Targeted Market Efficiency Project Type

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System Planning Modeling and Support

Market Efficiency Process Enhancement Task Force
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Where did we start?

- Significant historical border (market to market) congestion not captured in future PROMOD models
  - Topology changes
  - Generation changes
  - Outage patterns
  - Modeled transfer flows
- Identified many low cost upgrades (facilities not conductor limited)
Guiding Principles

- Small, low cost, short lead time projects
- Targeted at specific, historical congestion issues
- Simple method for benefit determination
- Avoid complicated analysis which would delay implementation
Targeted Market Efficiency Projects

- “Backward looking”
- Specific historical congestion
- Benefit based on relief of historical congestion
- Small, quick implementation projects only

Market Efficiency Projects

- “Forward looking”
- Projected future congestion
- Benefit based on projected load cost (and production cost) savings
- Can include large, longer lead time projects
• Current TMEP process applies only to M2M flowgates with MISO
• Codified in:
  – PJM/MISO JOA Article 9.3 & 9.4
    • Study and approval process
    • Interregional cost allocation
  – Regional OATTs
    • Regional cost allocation
  – FERC Docket: ER17-718

Slides 6 - 14 discuss the details of the approved interregional TMEP process; NOT a specific regional TMEP proposal
- TMEP study conducted throughout 2016
- Stakeholder interaction though IPSAC
- Five TMEPs recommended for board approval
- FERC accepted TMEP process subject to conditions on October 3, 2017
  - Minor JOA compliance filing November 2
- Projects approved by PJM and MISO Boards in December 2017
  - Combined cost: $20 million
  - Combined benefit: $100 million
1. Identify significant historical congestion
2. Identify mitigating factors (outages, planned upgrades)
3. Identify limiting elements and solicit upgrade proposals
4. Test efficacy of proposals
5. Check effective proposals against TMEP criteria
6. Jointly recommend passing projects to Boards
- Will the congestion continue?
  - Was congestion outage driven?
    - Operator knowledge
    - PROMOD simulation
  - Will a future transmission project impact congestion?
    - Planner knowledge
    - PROMOD simulation

- Will the upgrade resolve congestion?
  - PROMOD simulation

Breakdown of 50 Evaluated Flowgates (2016 Interregional Study)
TMEP Definition

- Limited to historically binding M2M flowgates
- Projects must be in service by 3rd summer peak
- Projects with capital cost over $20 million not eligible
  - must go through MEP process
- Benefits based on relieving average of past 2 years of historical congestion (Day Ahead + Balancing)
- Four years worth of benefits must completely cover project’s installed capital cost
- Discount/inflation rate not necessary as all projects are near term
- Interregional cost allocation based on congestion relief in each RTO
  - Adjusted by M2M payments
## Example TMEP (1/5)
### Historical Congestion

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PJM Congestion</td>
<td>$1,000,000</td>
<td>$1,500,000</td>
<td>Two years of historical values</td>
</tr>
<tr>
<td>MISO Congestion</td>
<td>$1,000,000</td>
<td>$1,250,000</td>
<td>Note M2M payments are equal and opposite</td>
</tr>
<tr>
<td>PJM M2M Payment</td>
<td>$150,000</td>
<td>$200,000</td>
<td>Sum of both RTOs</td>
</tr>
<tr>
<td>MISO M2M Payment</td>
<td>$(150,000)</td>
<td>$(200,000)</td>
<td></td>
</tr>
<tr>
<td>Total Congestion</td>
<td>$2,000,000</td>
<td>$2,750,000</td>
<td></td>
</tr>
</tbody>
</table>

*Note: In this example M2M payments are made by PJM to MISO

*All values and project details are for illustrative purposes only*
• Identify outages that drove congestion
  – No impact identified
• Identify planned upgrades that may relieve congestion
  – One potential upgrade identified
  – PROMOD analysis shows project will not have significant impact
• Identify limiting equipment and potential upgrades
  – Limiting element is a disconnect switch, followed by CTs and relays
  – Equipment could be replaced within 18 months for $2.5 million
  – Rating increases from 250/250 to 250/300 MVA
• PROMOD analysis
  – Shows the increased rating relieves congestion
• Projects must be in service by 3rd summer peak
  – 18 month timeline meets this criteria
• Projects over $20 million not eligible
  – $2.5 million is well below $20 million cap
• Four years of benefits (relieved historical congestion) must cover capital costs
  – Criteria met (see next slide)
Proposed upgrade is replacement of terminal equipment
  - Total cost $2.5 million

Analysis shows project eliminates congestion issue

Annual benefit is average of Total Congestion:

