PJM Regional Transmission Expansion Planning (RTEP) Process

IPSAC
December 14, 2020
• Planning Committee (PC)
• Transmission Expansion Advisory Committee (TEAC)
• Interregional Planning
• Services and Requests
  – http://www.pjm.com/planning/services-requests.aspx
• RTEP Development
• Manual 14B
  – http://www.pjm.com/-/media/documents/manuals/m14b.ashx
PJM RTEP Drivers and Planning Cycles
### PJM’s 2-year Reliability

**Cycle 1**
- Yr -1
  - Development of assumptions
  - Reliability criteria analysis for years 5 - 15
  - Perform criteria analysis for years 8 - 15
  - Re-tool of analysis for years 7 - 15 including solution options
- Yr 0
  - Develop assumptions and build Year 8 base case
  - Perform reliability and market efficiency analysis for Year 8 - 15
  - Re-tool of analysis for years 7 - 15 including solution options
  - Independent consultant reviews of buildability
  - Adjustments to solution options by PJM based on analysis
- Yr +1
  - Develop assumptions for years 5 - 15
  - Identify and evaluate solution options
  - Review with TEAC and approval by the PJM Board
- Yr +2
  - Develop assumptions for years 8 - 15
  - Identify and evaluate solution options
  - Review with TEAC and approval by the PJM Board

**Cycle 2**

### PJM’s 2-year Market Efficiency

#### Year 0
- Develop assumptions
  - (Year 1 and Year 5)
- Market Efficiency Analysis
  - (Year 1 and Year 5) accelerations and modifications
- Identify and evaluate solution options
- Accelerations and modifications
- Final review with TEAC and approval by the PJM Board

#### Year 1
- Develop assumptions
  - (Year 1, Year 5, Year 8, Year 11, Year 15)
- Market Efficiency Criteria Analysis
  - (Year 1, Year 5, Year 8, Year 11, Year 15)
- Market Efficiency Analysis
  - (Year 1, Year 5, Year 8, Year 11, Year 15)
- Identify proposed solutions
- Update significant assumptions
  - (Year 0, Year 4, Year 7, Year 10, Year 14)
- Independent consultant reviews of buildability
- Adjustments to solution options by PJM based on analysis

### Planning Cycles

[Diagram showing the timeline and flow of activities for both reliability and market efficiency planning cycles.]
PJM 2020 RTEP Update

- Baseline Projects – Projects that are driven by reliability criteria violations, operational performance issues, and congestion constraints.
- Supplemental Projects – Projects that are not required to address system reliability, Operational performance or economic criteria. Supplemental projects are planned according to the Tariff Attachment M-3 process.
• Per the PJM Operating Agreement, a proposal window was conducted for all reliability needs that were not Immediate Need reliability upgrades or were otherwise ineligible to go through the window process.

• PJM opened 3 windows as part of the 2020 study year
  – Proposal Window No.1  - 60 days window
  – Proposal Window No.2  - 30 days window
  – Proposal Window No.3 – 30 days window
2020 RTEP Window 1 Update
PJM as part of the annual Regional Transmission Expansion Plan conducted studies and originally identified 3228 flowgates. 207 of those flowgates were eligible for competition, where 3021 of the flowgates were excluded from the competition for various reasons.

- Window 1 Opened: July 1, 2020
- Window 1 Closed: August 31, 2020
Overview of 2025 Results

Total of 3228 flowgates identified

- 207 flowgates are eligible
  - 165 in the PJM West Region
  - 31 in the PJM South Region
  - 11 in PJM Mid-Atlantic Region

- 3021 flowgates excluded
  - 2226 due to the below 200 kV exclusion
  - 122 due to the substation equipment exclusion
  - 545 fixed by existing baseline
  - 108 Dominion Immediate Need
  - 11 fixed by supplemental project already in service due to customer needs or required as part of the customer service due to no harm studies
  - 6 Non PJM Facility
  - 3 suspended queue generator

