESO control room.

Step 3: The IESO will for the current hour apply a high operating limit to the maximum capacity values of the in-service PSUs at the station. This maximum capacity value will be provided by you to the IESO control room,

Step 4: Notify the IESO control room when the offer changes have taken effect and the high operating limit can be removed. The IESO will approve mandatory window offer changes in these instances.



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Real-Time Market Scenarios

Issue 5: IESO DSO does not calculate non-linear 2x1 or 3x1 ST MLP resulting in infeasible OR schedules.

Description: ST 2x1 (or greater) MLPs that are greater than the DSO calculated MLP are not used in the DSO when determining dispatch schedules. The submitted MLPs for having more than one CT in service are only used for determining the minimum constraint value when creating your commitment constraints. PSUs constraint calculations are outlined in the Market Renewal Program: Pre-Dispatch Calculation Engine Detailed Design Document Sections 3.10.3.4 CT Maximum Constraints and Section 3.10.1 (PSU) Model Parameters. This issue can produce infeasible OR schedules while ramping.

Scenario A: ST is being scheduled for 10 min OR when ramping up to its 2x1 MLP. Resource cannot provide OR since it is ramp limited.

Step 1: Based on PD commitments, **identify ramp hours in which the PSU resource will be ramping to a 1x1, 2x1 or 3x1 commitment** and will be unable to provide OR for the duration of the hour.

Step 2: Remove/adjust OR offers during those hours to reflect capability.

Step 3: Reject any infeasible energy and/or OR dispatches and contact the IESO control room.

Step 4: Notify the IESO once OR offers have been adjusted or capability of the resource to provide OR has changed.

