Update on PJM Price Formation Efforts

PJM Interconnection, L.L.C
February 22\textsuperscript{nd}, 2019
Objectives and Key Points

- Briefly review recent price formation discussions and developments
  - FERC Docket EL12-34-000 (Fast Start Pricing)
    - PJM Proposal
  - Formation of the Energy Price Formation Senior Task Force
    - Reserve Pricing

- Constraint Penalty Factor
- Impacts on Market-to-Market coordination
FERC requested PJM to investigate revising its Tariff to:

1) Expand the units eligible for special pricing treatment to all fast-start resources

2) Include a minimum run time and start-up time requirement in the definition of a fast-start resource

3) Allow full economic minimum relaxation for fast-start resources

4) Allow fast-start resource commitment costs to be reflected in prices

5) Consider fast-start resources within dispatch in a way that minimizes production cost
PJM has proposed (pending FERC approval) that resources that meet the following criteria be eligible for Fast Start pricing:

- Startup + Notification Time of 2 hours or less & Minimum Run Time of 2 hours or less
  - Aligns with the set of resources that are eligible to be committed in IT SCED
- Online
- Scheduled by PJM
- Block-loaded or non-block loaded
Many discussion topics including the following

- Updating Operating Reserve Demand Curves (ORDC)
- Additional Locational Reserves Zones
- Consolidation of Tier 1 and Tier 2 Reserves
Transmission Constraint Penalty Factors

• Transmission Constraint Penalty Factors are parameters used by the Security Constrained Economic Dispatch (SCED) applications to determine the maximum cost of the re-dispatch incurred to control a transmission constraint

• Historically, Constraint Relaxation Logic has applied when SCED cannot control a transmission constraint

• PJM stakeholders have approved tariff changes that allow the Transmission Constraint Penalty Factor to set the shadow price of a transmission constraint when the constraint cannot be adequately controlled
  – Changes Approved by FERC on 1/08/2019, implemented on \textit{internal} constraints only on 2/1/2019
Impacts on Market-to-Market Coordination

• Pricing Formation
  – PJM and MISO discussing impacts to M2M Coordination
  – Currently utilizing prices formulated in dispatch runs

• Transmission Constraint Penalty Factors
  – Currently still allowing Constraint Relaxation Logic
  – Working on updates to JOA language and software changes to allow disabling of CRL
  – MISO and PJM exploring enhancements to manage power swings that may be exasperated without CRL
Questions?

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Key Takeaways:

- MISO developed ELMP to allow Fast Start Resource to set prices including their commitment costs
  - Phase I: March 01, 2015
  - Phase II: May 01, 2017
  - Phase III: Evaluating implementation of short-term enhancements
- Other Price Formation efforts include Transmission Constraint Demand Curves
MISO Price Formation – Develop transparent market prices reflective of marginal system cost

Featured by:
- Energy & Reserve co-optimization
- Efficient Scarcity Pricing
- Market-based approach to integrate resources and incentivize flexibility
- Transparent pricing including eligibility of demand response
Extended LMP (ELMP) – *Allow Peaking Resources and Demand Response to set prices*

### Deficiencies of LMP and Lumpiness in Wholesale Electric Markets

<table>
<thead>
<tr>
<th>Peaking Resources</th>
<th>Demand Response</th>
<th>Uplift Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Certain peaking resource cannot fully set prices*</td>
<td>Demand Response may not set prices</td>
<td>Inability to fully price costs results in uplift</td>
</tr>
<tr>
<td>• Offline Fast Start Resources are not considered</td>
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</tbody>
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### Allow online peaking resources to set prices, including their commitment costs

- Include offline Fast Start Resources in price setting

### Allow Demand Response Resources to set prices

- More costs reflected in prices and reduced uplift

**Effectiveness of ELMP to reflect the true cost to meet demand**
Production Experiences validate design objective – *Phase I modest results; Phase II captured broader benefits*

- Online Fast Start Resources (FSR)*: **Start up notification time of sixty (60) minutes or less; minimum run time of one hour or less**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Phase I</th>
<th>Phase II</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSR Capacity / Real-Time Participation</td>
<td>~ 2 GW / ~7%</td>
<td>~10 GW / ~23%</td>
</tr>
<tr>
<td>Online FSR Price Impact</td>
<td>~$1/MWh average increase over relevant Real Time Pricing intervals</td>
<td>~$3/MWh average increase over relevant Real Time Pricing intervals</td>
</tr>
<tr>
<td>Offline FSR Price Impact</td>
<td>~$35/MWh average decrease during relevant Real Time Pricing intervals</td>
<td>~$60/MWh average decrease during relevant Real Time Pricing intervals</td>
</tr>
<tr>
<td>RSG Make Whole Payment</td>
<td>~1% RSG reduction during expected periods</td>
<td>~9% overall RSG reduction</td>
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Note: Offline Fast Start Resources are still limited to 10 minutes start up and notification time and 1 hour min run time
MISO is Evaluating Implementation of three ELMP III Short-Term Enhancements

- Convex Envelope*: Implementation after Market System Enhancement
- Expand eligibility of Fast Start Resources to include Day-Ahead Committed ones (IMM 2015-1a): Near-term implementation
- Real-Time Regulation Enhancement: Near-term implementation
- *Relax ramp rate to allow FSR to set prices (IMM 2015-1b): MISO recommends further study

Note: A recently developed convex primal formulation that better approximates or sometimes even exacts full ELMP
Transmission Constraint Demand Curve – *Specify how valuable it is to keep the flow below limit*

**Example: TCDC for Group 1 Transmission Constraints (Tariff Schedule 28A)**

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Type and Voltage (V)</th>
<th>$/MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>V &lt;= 100kV</td>
<td>$/MWh</td>
<td>$500</td>
</tr>
<tr>
<td>&gt;100kV and &lt;161kV</td>
<td>$/MWh</td>
<td>$1,000</td>
</tr>
<tr>
<td>&gt;= 161kV</td>
<td>$/MWh</td>
<td>$2,000</td>
</tr>
<tr>
<td>IROL</td>
<td>$/MWh</td>
<td>$4,000</td>
</tr>
</tbody>
</table>

- TCDC limits the re-dispatch of generating resources to manage the constraint when relief costs exceed the value the RTO placed on the constraint, and reflects the value into locational price differences.
- Values based on voltage level of constraint and reliability impact, and increase with constraint exceedance to reflect the increasing risks.
Links

- ELMP III white paper: https://cdn.misoenergy.org/20190117%20MSC%20Item%20ELMP%20III%20Whitepaper315878.pdf
- ELMP: MISO Tariff Schedule 29A; TCDC: MISO Tariff Schedule 28A

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