Note: PJM made several updates/corrections after the window was initially opened which resulted in a reduction in the number of violations identified in the 2020 RTEP.
<table>
<thead>
<tr>
<th>Voltage</th>
<th>Baseline Project</th>
<th>Below 200 kV exclusion</th>
<th>Immediate Need</th>
<th>Non PJM Facility</th>
<th>Substation Equipment exclusion</th>
<th>Supplemental Project</th>
<th>Suspended Queue Generator</th>
<th>Window Included</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;69 kV</td>
<td>345</td>
<td>642</td>
<td>40</td>
<td>40</td>
<td>76</td>
<td>1,103</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>69 kV</td>
<td>163</td>
<td>896</td>
<td>3</td>
<td>10</td>
<td>87</td>
<td>1,217</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115 kV</td>
<td>59</td>
<td>61</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>166</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>138 kV</td>
<td>37</td>
<td>585</td>
<td>12</td>
<td>1</td>
<td>635</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>230 kV</td>
<td>2</td>
<td>47</td>
<td>1</td>
<td>3</td>
<td>30</td>
<td>83</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>345 kV</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>11</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 kV</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>765 kV</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>545</td>
<td>2,226</td>
<td>108</td>
<td>122</td>
<td>11</td>
<td>207</td>
<td>3,228</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Diagram:**
- **Legend:**
  - Baseline Project
  - Below 200 kV exclusion
  - Immediate Need
  - Non PJM Facility
  - Substation Equipment exclusion
  - Supplemental Project
  - Suspended Queue Generator
  - Included
• 47 proposals received from 8 entities to address the flowgates eligible for competition
  – 12 proposals include greenfield construction
• PJM so far have received 52 proposals to address the flowgates excluded from the competition.
  – 5 proposals include greenfield construction

➢ Proposals evaluation in progress
2020 RTEP Window 2 Update
Violation was identified for Dominion’s FERC 715 Planning Criteria (End of Life Criteria)

• Proposal Window No.2 Opened: July 1, 2020
• Proposal Window No.2 Closed: July 31, 2020

1 proposal was received from 1 entity

• Proposal is from an incumbent entity
  – Rebuild 500kV Line #514 (Doubs(FE) - Goose Creek(DEV) 500kV transmission). (Baseline upgrade # B3247)
2020 RTEP Window 3 Update
Proposal Window No.3 Opened: September 18, 2020
Proposal Window No.3 Closed: October 19, 2020

This window includes 24 Thermal AEP FERC 715 Violations, primarily on 69kV facilities resulting from contingency correction:

- 8 flowgates are from the 2020 RTEP Window 1 violations
- 16 flowgates are new violations for 2020 RTEP Window 3

