Order 841: Key Considerations for Compliance

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PJM MIC Special Session

May 10, 2018

Energy Storage Association

About the Energy Storage Association

ESA's mission is to accelerate the widespread use of competitive and reliable energy storage systems in North America.

- Established 28 years ago
- Diverse membership—vendors, developers, independent generators, utilities & other power sector stakeholders
- Federal, regional, & state policy engagement

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In this presentation

- Identified Order 841 compliance requirements
- Key considerations for Order 841 compliance choices
- Opportunity for PJM in Order 841

Compliance requirements (1)

- Participation in all market products
  - Ensures resource using the storage participation model is eligible to provide all capacity, energy, and ancillary services that the resource is technically capable of providing
  - Non-market services also included (blackstart, VLR, etc)
- Clarity on market access
  - PJM to specify: (1) whether storage resources will participate through existing or new market participation agreements and (2) whether existing market rules apply to storage resources, including to provide capacity
  - Allows storage resources to de-rate capacity to meet minimum run-time requirements
  - States storage de-rating its capacity to meet minimum run-time requirements for capacity or other services is not engaging in physical withholding
  - All storage capable of injecting power may participate in wholesale markets, regardless of where interconnected to the transmission system, to the distribution system, or behind a retail meter
- Improves dispatch flexibility and price formation
  - PJM must represent the physical & operating characteristics of storage (parameters on next slide)
  - Gives storage resources the right to manage their own state of charge
  - Storage can be dispatched and can set the wholesale market clearing price as both a wholesale seller and wholesale buyer
  - Storage can participate as a price taker
  - Allows storage resources to be eligible for make-whole payments

Physical/operational characteristics

Characteristic	FERC Explanation	Considerations
State of Charge	Amount of energy stored in proportion to the limit on the amount of energy that can be stored, (%), the forecasted starting State of Charge for the market interval being offered into	Can be considered either as MWh or as a proportion of the maximum amount of energy that can be stored (%), at any point in time
Maximum State of Charge	SOC value that should not be exceeded (i.e., gone above) when a storage resource is receiving electric energy from the grid (e.g., 95% SOC)	Can be in MWh or %; may capture depth of charge preferences
Minimum State of Charge	SOC value that should not be exceeded (i.e., gone below) when a storage resource is injecting electric energy to the grid (e.g., 5% SOC)	Can be in MWh or %; may capture depth of discharge preferences
Maximum Charge Limit	Maximum MW quantity of electric energy that a storage resources can receive from the grid	Can include charging from on-site/co-located energy source, in addition to or instead of grid
Maximum Discharge Limit	Maximum MW quantity that a storage resource can inject to the grid	
Minimum Charge Time	Shortest duration that a storage resource is able to be dispatched by the RTO/ISO to receive electric energy from the grid (e.g., one hour)	Derives from pump hydro model
Maximum Charge Time	Maximum duration that a storage resource is able to be dispatched by the RTO/ISO to receive electric energy from the grid (e.g., four hours)	Specified at maximum charge limit? Derives from pump hydro model
Minimum Run Time	Minimum amount of time that a storage resource is able to inject electric energy to the grid (e.g., one hour)	Derives from pump hydro model
Maximum Run Time	Maximum amount of time that a storage resource is able to inject electric energy to the grid (e.g., four hours)	Specified at maximum discharge limit? Derives from pump hydro model
Minimum Discharge Limit	Minimum MW output level that a storage resource can inject onto the grid	Derives from pump hydro model
Minimum Charge Limit	Minimum MW level that a storage resource can receive from the grid	Derives from pump hydro model
Discharge Ramp Rate	Speed at which a storage resource can move from zero output to its Maximum Discharge Limit	Can be considered as a rate (MW/minute); can account for any incremental increase, not just 0 to max
Charge Ramp Rate	Speed at which a storage resource can move from zero output to its Maximum Charge Limit	Can be considered as a rate (MW/minute); can account for any incremental increase, not just 0 to max

Compliance requirements (2)

