

characteristics of electric storage resources and facilitates their participation in the RTO/ISO markets.⁵ The participation model must:

(1) ensure that a resource using the participation model is eligible to provide all capacity, energy, and ancillary services that the resource is technically capable of providing in the RTO/ISO markets; (2) ensure that a resource using the participation model can be dispatched and can set the wholesale market clearing price as both a wholesale seller and wholesale buyer consistent with existing market rules that govern when a resource can set the wholesale price; (3) account for the physical and operational characteristics of electric storage resources through bidding parameters or other means; and (4) establish a minimum size requirement for participation in the RTO/ISO markets that does not exceed 100 kW.⁶

Consistent with these directions, the Commission makes explicit that the Final Rule is not intended to subsidize or unduly advantage storage resources. The Final Rule is intended to allow storage resources to provide services in RTO markets that they are technically capable of providing. The Commission states that the “Final Rule does not grant undue preference to electric storage resources as a group or to specific electric storage technologies; rather, it removes barriers to their participation, enhancing competition among all resources that are technically capable of providing wholesale services.”⁷

PJM’s proposed participation model for Electric Storage Resource (ESR) falls short of the Commission’s objectives. PJM’s participation model for ESR capacity resources provides undue preference for ESR capacity resources relative to other resource types in both the energy and capacity markets. PJM’s ESR participation model does not address the

⁵ *Id.* at 3

⁶ Order No. 841 at P 4.

⁷ *Id.* at 52.

differences between storage devices and generators. PJM's ESR participation model should be adjusted to reflect the characteristics of storage devices.

The Market Monitor recognizes that the issues created by the entry of ESR into the PJM markets are complex and will not be fully resolved in this proceeding. Consideration of ESR raises questions about the capacity market design. Should the definition of the demand for capacity be limited to one hour or five hours per year when it is clear that capacity has a value over many more hours? It is essential that as the rules are developed, ESR is neither provided advantages or disadvantages in the markets. The development of rules for demand response illustrates how not to proceed. This objective is made more difficult by the fact that ESR is a net load to the system and not net generation. ESR shifts energy usage but does not create energy. The objective is also made more difficult by PJM's historical treatment of pumped hydro resources. The rules should be based on the requirement that the rules work regardless of the level of ESR market penetration. The rules should work with very small and very large levels of ESR.

A. ESR Are Not Currently Economic in PJM Markets.

Some of the urgency to address ESR related issues is removed when the basic economics of ESR is recognized.

Table 1 shows the estimated revenue in dollars per MW-year and dollars per MW-day for participation of ESR in each PJM market for 2018 based on public information.⁸ The Market Monitor has verified the reasonableness of the public information on market revenues. The regulation market revenues are the highest but it should be recognized that the regulation market rules have resulted in the overpayment of ESR in recent years. The capacity values are calculated using the RTO Capacity Performance clearing price for the 2018/2019 Delivery Year, \$164.77 per MW-day. The approximate levelized gross cost of an

⁸ Lazard, *Lazard's Levelized Cost of Storage Analysis—Version 4.0*, November 2018, slide 16.

ESR is \$781 per MW-year.⁹ The simple conclusion is that, if these numbers are even approximately correct, ESR are not economic in PJM markets as energy and capacity resources and are not likely to become economic unless the difference between on peak and off peak prices changes significantly.

Table 1 Estimated revenue for energy storage resources¹⁰

Participation Type	\$ per MW-year	\$ per MW-day
Regulation	\$225,000	\$616.44
Capacity 4 hour duration	\$15,035	\$41.19
Capacity 10 hour duration	\$6,014	\$16.48
Energy	\$10,000	\$27.40
Spinning Reserves	\$10,000	\$27.40

B. PJM’s Proposed ESR Capacity Market Participation Model Is Not Adequate.

PJM states that “[t]he capacity market is resource agnostic, meaning RPM clears offered resources not by resource type but rather through an algorithm that matches offered MW to system demand in a least cost manner.”¹¹ But PJM does not explain why ESR is a substitute for generation. In order for the capacity market to function on a resource agnostic basis, every MW of capacity offered must be a substitute for every other MW, so that a capacity MW from a steam plant is a substitute for a MW from a battery or any other resource. PJM does not explain how it meets its own design test.

ESRs are net load. ESRs are not net generation. This means that the system cannot be served by ESR capacity alone. ESRs can only shift energy intertemporally. ESRs could be economic in an energy market where price differentials were sufficiently large.

Rather than maintaining its resource agnostic standard, PJM is proposing a standard for ESR that is quite different from the standard that exists for thermal generation. PJM

⁹ *Id.*

¹⁰ *Id.*

¹¹ PJM at P 18.

proposes to allow storage resources to base their capacity MW value on “the resource’s MW output capability that can be maintained over a continuous ten-hour period when starting at a fully charged state with an assumed ability to return to a fully charged state during the fourteen-hour period remaining until the start of the next ten-hour discharge period.”¹² Under PJM’s proposed market participation model an ESR with 100 MW of storage that could only sustain and make available 10 MW output for 10 hours would be rated as a 10 MW resource in PJM’s Capacity Market.

