



Agenda

DR resources need the same parameters as generators

- Summary
- DR offer parameters
- Duration limits for non-DR resources
- How offer parameters will increase market access

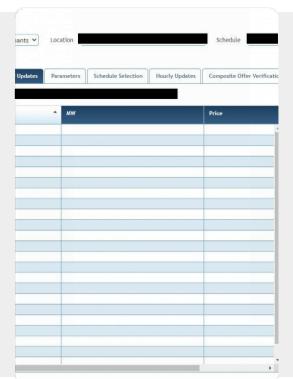
Summary

Seeking parity with other PJM resources & with DR treatment in other markets

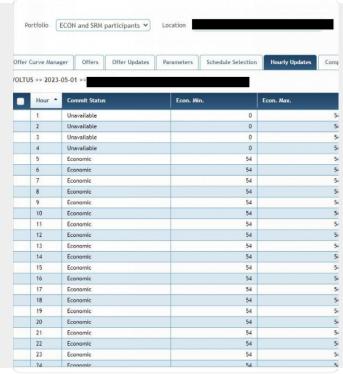
- Economic demand response participating in the PJM energy market has access to limited offer parameters to reflect operational constraints.
- Economic DR can specify *minimum* downtime—the minimum contiguous hours for a dispatch—but cannot specify *maximum* downtime.
- Generators can set "maximum run time" and energy storage resources can set a "minimum state of charge". These parameters set a maximum duration on dispatches.
- In MISO and SPP—which also have co-optimized markets where demand response can offer into reserve products and the energy market— demand response assets can specify maximum downtime in their offers (+ other parameters that limit the number of dispatches and downtime between).

Current Offer Options for DR in Energy Market

Limited to MW, price, downtime limit, notification time, MW, & commit status







Duration Limits for Other PJM Resources

| Resource Type | Parameter | Definition |
|-----------------------------------|------------------------------|--|
| Generator in PJM | Maximum Runtime (hour) | Maximum run time is defined in the Markets Gateway User Guide in Section 8.7 and states: "Maximum Runtime (hour) – The maximum number of hours a unit can run before it needs to be shut down, calculated as difference between the time the unit is put on-line to the time the unit is shut down. In the Day-Ahead Scheduling process, it is calculated at the maximum number of hours a unit is producing > 0 MW output. The default value is infinity. |
| Energy Storage Resource in PJM | State of Charge Min (MWh) | Section 27.4 of Markets Gateway User Guide allows energy storage resources to specify a "State of Charge Min (MWh) – The minimum State of Charge, in MWh, that should be maintained." |



Duration Limits for DR in Similar Markets

| Resource Type | Parameter | Definition |
|---|-------------------------------|--|
| Demand Response Resource Type I in MISO | Maximum Interruption Duration | Per MISO Business Practice Manual 26: The Maximum Interruption Duration restricts the number of consecutive hours a DRR -Type I can be committed during the Day-Ahead Energy and Operating Reserve Market and the Real-Time Energy and Operating Reserve Market. |
| Dispatchable Demand Response in SPP | Max Runtime | Defined in SPP's Integrated Marketplace Protocols Revision 91 as: The maximum length of time a Resource can run from the time the Resource is synchronized to the time the Resource is off-line. |



Why DR Needs a Duration Limit

Increasing market access & demand side participation

- HVAC load: price-sensitive, but can generally only participate for limited durations.
 - ~65 GW of HVAC load in PJM.
 - A large fraction of that is residential, which Voltus is prepared to tap into.
- EV load: projected to increase 10x in PJM by 2030.
 - ESR model will not work for all use cases; will sometimes need to participate as DR.
- Every demand resource in every industry ultimately has some operational constraints (just like generators).
 - 8 GW of DR currently enrolled in PJM; Voltus models peg potential at almost 20 GW.

Thank you

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