Storage As Transmission Asset (SATA) Combined Package Summary

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Markets and Reliability Committee
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Informational Post

- Presented for informational review of combined Phase 1 and Phase 2 combined package from PC and OC.

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Overall Timeline

- In June of 2020, PJM began analyzing how Energy Storage Resources SATA Problem Statement which initially began looking at all types of resources available and evaluation against planning criteria in this presentation.
- At the conclusion of working item at PC, a package was developed and approved by Planning Committee.
- The package was moved to Markets and Reliability Committee, and work was put on hold.
- Phase 2, building upon Phase 1 began as a working item in August of 2025 in Operating Committee
- Phase 1 and 2 was moved to MRC in June 2026

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Background

Guiding Principles:

- SATA participation in PJM Markets is out of scope
- SATA operations should be similar to a wired solution (SATOA)
- Operational procedures should be as streamlined as possible
- SATA is considered transmission only and not generation

Combined Deliverable:

- Detailed design for transmission only asset operation and associated manual and tariff language building on 2020 Phase 1 proposal from Planning Committee as to how it will be studied in RTEP process then operated if chosen as most cost effective transmssion solution.

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Design Components

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Operations Design Component 1

#	Design Components[1]	Priority	Status Quo	Package A - PJM/Constellation
*	Implementation			
1	Operation of the SATA	High	None	SATA must mitigate the identified RTEP violation. SATA operating types may include: 1) Pre-contingency response (automatic) 2) Post-contingency response (automatic) 3) Local load security (automatic)

- Operation of SATA will be automatic for identified RTEP violation it was studied to mitigate.

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Operations Design Component 2

#	Design Components[1]	Priority	Status Quo	Package A - PJM/Constellation
2	Charge/Discharge of SATA	High	None	PJM establishes timeframes when charge and discharge schedules can be accomodated. Discharge occurs when needed to solve identified RTEP violation. Asset owners responsible for maintaining state of charge and submitting schedules to PJM.

- Discharge occurs to mitigate RTEP violation resource designed to resolve.
- Charge occurs after designed use, coordinated with PJM, asset owner responsible

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Operations Design Component 3,4,5

#	Design Components[1]	Priority	Status Quo	Package A - PJM/Constellation
3	Telemetry of SATA	High	None	SATA Telemetry requirements same as ESR
4	Telemetry State of Charge of SATA	High	None	SATA State of Charge requirement same as ESR
5	Metering Requirement of SATA	High	None	POI - Revenue grade meter, ESR - output telemetry standard telmetery scan rate (2-10 seconds)

- Telemetry for SATA will be same as energy storage resources and include state of charge. Metering is revenue grade meter.

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Operations Design Component 6,7

#	Design Components[1]	Priority	Status Quo	Package A - PJM/Constellation
6	Voltage Level	High	None	SATA will operate at intended use as per RTEP study.
7	SATA Status	High	None	Battery is offline, available to enable for its intended use of the asset

- Operated at voltage as studied in RTEP
- SATA will be considered offline and available to enable for intended use.

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Operations Design Component 8

#	Design Components[1]	Priority	Status Quo	Package A - PJM/Constellation
8	SATA Settlements	High	None	The resource payment and cost allocation for SATA for the Annual Transmission Revenue Requirement will be handled via Schedule 12 billing - Transmission Enhancement Credits. SATA resource will be paid via normal Energy Settlements for energy injections/withdrawals reported via Power Meter. To avoid double compensation, the SATA owner must account for any Energy revenues earned in the formulation of the next year's Annual Transmission Revenue Requirements. SATA resources should be modeled in separate sub-accounts to facilitate accurate accounting of Energy settlements for actual charging/discharging payments.

- Cost of service per Schedule 12 Transmission Enhancement Credits (TEC).
- As resource discharges for intended use, and charges to get ready for next use, settlements calculates amounts, kept in separate sub-account.

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Operations Design Component 9,10

#	Design Components[1]	Priority	Status Quo	Package A - PJM/Constellation
9	Interconnection Queue Entry	High	None	Ineligible to enter the interconnection queue
10	Market Participation	High	None	Ineligible to partipate in PJM markets, SATA is a price taker when operated for intended purpose, energy only resource, no capacity value.