3 proposals received from 2 entities

Proposals evaluation in progress
2020 RTEP M-3 Process
• Development of Supplemental Projects:
  • PJM coordinated the Supplemental projects planning as described in the Tariff, Attachment M-3.
    – PJM received/presented 310 Supplemental Needs from 1/1/2020 to 11/30/2020
    – Solutions were proposed for 185 of the 310 projects
    – 116 projects completed all necessary reviews and the projects will be integrated into the 2021 Regional Transmission Expansion Plan.
Generation Deactivation Notification Update
(Between 4/1/2020 and 11/1/2020)
<table>
<thead>
<tr>
<th>Unit(s)</th>
<th>Transmission Zone</th>
<th>Requested Deactivation Date</th>
<th>PJM Reliability Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalk Point Unit 1 and 2 (670 MW)</td>
<td>PEPCO</td>
<td>6/1/2021</td>
<td>Reliability analysis complete. No violation identified</td>
</tr>
<tr>
<td>Dresden 2 and 3 (1798 MW)</td>
<td>ComEd</td>
<td>11/1/2021</td>
<td>Reliability analysis complete. No violation identified</td>
</tr>
<tr>
<td>Birchwood Plant (238 MW)</td>
<td>Dominion</td>
<td>3/1/2021</td>
<td>Reliability analysis complete. No violation identified</td>
</tr>
<tr>
<td>Harwood 1 and 2 (27.2 MW)</td>
<td>PPL</td>
<td>5/31/2021</td>
<td>Reliability analysis Underway</td>
</tr>
<tr>
<td>Countryside Landfill (5.8 MW)</td>
<td>ComEd</td>
<td>1/27/2021</td>
<td>Reliability analysis Underway.</td>
</tr>
<tr>
<td>Unit(s)</td>
<td>Transmission Zone</td>
<td>Actual Deactivation Date</td>
<td>PJM Reliability Status</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------</td>
<td>--------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Westport 5 (116 MW)</td>
<td>BGE</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Wagner 2 (135 MW)</td>
<td>BGE</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>W M Sammis 1, 2, 3 and 4 (669 MW)</td>
<td>ATSI</td>
<td>6/1/2020</td>
<td>Reliability analysis complete and upgrades expected to be completed in time for unit to deactivate as scheduled.</td>
</tr>
<tr>
<td>Sussex County LF (2 MW)</td>
<td>JCPL</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Salem County LF (1.7 MW)</td>
<td>AEC</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td><strong>Unit(s)</strong></td>
<td><strong>Transmission Zone</strong></td>
<td><strong>Actual Deactivation Date</strong></td>
<td><strong>PJM Reliability Status</strong></td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------------</td>
<td>------------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Pennsbury Generator Landfill 1 and 2 (4.7 MW)</td>
<td>PECO</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Notch Cliff GT1, GT2, GT3 and GT4 (64 MW)</td>
<td>BGE</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified</td>
</tr>
<tr>
<td>Keystone Recovery Units 1 - 7 (4.9 MW)</td>
<td>PPL</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified</td>
</tr>
<tr>
<td>Fairless Hills Landfill A and B (60 MW)</td>
<td>PECO</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified</td>
</tr>
<tr>
<td>Unit(s)</td>
<td>Transmission Zone</td>
<td>Actual Deactivation Date</td>
<td>PJM Reliability Status</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------</td>
<td>--------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Conesville 4 (780 MW)</td>
<td>AEP</td>
<td>6/1/2020</td>
<td>Reliability analysis complete; upgrades expected to be completed in future, but interim operating measures identified and unit can deactivate as scheduled</td>
</tr>
<tr>
<td>BC Landfill (6 MW)</td>
<td>PSEG</td>
<td>6/1/2020</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Dickerson Unit 1, 2 and 3 (543 MW)</td>
<td>PEPCO</td>
<td>8/13/2020</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
</tbody>
</table>
RTEP Projects Electrically Near the PJM-NYISO Interface Between March and December 2020
Process Stage: Second Review
Criteria: Winter Baseline
Assumption Reference: 2025 RTEP assumption
Model Used for Analysis: 2025 RTEP Winter case
Proposal Window Exclusion: Below 200 kV

Problem Statement: Post contingency voltage drop violation on the Williams 115 kV substation. The Williams 115 kV bus has a voltage drop issue for a line fault stuck breaker contingency loss of the Williams – Tiffany – Laurel lake – Westover 115 kV circuit. Violations were posted as part of the 2020 Window 1: FG# N1-WVD1

Existing Facility Rating: N/A
Proposed Facility Rating: N/A

Recommended Solution:
Construct a new breaker-and-a-half 115 kV (Warriner Pond) substation near Tiffany substation. All transmission assets and lines will be relocated from Tiffany to the new substation. The two distribution transformers will be fed via two dedication 115 kV feeds to the existing Tiffany substation. (b3245)

Estimated Cost: $23.2 M

Alternatives: Convert Tiffany Substation to a ring bus configuration (Not feasible).
Required In-Service: 6/1/2025
Need Number: PN-2020-002
Process Stage: Solution Meeting 07/07/2020
Previously Presented:
Need Meeting 5/12/2020
Project Driver:
Equipment Material Condition, Performance and Risk
Specific Assumption Reference:
Substation Condition Rebuild/Replacement
Problem Statement:
Erie West #1 345/115 kV Transformer
• Transformer has increased failure probability due to:
  • Transformer is 47 years old.
  • High level heating gases and moisture
  • HV bushings have significant deterioration
  • Obsolete parts
  • Nitrogen and oil leaks

