

Electric Storage Resource Participation Model

Version: June 8, 2018

Q 21. What is reactive and how is it compensated? What are reserves in real time and how are they compensated?

A Please see Scott Benner's presentation here: <http://www.pjm.com/-/media/committees-groups/committees/mic/20180614-special/20180614-item-05-esr-reactive-and-reserves.ashx>

Q 20. How do demand bids, load response, virtual bidding and pumped storage currently work in the Day Ahead Energy Market?

A Please see Keyur Patel and Stefan Starkov's presentation here: <http://www.pjm.com/-/media/committees-groups/committees/mic/20180614-special/20180614-item-04-demand-virtual-bidding-pump-storage-in-da-market.ashx>

Q 19. What is status quo for interconnection behind the customer's load meter?

A Please see Scott Baker's presentation on this issue starting on slide 3: <http://www.pjm.com/-/media/committees-groups/committees/mic/20180614-special/20180614-item-03-esr-review-of-interconnection.ashx>

Q 18. What parameters are required for a Day Ahead (DA) offer?

A Parameters for all resources bidding into the DA market are located in Manual 11: <http://www.pjm.com/-/media/documents/manuals/m11.ashx>. Currently, pumped storage hydro can self-schedule or bid into the DA Market using the hydro optimizer. The parameters for the optimizer are listed in Attachment B of Manual 11. They include: initial storage level, final storage level, maximum storage level, minimum storage level, pumping efficiency factor and minimum/maximum generating and pumping limits.

Q 17. Are ESR excluded from Day Ahead Scheduling Reserve (DASR)?

A No, ESRs are eligible to provide DASR by exception historically this has consisted of pumped hydro. Details can be found in Manual 11, Section 11: <http://www.pjm.com/-/media/documents/manuals/m11.ashx>

Q 16. What is in Order 841? What are the directives to PJM?

A Please see this presentation: <http://www.pjm.com/-/media/committees-groups/committees/mic/20180510-special-electric/20180510-item-02a-energy-storage-order-presentation.ashx>

And this word document outlining the directives: <http://www.pjm.com/-/media/committees-groups/committees/mic/20180510-special-electric/20180510-item-02b-ferc-directives-841.ashx>

The order can be found here: <http://pjm.com/-/media/documents/ferc/orders/2018/20180215-rm16-23-000.ashx>

Q 15. What are the current gaps associated with Order 841?

A Please see educational presentation: <http://www.pjm.com/-/media/committees-groups/committees/mic/20180510-special-electric/20180510-item-03a-esr-841-status-quo-review.ashx>

Q 14. Where are the rules for Electric Storage Resources?

A Please see compiled ESR rules here: <http://www.pjm.com/-/media/committees-groups/committees/mic/20180510-special-electric/20180510-item-03b-all-manual-citing-of-esr-status-quo.ashx>

Q 13. When will Order 841 be discussed in the stakeholder process?

A Please see work plan here: <http://www.pjm.com/-/media/committees-groups/committees/mic/20180510-special-electric/20180510-item-03b-all-manual-citing-of-esr-status-quo.ashx>

Q 12. How does PJM plan to comply with FERC Order 841?

A PJM intends to file the compliance filing by the deadline of December 3, 2018. Feedback sessions to get thoughts and recommendations from stakeholders have been scheduled as special sessions of the Market Implementation Committee: Electric Storage Participation – FERC Order 841 on May 10, June 14, June 27, August 3 and September 14, 2018. Registration and meeting materials can be found here: <http://www.pjm.com/committees-and-groups/committees/mic.aspx>. Additionally, stakeholders can email their questions or feedback to esr@pjm.com

Q 11. What is an electric storage resource?

A As stated in FERC Order No. 841, the Commission defined an electric storage resource as “a resource capable of receiving electric energy from the grid and storing it for later injection of electricity back to the grid.” This includes ESRs located on the interstate transmission system, on a distribution system, or behind the meter, regardless of their storage medium (e.g., batteries, flywheels, compressed air and pumped-hydro). PJM is tasked with defining the qualifications of what resources can use the ESR participation model in the FERC Order 841 compliance filing.

Q 10. Currently, can electric storage self schedule in day-ahead and real-time?

A All electric storage is currently eligible to self-schedule into both the DA and RT Energy Markets by operating as fixed non-dispatchable price-taking resources. A resource cannot currently enter negative incremental MW segments in the offer curve in Market Gateway. Currently pumped storage reflects pumping (charging) by entering negative eco min and eco max values but not a negative offer curve.

Q 9. Can self-scheduled electric storage resources alter their schedules for use in the RT Energy Market only on an hour-to-hour basis and only up to 65 minutes prior to the start of the operating hour?