- Not allowed in Queue
- Does not participate in PJM markets, no capacity value

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Planning Design Component 1,2

#	Category	Design Components[1]	Priority	Status Quo	Package A - PJM Approved Package from OC and PC
1	Phase 1 - Reliability	Sensitivity cases to ensure compliance with Planning criteria	High	50/50, summer peak 90/10, winter peak, and light load. Sensitivity cases are ran ad hoc based on any issues that may arise	SATA sensitivity with it charging and discharging in the study case
2	Phase 1 - Reliability	Forecast mechanism to model daily load curves to within an acceptable margin of error, in relation to 5-year planning studies	High	No current consideration of load curves for reliability studies	SATA must be sized appropriately to mitigate the reliability violation for a minimum duration based upon sensitivity analysis using granular load curves, as available. If granular load curves are not available, SATA must be sized to mitigate the reliability violation for a minimum of 4-hours, based on Long-term Emergency Rating.

- Speaks to SATA Sensitivity for Charge/Discharge
- Sizing requirements and Timing Requirements

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Planning Design Component 3,4

#	Category	Design Components[1]	Priority	Status Quo	Package A - PJM Approved Package from OC and PC
3	Phase 1 - Reliability	Generator Interconnection Study criteria - special cases to consider	High	Storage is modeled as discharging for summer and winter studies but is charging during light load study The Queue battery generator under study undergoes a Dynamic Dispatch to determine the worst case loading on any facility. Dynamic Dispatch means that the battery is dispatched in two seperate modes; as injecting power (generator), and as consuming power (load). Each flow gate considers both dispatch modes so that the loading reported on any facility is whichever mode yields the worst case loading.	SATA sensitivity with it charging and discharging in the study case. The sensitivity case charge/discharge rates to be consistent with worst case violation studied rates. Charge and discharge will not be studied at the same peak/valley case.
4	Phase 1 - Reliability	Design for violation and identify its role as a harmer or a helper on other criteria tests	High	Complete do-no-harm testing	PJM will complete do-no-harm testing utilizing the capability of the controls as specified by the proposing entity Proposing entity identifies any additional violation mitigation or help

- Special case considerations for how SATA is modeled summer/winter and light load
- No harm testing

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Planning Design Component 5,6,7

#	Category	Design Components[1]	Priority	Status Quo	Package A - PJM Approved Package from OC and PC
5	Phase 1 - Reliability	Performance expectations requirements	High	Assumes transmission facilities maintain 100% capability	Ensure SATA capability is able to meet performance requirements for the life of the facility, while recognizing the unavailability of asset while charging
6	Phase 1 - Reliability	Allowable modes of operation	High	None	SATA must be at the desired state of charge and available to mitigate the violation as intended . SATA operating types may include: 1) Pre-contingency response (automatic) 2) Post-contingency response (automatic) 3) Local load security (automatic)
7	Phase 1 - Reliability	Charge and discharge schedules and responsibilities	High	None	PJM establishes timeframes when charge and discharge schedules can be accomodated and will be documented in operating procedures. Asset owners responsible for maintaining state of charge and submitting schedules to PJM. Submitted schedules would accommodate single peak and multipeak days with allowance for off peak recharging.

- Life of facility requirement
- Allowable modes of operation (in line with Operations usage)
- Charge and Discharge schedules

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Planning Design Component 8, 9

#	Category	Design Components[1]	Priority	Status Quo	Package A - PJM Approved Package from OC and PC
8	Phase 1 - Reliability	*Benefit measurements of SATA vs. traditional resources in reliability studies (subcomponents listed below)*	--------	--------	--------
8a	Phase 1 - Reliability	Cost elements	High	Facility costs include initial cost, maintenance costs for the lifespan of the asset based on net present value	SATA estimated life should be a composite of all the major components (i.e.battery cells, inverters, GSU, auxilliary equipment). SATA will not participate in its markets but will use the appropriate settlement mechanisms to settle the charging and discharging functions to offset the rate of recovery
8b	Phase 1 - Reliability	Additional benefits	Medium	Transmission facilities are in-service and available for any violations but their characterisitcs are limited to the asset type	Proposing entity identifies additional benefits
9	Phase 1 - Reliability	Lifespan and retirement considerations	High	Traditional assets can be retired at it's end-of-life. Moving the asset is a maintenance cost, not a capital cost.	Components of SATA can be replaced as needed. At PJM's direction, SATA can be relocated to a different area of the system when system needs change. This would be driven by a baseline reliability study.

