



Order 841: Status Quo in PJM

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Special MIC on ESR #1

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- “a resource capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid.”
 - Regardless of their storage medium (e.g., batteries, flywheels, compressed air, and pumped-hydro)
 - Located on the interstate transmission system, on a distribution system, or behind the meter fall under this definition,

Today...

Battery/ Flywheel:

- Participates entirely in Regulation Market

Pumped Storage Hydro:

- Participates in Energy, Capacity, Regulation, Reserves, Etc



Regulation Market

ESR Participation Allowed	Min Size Requirements	Participation Model Changes
Yes	0.1 MW	No Changes

Market Requirements	Gaps Identified	Technical Requirements (not 841 scope)
<ul style="list-style-type: none"> • Almost 300 MW of ESR participating in PJM Regulation Market today • Regulation Only resource option exists 	<ul style="list-style-type: none"> • Ongoing activity with respect to PJM FERC 205 filing in ER18-87-000 will be in-line with Order 841 	<ul style="list-style-type: none"> • RT telemetry and able to follow AGC • Performance demonstration of following PJM Regulation signal(s) • 1 hour assignments • Capability MW must be bi-directional and symmetric



Reserves Market

ESR Participation Allowed	Min Size Requirements	Participation Model Changes
By exception	0.1 MW	Needs Review (see gaps identified)

Market Requirements	Gaps Identified	Technical Requirements (not 841 scope)
<ul style="list-style-type: none"> • T1 SR, T2 SR, NSR: ESR currently excluded in reserve calculations, can request an exception (and demonstrate ability) to be included • ESR can respond to a spin event in real-time and be compensated based on MW they provided during the event • DASR: ESR is currently excluded 	<ul style="list-style-type: none"> • Do resources need to be available for a full hour if we commit them for 5 minute intervals? • Can we include ESR in DASR if they provide a schedule or SoC information? 	<ul style="list-style-type: none"> • DASR: provide MW for 30 minutes • SR/NSR: provide MW in 10 minutes, for 30 minutes • RT telemetry for SR

ESR Participation Allowed	Min Size Requirements	Participation Model Changes
Yes	0.1 MW	No Changes

Service Requirements	Gaps Identified	Technical Requirements (not 841 scope)
<ul style="list-style-type: none"> • Reactive Supply: Captures resources reactive capability. Filed with FERC under Schedule 2 • Reactive Service: resources provided LOC for backing down real power to provide VAR support if PJM calls on for reactive • Testing: Testing required to demonstrate D-Curve for resources >25MVA and plants >75MVA 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Available reactive supply

ESR Participation Required	Min Size Requirements	Participation Model Changes
New: Yes Old: Maybe	0.1 MW	No Changes

Service Requirements	Gaps Identified	Technical Requirements (not 841 scope)
<ul style="list-style-type: none"> New interconnected (after Oct 31, 2018) ESR will be required to provide PFR under FERC Order 842 	<ul style="list-style-type: none"> Existing ESR providing PFR being discussed in PFRSTF. Solutions will be aligned with FERC Order 842 and no additional modifications will be needed for Order 841 compliance. 	<ul style="list-style-type: none"> Operating range specified in which ESR will be required to provide primary frequency response Set droop $\leq 5\%$ and deadband $\leq 36\text{mHz}$



Black Start Service

ESR Participation Required	Min Size Requirements	Participation Model Changes
Yes	Determined on Restoration Plan	No Changes

Service Requirements	Gaps Identified	Technical Requirements (not 841 scope)
<ul style="list-style-type: none"> Resources participate in a technology-neutral RFP process to procure service for situational needs (Schedule 6A) Annual (13 month) testing for compliance and revenues 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> 16 hours min run, or as defined in the restoration plan Cost recoverable that were procured solely for Black Start

ESR Participation Allowed	Min Size Requirements	Participation Model Changes
Yes	0.1 MW	Needs Review (see gaps identified)

Market Requirements	Gaps Identified	Technical Requirements (not 841 scope)
<ul style="list-style-type: none"> • ESR can offer positive MW (discharge) • Min/Max run time of resource is honored in DA • Pumped-Hydro Optimizer does not set price • Self scheduling available 	<ul style="list-style-type: none"> • Feasibility of DA schedule is not guaranteed • ESR needs to be able to offer negative MW (Charging) 	<ul style="list-style-type: none"> • Monotonically increasing cost curve

ESR Participation Allowed	Min Size Requirements	Participation Model Changes
Yes	0.1 MW	Needs Review (see gaps identified)

Market Requirements	Gaps Identified	Technical Requirements (not 841 scope)
<ul style="list-style-type: none"> • ESR can offer positive MW (discharge) • IDO offer curve update can be utilized to manage discharge willingness • 20 min notification to PJM required for self-scheduled unit commitment (change in availability) in real-time 	<ul style="list-style-type: none"> • Unable to offer negative MW on offer curves • No demand model available for charging (DR model not useful to reflect the bi-directional state of ESR) 	<ul style="list-style-type: none"> • Must follow dispatch, deviations applied for not following • Must have bid-in parameters, fuel cost policies, PLS parameters • Monotonically increasing cost curve

ESR Participation Allowed	Min Size Requirements	Participation Model Changes
Yes	0.1 MW	Needs Review (see gaps identified)

Market Requirements	Gaps Identified	Technical Requirements (not 841 scope)
<ul style="list-style-type: none"> • No must-offer requirement into RPM for ESR • Must offer into DA energy market for Capacity Resources • 1 capacity test required • ICAP rating defined (de-rate capability) as total MWh/10 hours • 10 hour run time for CIR (ex. 10MWh ESR = 1MW CIR) 	<ul style="list-style-type: none"> • How to address ESR charge capability degradation in CIR and capacity • Business rules for ESR participating in Capacity & Energy/Ancillaries (Regulation) • How to treat ESR that are net load over an interval in Capacity • EFORd and UCAP calculations • DA offer requirements for capacity storage • Unit Specific ACR 	<ul style="list-style-type: none"> • Performance Assessment Hour requirements

Parameter	Requested Today?	Required/ Optional?	Where will data be submitted? (ISA, Market Gateway, Telemetry, etc)	Where will data be used? (Planning, Markets, Operations)
State of Charge	No			
Min/Max State of Charge	No			
Min/Max Charge Limit	Yes- Eco Min			
Min/Max Charge Time	No			
Min/Max Run Time	Yes			
Min/Max Discharge Limit	Yes- Eco Max			
Charge/Discharge Ramp Rate	Yes- Ramp Rate			
Duration (MWh)	No			

Market Solution

- Outage rules
- Cost offers
- PLS parameters
- Modeling and telemetry

- Email questions & comments to ESR@PJM.com