Market Efficiency Update

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Market Efficiency Special Session

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Emergent Technologies
Market Efficiency Modeling

Emergent Technology
Dynamic Line Ratings (DLR)

Market Efficiency Analysis Overview

- Emergent Technology proposals analyzed consistent with manuals 14B and 14F
- Evaluated similar to other transmission asset approved for Market Efficiency:
  - Performance based on congestion reductions and net load payment savings
  - Benefits calculated as decreases in 15-years NPV Annual Net Load Payments for benefiting zones
- Costs based on assumed Annual Revenue Requirements
- Must pass the bright line economic efficiency tests:
  - B/C Ratio Threshold of 1.25
  - Significant decrease of the target congestion driver

Other Analyses

- Reliability Analysis
  - Additional reliability upgrades
- Independent Cost Analysis
  - Projects exceeding $50M Independent cost analysis
- Constructability Analysis
  - Verification of proposed schedule duration
  - Other risks to both cost and schedule

Emergent Technology
Dynamic Line Ratings (DLR)

DLR Technology Overview

DLR technology does not modify the physical characteristics of a line, but rather provides a means for determining instant line ratings more precisely by using specialized sensors that provide a more precise indication of the current ratings.

DLR Market Efficiency Modeling

- **Market Efficiency Base Case** uses planning seasonal ratings
  - Summer Normal & Emergency, Winter Normal & Emergency

- **Accounting for DLR in the Market Efficiency models:**
  - Ratings for lines equipped with DLR devices will be modeled using a DLR Hourly Rating Modifier on top of the Planning seasonal ratings
  - The DLR Hourly Rating Modifier will be calculated as the forecasted hourly difference between forecasted DLR ratings and ambient-ratings for the DLR line

Emergent Technology
Electric Energy Storage (Battery)

Electric Energy Storage (Battery) Overview

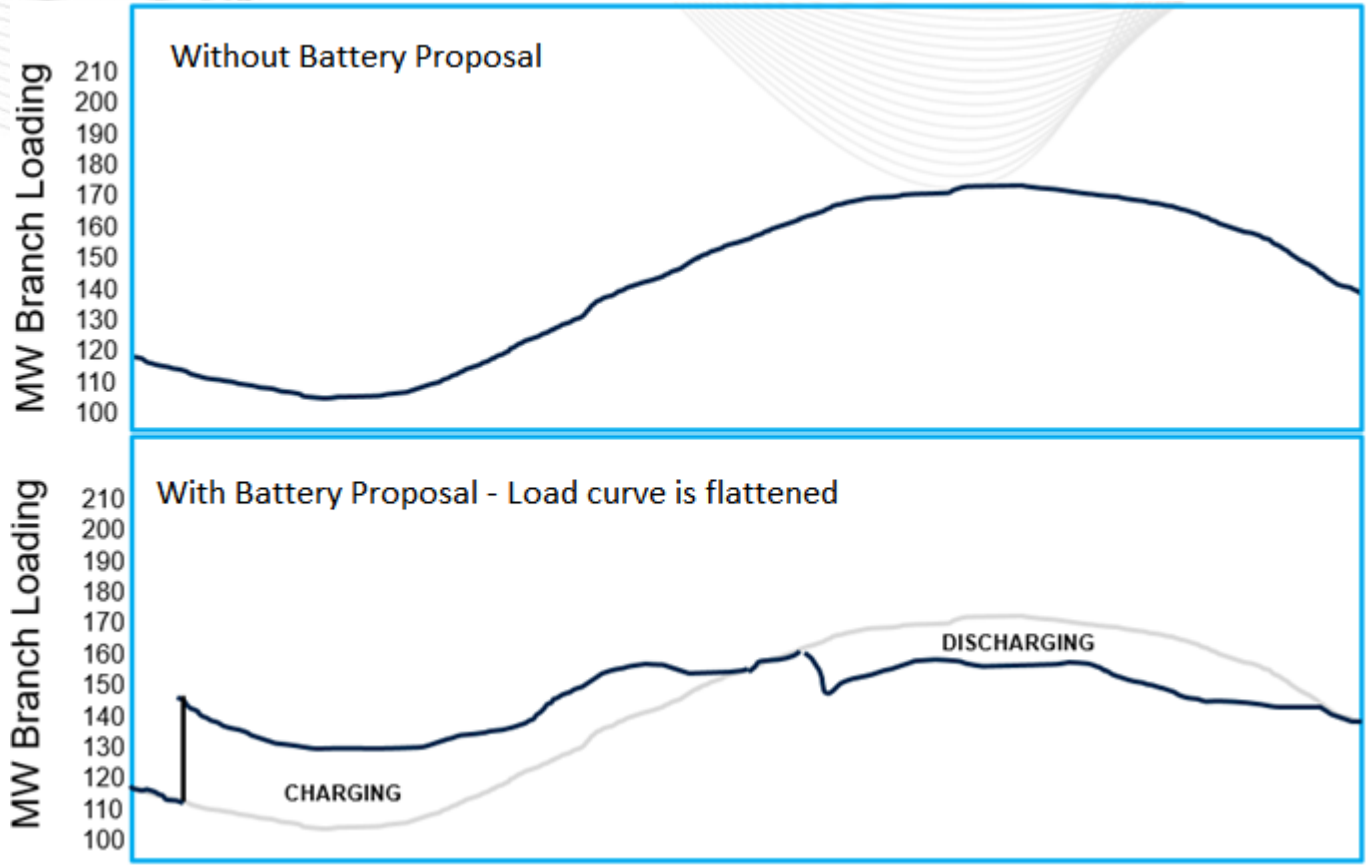
Electric Energy Storage technology does not modify the physical characteristics of a line, but rather provides a means for injecting flows when needed to achieve a more economic dispatch and decrease congestion.

Market Efficiency Battery Storage Proposals

- During previous Long-Term Windows, PJM evaluated a number of battery proposals:
  - 2016/17 RTEP Window – 2 proposals
  - 2018/19 RTEP Window – 6 proposals
- Some battery proposals were submitted as stand-alone, others as combination with new lines
- Battery Proposal Statistics:
  - Peak MW: 10 to 50 MW
  - Duration: 2 to 4 hrs
  - Capital Cost: $17.36 to $165.74

Electric Energy Storage (Battery) Modeling

- Market Efficiency models battery proposals using an Energy Storage model:
  - Assumes optimization based on lowest production cost
  - Economic behavior:
    - off-peak charge “valley fill-in”
    - on-peak discharge “peak clipping”



Emergent Technology
Variable Impedance Devices

Variable Impedance Devices Overview

Variable impedance devices change the impedance of existing lines to provide supplemental push/pull flows to the existing transmission system for a more efficient transfer capability.

Variable Impedance Devices Modeling

- **Previous 2018/19 RTEP Long-Term Window**
  - During previous 2018/19 RTEP Long-Term Window, PJM evaluated a Variable Impedance Device proposal

- **Powerflow model**
  - In the powerflow Variable Impedance Devices are each modeled with a bypass to provide the ability to switch the device in and out
  - Two operating modes: On(at full impedance change)/Off

- **Hourly operation schedules**
  - Developed based on the congested hours in the base case
    - Hours when the line flows from the base case reach the seasonal limits
  - Individual schedule for each simulated year

Contact

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Revision History

- V1 – 12/18/2020 – Original slides posted