- Cost elements
- Additional benefits
- Lifespan and retirement

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Planning Design Component 10,11,12

10	Phase 1- Market Efficiency	Generator Interconnection Study Process - special cases to consider (IARRs)	High	Only the network upgrades associated with storage can be considered for IARR	Status Quo
11	Phase 1- Market Efficiency	Allowable modes of operation	High	Present: Generating, charging, economic. (Dispatched by SCED to minimize production cost, may become depleted) 2024 (Order 841/ESR Implementation): State of charge optimization based on parameters provided by proposing entity	Status Quo
12	Phase 1- Market Efficiency	Charge and discharge schedules and responsibilities	High	Present: Charge and discharge schedules determined by the simulation engine to achive the lowest production cost 2024 (Order 841/ESR Implementation): State of charge optimization based on parameters provided by proposing entity	Status Quo

- Order 1000 study of study of Market Efficiency projects during the RTEP process.
- In PJM, this is implemented through the RTEP process, with a competitive planning component that applies to both:
  - Reliability-driven needs
  - Market efficiency projects

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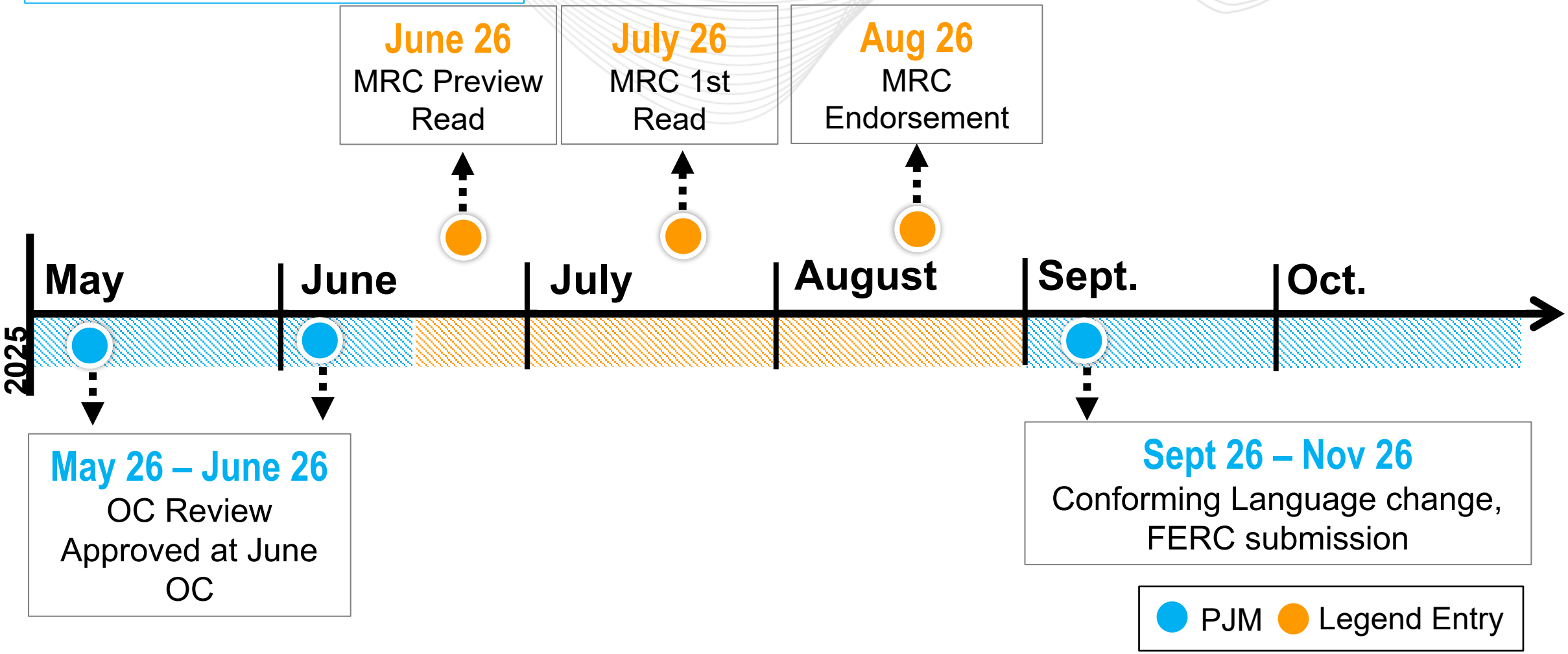
Review/Endorsement Timeline

PJM Highlighted Time Period



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Key Takeaways

1	2	3
• Combined Package Planning and Operations Committee.	• MRC will review and move combined package to MC	• MC Approval to final endorse package then file with FERC.

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