Order 841: Key Considerations for Compliance

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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
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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>FERC Explanation</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State of Charge</strong></td>
<td>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</td>
<td>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</td>
</tr>
<tr>
<td><strong>Maximum State of Charge</strong></td>
<td>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)</td>
<td>Can be in MWh or %; may capture depth of charge preferences</td>
</tr>
<tr>
<td><strong>Minimum State of Charge</strong></td>
<td>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)</td>
<td>Can be in MWh or %; may capture depth of discharge preferences</td>
</tr>
<tr>
<td><strong>Maximum Charge Limit</strong></td>
<td>Maximum MW quantity of electric energy that a storage resource can receive from the grid</td>
<td>Can include charging from on-site/co-located energy source, in addition to or instead of grid</td>
</tr>
<tr>
<td><strong>Maximum Discharge Limit</strong></td>
<td>Maximum MW quantity that a storage resource can inject to the grid</td>
<td></td>
</tr>
<tr>
<td><strong>Minimum Charge Time</strong></td>
<td>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)</td>
<td>Derives from pump hydro model</td>
</tr>
<tr>
<td><strong>Maximum Charge Time</strong></td>
<td>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)</td>
<td>Specified at maximum charge limit? Derives from pump hydro model</td>
</tr>
<tr>
<td><strong>Minimum Run Time</strong></td>
<td>Minimum amount of time that a storage resource is able to inject electric energy to the grid (e.g., one hour)</td>
<td>Derives from pump hydro model</td>
</tr>
<tr>
<td><strong>Maximum Run Time</strong></td>
<td>Maximum amount of time that a storage resource is able to inject electric energy to the grid (e.g., four hours)</td>
<td>Specified at maximum discharge limit? Derives from pump hydro model</td>
</tr>
<tr>
<td><strong>Minimum Discharge Limit</strong></td>
<td>Minimum MW output level that a storage resource can inject onto the grid</td>
<td>Derives from pump hydro model</td>
</tr>
<tr>
<td><strong>Minimum Charge Limit</strong></td>
<td>Minimum MW level that a storage resource can receive from the grid</td>
<td>Derives from pump hydro model</td>
</tr>
<tr>
<td><strong>Discharge Ramp Rate</strong></td>
<td>Speed at which a storage resource can move from zero output to its Maximum Discharge Limit</td>
<td>Can be considered as a rate (MW/minute); can account for any incremental increase, not just 0 to max</td>
</tr>
<tr>
<td><strong>Charge Ramp Rate</strong></td>
<td>Speed at which a storage resource can move from zero output to its Maximum Charge Limit</td>
<td>Can be considered as a rate (MW/minute); can account for any incremental increase, not just 0 to max</td>
</tr>
</tbody>
</table>
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 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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