- Improves market access for distributed resources
  - Minimum size requirement for participation must not exceed 100 kW
- Ensures charging energy will be priced appropriately
  - Energy from PJM to storage resource that is resold back to PJM or used to provide ancillary services must be at the wholesale locational marginal price (LMP)
  - Wholesale energy purchases should be at the applicable nodal LMP and not the zonal price
  - Conversion efficiency losses to be settled at the wholesale LMP, and are not a component of onsite retail load
  - Requires storage to pay transmission charges when it is acting as load, even if sale for resale
  - Storage should not be charged transmission charges when dispatched by PJM to consume energy to provide a service
  - Distributed storage resources cannot be forced to pay twice for charging energy

Compliance choices: Qualification

- What are the qualification criteria for a resource to use the storage participation model?
- What are the qualification criteria for storage to provide market products?
  - How is technical ability to provide a particular service tested and verified?
    - E.g., storage response times faster than conventional telemetry; ramp rate in MW/min approaches infinity
  - How will technical characteristics different than generation be treated?
    - E.g., requirement to be “synchronized”
- How might product definitions and/or metrics be changed for efficient storage utilization and market operations?
- **ESA Principle: use single asset registration type and avoid “fitting” to existing definitions; provide clear and specific criteria based on market needs rather than tech attributes; ensure storage resource owners have appropriate means to demonstrate performance**

Compliance Choices: Must-Offer Obligations

- What if any must-offer obligations will storage resources have?
  - Are there existing rules to accommodate energy-limited resources, like pumped hydro? Are they explicitly defined in tariff?
- How will must-offer obligations apply for storage that de-rates capacity to meet minimum run-time requirements?
  - What if any barriers for multiple-use storage (wholesale/distribution)?
- Does an offer to buy energy count as satisfying an must-offer obligation?
- Is an energy schedule required for Ancillary Services?
- **ESA Principle: must-offer obligations should recognize the full range of capabilities and services that storage can provide, support flexible provision**

Compliance Choices: Physical & Operating Characteristics

- What characteristics should be represented as a bid parameter versus something else?
  - What should be a registration parameter?
  - Can registration parameter serve as default but not obligation? i.e., can a bidding parameter override registration parameter?
  - What other means if any can represent characteristics?
- What parameters are mandatory versus optional?
- Are there other operating characteristics to review and include?
  - Existing values -- E.g., XEFORd rate
  - Other resource characteristics? E.g., to universalize resource models
- How will parameters be represented in software?
  - E.g., state of charge as % vs MWh
- Will implementation be available in both DA and RT?
- **ESA Principle: greater availability of bid parameters and ability to modify in RT will maximize flexible use of storage for value to system and enhance optimization**
  - Mandatory: max/min charge/discharge limits, max/min charge/discharge ramp rates
  - Optional: state of charge, max/min SoC, max/min charge time, max/min run time

Compliance Choices: Energy Accounting and Metering

- Are ancillary / auxiliary loads are a component of charging energy or a component of station power?
- What metering and accounting practices will adequately address DER storage providing wholesale services?
  - Is direct metering an option for customer-sited assets?
  - How will PJM coordinate with RERRAs to implement wholesale charging and avoid double charges?
- **ESA principle: markets should net from charging where possible; create a pathway for distribution-connected storage that is not overly burdensome**

Compliance Choices: Market Mitigation

- Do rules on withholding need updating? Are there clear and documented processes for verification?
  - E.g., for de-rated storage
- What if any updates are needed to rules/formulas for market power mitigation?
  - How do cost-based offers get established? Especially since almost entirely characterized as opportunity costs of providing one service vs. another service/idling?
- How explicit will tariffs be?
- **ESA principle: market mitigation should avoid unreasonably restricting storage flexibility in offer prices**

An Opportunity for PJM

- Order 841 provides an opportunity to create a "universal participation model" for all generation and load resources, which can make both market and software designs simpler and more consistent
  - Storage resources possess suite of capabilities of other technologies
  - Start with the most general and idealized conceptual resource as the general case, then turn off or adjust the parameters of this idealized model with bidding parameters
  - Eliminate the hodgepodge of tacked-on exceptions that are growing and will only become more complex in the future
- Without a universal model, markets/systems will increasingly become convoluted and limited from effectively incorporating future resources for full system benefit
  - "Storage plus" plants, DER aggregated virtual power plants, etc.
  - Traditional ways of looking at generators/loads are no longer sufficient and will be increasingly deficient
- **PJM Staff should take advantage of this opportunity to create a universal model and lead the future of electricity markets**

Thank you

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