PJM states that anything less than the 10 hour continuous injection requirement would create reliability issues. PJM points to its experience with demand response which only had to reduce consumption for six hours to qualify as limited DR capacity under the prior RPM rules.¹³ PJM notes that if it committed too many MW of a demand resource as capacity that was only required to “provide interruptions for six hours, the peak load for a given day was no longer reduced but instead was merely shifted to a time outside the six-hour window.”¹⁴ PJM states that “analysis at the time showed that increasing the interruption window from six hours to ten hours avoided the risk of shifting, rather than reducing, the peak load.”¹⁵ PJM argues that the 10 hour period referenced in PJM Manual 21 “is consistent with the period of elevated demand on a typical peak summer weekday.”¹⁶

¹² PJM at 25.

¹³ *Id.* at 23

¹⁴ *Id.*

¹⁵ *Id.*

¹⁶ PJM at 22

PJM's basic point is valid but does not go far enough. PJM's analysis and argument make it clear that while the rules would work with very small levels of ESR, the rules will not work with very large levels of ESR.¹⁷

Under PJM's proposal, every ESR MW of capacity cleared in the capacity market displaces a MW of capacity capable of producing output for 24 hours with a resource that can inject 1.0 MW for 10 hours and then creates an off peak load on the system. As more ESR MW are added, displacing generation, the size of and the duration of the associated off peak load increases, and the generation available to serve that load decreases. This means there is a maximum sustainable market penetration possible for ESR based on PJM's proposed market participation model.

A maximum sustainable market penetration for ESR means that PJM's proposal to base storage capacity, for purposes of participation in the capacity market, on 10 hour continuous output, is not consistent with the obligations required of resources providing capacity service and it is not consistent with a metric of capacity that is "consistent with achieving uniformity for planning, operating, accounting and reporting purposes."¹⁸

C. What is an Outage?

PJM proposes to use its current requirements for pumped storage hydroelectric resources in reporting outages under the ESR participation model. But PJM is not careful enough about the differences between pumped hydro and new ESR technologies and does not recognize the historical reasons for the current treatment of pumped hydro. Rather than using the treatment of pumped hydro as a model for new ESR technologies, the storage paradigm needs to be reconsidered. The treatment of pumped hydro needs to be

¹⁷ See "Limited Energy Capability Resource (LECR) Duration Requirement for the Capacity Market," presentation to the special session of the MIC; Electric Storage Resources (September 14, 2018). <https://www.pjm.com/~media/committees-groups/committees/mic/20180914-special/20180914-item-05-esr-duration-slidedeck-0914.ashx>.

¹⁸ RAA, Schedule 9

reconsidered rather than simply accepting a model of pumped hydro that predates markets. Pumped hydro is a flexible resource that facilitates system operation in important ways. PJM ignores its own role in the optimization of pumped hydro which PJM does not want to replicate for new ESR. For all these reasons, simply porting the pumped hydro paradigm to new ESR is not supported.

Currently, market participants with pumped hydro resources in PJM are required to report an outage when a unit's ability to meet its capacity obligation is limited by equipment. PJM states that "[t]his requirement accounts for the fact that a pumped hydroelectric unit is not experiencing an 'outage' every time the unit is unable to generate, such as when operating in pump mode."¹⁹ This means that an ESR that chooses to be in "charge mode" will not be available for dispatch as an energy source but will not be considered to be on outage for purposes of EFORd calculations. PJM proposes that an ESR that is "Out of charge" will not be considered on outage for the purposes of EFORd calculation, unless the ESR was explicitly directed to discharge and was unable to do so due to lack of stored charge.²⁰

The proposed outage rules mean that ESR that choose "charge mode" can be unavailable for providing capacity without taking an outage. An ESR that is "out of charge" should be required to inform the system operator of its unavailability and take an outage analogous to a lack of fuel outage.

PJM's proposed ESR participation model makes ESR based capacity MW inferior to capacity MW provided by thermal resources. PJM's proposed rules would allow an ESR to sell capacity but not make the associated energy available without affecting the level of UCAP for the ESR.

¹⁹ PJM at 46.

²⁰ *Id.*

D. Another Approach to ESRs in PJM Markets.

Part of the difficulty in creating a good model for ESR participation is that PJM's capacity market is based on atavistic rules about the determinants of the need for capacity based on peak load only. The roots of this approach are in cost of service studies that defined retail rate designs under cost of service regulation.

There is no way to reflect ESR as off peak capacity demand, with a capacity payment obligation, and as on peak capacity source, that is a provider of capacity, within the a peak only capacity market.

If the cost of capacity were assigned in a way more consistent with the actual economics, the fact that ESR is using capacity at times and providing capacity times could be reflected in ESR costs and revenues in a manner analogous to the energy market.

Another model for ESR participation is as a well designed demand side product. Rather than attempting to fit ESR into the existing capacity construct, equivalent revenue streams would result if ESR, outside the capacity market, were used to reduce customers' loads. The revenues to ESR in that case would result from the reduction of actual payments by customers for capacity which are in turn a function of both the wholesale and retail allocation of capacity costs to customers.

II. CONCLUSION

The Market Monitor respectfully requests that the Commission afford due consideration to these comments as it resolves the issues raised in this proceeding.

Respectfully submitted,



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CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated at Eagleville, Pennsylvania,
this 7th day of February, 2019.



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