Electric Storage Participation

Laura Walter
Sr. Lead Economist
PJM Advanced Analytics Department
Members Committee Webinar
October 22, 2018
Timeline

- February, 2018: FERC final rule on storage …
  - **Filing due Dec 3, 2018.**
  - Implementation due Dec 3, 2019.

• Electric Storage Resource (ESR) = “a resource capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid.”

• Connected at: transmission, distribution, or behind a customer meter.
  - PJM has ESR at both T and D today, none behind a meter that inject.

• Excludes demand response.
• Includes pumped hydro

Over 5,300 MW of Electric Storage Resources currently in PJM

Pumped Hydro 96%
Other Storage 4%

** Data taken from Generation Queue and EIA 860
1. Can sell* energy, **Capacity**, and A/S (incl. Black Start etc.) the resource is technically capable of providing

2. Dispatched and **sets price** as seller and buyer

3. Bid parameters that account for ESR characteristics

4. Min market threshold is 100 kW

5. Stored MWh are billed at LMP as wholesale

* “Eligible to provide…”
Participation Model

- ESRs will be modeled as one continuous resource
- PJM will not make commitment decisions in the ESR model and not manage state of charge
  - Start and no load cost will not be considered
- 3 modes of operation:
  - Continuous, Charge & Discharge
- Parameters
  - Offered in through Markets Gateway
    - Max/Min charge/discharge, etc
    - Ramp considered infinite only in continuous mode

<table>
<thead>
<tr>
<th>Price</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10.00</td>
<td>20</td>
</tr>
<tr>
<td>$ 9.00</td>
<td>15</td>
</tr>
<tr>
<td>$ 8.00</td>
<td>10</td>
</tr>
<tr>
<td>$ 7.00</td>
<td>5</td>
</tr>
<tr>
<td>$ 6.00</td>
<td>0</td>
</tr>
<tr>
<td>$ 5.00</td>
<td>0</td>
</tr>
<tr>
<td>$ 4.00</td>
<td>0</td>
</tr>
<tr>
<td>$ 3.00</td>
<td>-5</td>
</tr>
<tr>
<td>$ 2.00</td>
<td>-10</td>
</tr>
<tr>
<td>$ 1.00</td>
<td>-15</td>
</tr>
</tbody>
</table>
Continuous operation mode - ESRs can update their max charge and discharge limits hourly in day-ahead and more frequently in real-time.

** State of charge telemetry will be requested for telemetered resources
Charge & Discharge mode will be available to ESR resources in DA and RT
PJM proposes that status quo, per manual 21, of a minimum of 10 hour duration is maintained in the capacity market.
Questions or Feedback?

esr@pjm.com