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Congestion</th>
</tr>
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<tbody>
<tr>
<td>2016</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>2017</td>
<td>$2,750,000</td>
</tr>
</tbody>
</table>

Four years of benefits exceeds the installed cost

$2,375,000

$2.5 million

$9.5 million > $2.5 million

The project passes the benefit threshold

*All values and project details are for illustrative purposes only*
Cost allocation determined by TOs

Interregional cost allocation
- JOA §9.4.4.1.5
  - Based on share of regional congestion relief

PJM regional cost allocation
- OATT Schedule 12
  - Based on allocation of the historical M2M congestion to load buses
  - Uses two historical years, consistent with benefit determination

Recommend project along with interregional and regional cost allocations to Boards for approval
• Complementary to Market Efficiency Projects, not a replacement
  – Look ‘backward’, while MEPs look ‘forward’
• Potential solution to observed market issues
• Focus on small, quick implementation projects which bring significant congestion reduction

PJM and MISO are currently conducting an Interregional TMEP study. Please join us at the IPSAC to learn more.
Phase I Summary

- General support for concept
- Matrix developed with 7 design components
  - Largely mirrors interregional process
- 4 solution options developed
  - Different benefit calculations
  - Different periods used for B/C test
- Concerns about how project type fits into Order 1000 competitive process
**Proposed Timeline**

* Based on current Market Efficiency 24-month cycle.

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<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
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<tbody>
<tr>
<td>Jan</td>
<td>Jan</td>
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<tr>
<td>Feb</td>
<td>Feb</td>
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<td>Mar</td>
<td>Mar</td>
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<td>Apr</td>
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<td>May</td>
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<td>Nov</td>
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<td>Dec</td>
<td>Dec</td>
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</tr>
<tr>
<td>Develop Input Assumptions</td>
<td>Identify Regional TMEP, Review with TEAC and Approval by Board</td>
</tr>
<tr>
<td>Identify Regional TMEP, Review with TEAC and Approval by Board</td>
<td>Build the draft base case</td>
</tr>
<tr>
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<td>Market Efficiency Analysis</td>
</tr>
<tr>
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<td>Proposal Window</td>
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<td>Identify Regional TMEP, Review with TEAC and Approval by Board</td>
</tr>
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<td>Mid Cycle Update</td>
</tr>
<tr>
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<td>Market Efficiency Proposal Analysis</td>
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<tr>
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<td>Incremental, Combo and Multi Driver Analysis</td>
</tr>
<tr>
<td>Incremental, Combo and Multi Driver Analysis</td>
<td>Final Review with TEAC and approval by Board</td>
</tr>
<tr>
<td>Final Review with TEAC and approval by Board</td>
<td></td>
</tr>
</tbody>
</table>

**Market Efficiency 24-month cycle**
```
### Past Approved MEP/TMEP Candidates

<table>
<thead>
<tr>
<th>PJM-Identified Constraint</th>
<th>Safe Harbor to Graceton 230 kV Line</th>
<th>Brunner Island to Yorkana 230 kV Line</th>
<th>Worcester to Ocean Pines 69 kV Line</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Reconductor two spans of the graceton-Safe Harbor 230kV transmission line. Includes termination point upgrades.</td>
<td>Reconductor three spans limiting the Brunner Island-Yorkana 230kV line, add 2 breakers to Brunner Island switchyard, upgrade associated terminal equipment.</td>
<td>Rebuild Worcester-Ocean Pine 69 kV ckt 1 to 1400A capability summer emergency.</td>
</tr>
<tr>
<td><strong>PJM Window Project ID</strong></td>
<td>201415_1-2A</td>
<td>201415_1-2B</td>
<td>201415_1-13E</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>PPL/BGE</td>
<td>ME/PPL</td>
<td>DPL</td>
</tr>
<tr>
<td><strong>Historical Congestion ($M)</strong></td>
<td>$4.90</td>
<td>$2.50</td>
<td>$5.40</td>
</tr>
<tr>
<td><strong>Project Cost ($M)</strong></td>
<td>$1.10</td>
<td>$3.10</td>
<td>$2.40</td>
</tr>
<tr>
<td><strong>B/C Ratio</strong></td>
<td>17.82</td>
<td>3.23</td>
<td>9.00</td>
</tr>
<tr>
<td><strong>TMEP Criteria</strong></td>
<td>Is Upgrade: Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Costs $20M or less: Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Has historical congestion: Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Cost is recovered in 4 years: Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Will be in-service by third summer season: Assuming these upgrades could have been completed in 3 years.</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
• Benefit calculation consistent with principles?
• Upgrades limited to substation equipment?
• Is a short proposal window justified?
  – Could a window fit in schedule?
  – What data/models would be required?