A Self-scheduled non-dispatchable resources need to provide 20 minute notice for a change in commitment status (Manual 11 Section 2.3.3) and, if a Capacity resource, must follow any instructions from PJM dispatchers. The resource will incur deviation charges for not following any Day Ahead schedule. The provisions of Manual 11 Section 9.1 generally apply to changes in offers for resources that are economically committed and dispatchable in real time. All non-pumped storage resources are eligible to enter hourly-differentiated offers in DA and Rebid periods. Only resources that opt-in to Intraday Offers can alter their energy offers up to 65 minutes before the operating hour. However, resources cannot increase their price offer in RT if a unit has a DA schedule.

Q 8. Given PJM's recent move to 5-minute settlements, can storage schedule at a 5-minute granularity?

A No, the Day-Ahead Market is made up of hourly schedules.

Q 7. Instead of self-scheduling, can storage participate by submitting price-based offers into DA and RT Energy Markets and self-managing state of charge?

A Pumped hydro cannot do this under the status quo. Other ESRs could theoretically submit price-based offers for positive MW only (discharging). However, our interpretation of Order 841 is that we must make such a mechanism available to ESRs.

Q 6. Does PJM post a pre-DA price forecast that can be used by self-scheduled resources in the DA Energy Market? For example, does PJM post the implied prices from day two of the prior day's DA Energy Market run?

A No.

Q 5. Can storage deviate in real time from their DA Energy Market schedule and settle ex-post? If so, would deviations just be paid/charged at the RT Price or would there be any additional charges or penalties?

A Yes, an electric storage resource may deviate from their DA schedule unless they are a Capacity resource that received PJM dispatch instructions, and provided they provide 20 minute's notice for a change in commitment status. Deviations from the DA schedule generally incur Balancing Operating Reserves charges, in addition to balancing settlement at the RT Price.

Q 4. Would storage have to submit cost based offers?

A Cost based offers are required in energy and ancillary services markets. A \$0 cost-based offer is generally acceptable with minimal supporting documentation. Currently the rules for cost-based offers are listed in PJM

Manual 15: Cost development guidelines. Battery and flywheels currently have a \$0 cost offer. Price-based offers can be developed at the discretion of the ESR owner/market.

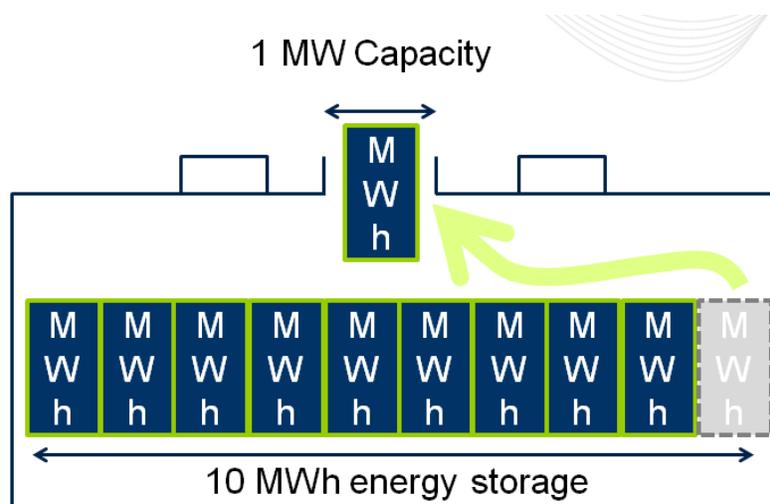
Q 3. Participation rules for regulation are clearly specified, but in practice how can storage participate in PJM’s synchronized and non-synchronized reserve markets?

A Units can offer or self-schedule in to the PJM Tier 2 Synchronous Reserve Market similar to Regulation. PJM will only clear Tier 2 reserves if there are not enough Tier 1 reserves on the system. Tier 1 is calculated as the available headroom of resources that are online for Energy. All Electric Storage Resources are excluded from Tier 2 synchronized reserves unless an exception is requested. To provide synchronized reserves, a resource must be able to provide the assigned MWs in 10 minutes and be able to deliver those MW for up to 30 minutes.

Pumped-Hydro resources are eligible for non-synchronized reserves because they can be online in 10 minutes. Generation resources that are not available to provide energy are no considered for non-synchronized reserves. There are no offers into Non-Synchronous Reserve and assignment is automatically designated in real-time to eligible resources.

Q 2. Is there a minimum duration in the capacity market for storage?

A Currently an ESR must be available spanning a 24 hour block with a minimum 10 hour run time requirement available by adjustment (per PJM Manual 21). Currently PJM will derate the unit by modifying the amount of CIRs that the unit is able to produce over the run time requirement (24 or 10).



Q 1. Will PJM treat all storage exactly the same as generators when assessing Non-Performance Charges and Bonus Performance Credits? If the treatment is not expected to be identical, please clarify how storage might be considered in performance charges and credits

A Yes, we do not expect any exceptions to Performance Assessment Interval.

Parking lot

Reactive Requirements