Transformer circuit rating is the existing transformer rating of 266/333 MVA (SN/SE).
Need Number: PN-2020-002

Process Stage: Solutions Meeting 07/07/2020

Proposed Solution:

Replace Erie West #1 345/115 kV Transformer

- Replace the #1 345/115 kV transformer and associated equipment with a 168/224 MVA transformer

Transformer Rating:

Erie West #1 345/115 kV Transformer

- Before Proposed Solution: 266 / 333 MVA (SN/SE)
- After Proposed Solution (anticipated): 280 / 341 MVA (SN/SE)

Alternatives Considered:

- Maintain existing condition

Estimated Cost: $3.3M

Projected In-Service: 12/31/2021

Project Status: Conceptual

Model: 2020 Series 2025 Summer RTEP 50/50
Process Stage: Second Review
Criteria: Summer and Winter N-1-1
Assumption Reference: 2025 RTEP assumption
Model Used for Analysis: 2025 RTEP Summer and Winter cases
Proposal Window Exclusion: None

Problem Statement: Post contingency high voltage violation on the Pierce Brook 345kV substation. The Pierce Brook 345kV bus has high voltage issue for N-1-1 contingency loss of the Pierce Brook – Five Mile 345 kV circuit plus Pierce Brook shunt reactor, and Pierce Brook – Five Mile 345 kV circuit plus Lewis Run - Pierce Brook 230 kV circuits in both summer and winter analysis results.

Violations were posted as part of the 2020 Window 1: FG# N2-SVM52 to N2-SVM55 and N2-WVM15 to N2-WVM19

Existing Facility Rating: N/A
Proposed Facility Rating: N/A

Recommended Solution:
Install a second 125 MVAR 345 kV shunt reactor and associated equipment at Pierce Brook Substation. Install a 345 kV breaker on the high side of the #1 345/230 kV transformer. (B3306)

Estimated Cost: $8.08 M
Alternatives: N/A
Required In-Service: 6/1/2025
PJM Market Efficiency Update

Nick Dumitriu
Sr. Lead Engineer, PJM Market Simulation
2020/2021 Long-Term Window
• Market Efficiency Input Assumptions presented at TEAC meetings June through August
  – 20/21 Market Efficiency Analysis Assumptions [whitepaper](#) was shared with the PJM board for consideration at the September Board meeting and posted with the October TEAC materials

• Market Efficiency Training, available [here](#) completed October 20th

• Long-Term Window Materials Posting Schedule
  – Retooled PROMOD model to be posted during the month of November (XML format)
    • XML files compatible with PROMOD 11.3
  – ME Window Congestion Drivers, ME Window Base Case, and Sensitivity scenarios to be posted in December, before start of 20/21 Long-Term Window
• Retooled model includes (to-be posted during November)
  – MISO data update
  – Updated PJM Generation Expansion (ISA/FSA status, retirements)
  – Updated topology using the retooled 2025 powerflow from Transmission Planning
    • Also updated PJM line ratings and contingency definitions
  – ABB-Hitachi PROMOD data updates (heat rates, generator outages)
  – Updated PROMOD setup
• Final sensitivity cases to-be posted during November
# PJM Base Case Updated Preliminary Results - 2025 Simulated Congestion*

*Preliminary results, not final congestion drivers. List of constraints and congested areas may change in the final base case.

**Table identifies correlated historical constraints with 2025 PROMOD simulated congestion in the same area/group.

<table>
<thead>
<tr>
<th>Group**</th>
<th>Correlated Historical Constraints***</th>
<th>Congested Area</th>
<th>Type</th>
<th>Historical 2019 Day Ahead Congestion</th>
<th>Historical 2020 Day Ahead Congestion</th>
<th>Simulated 2025 Area Congestion*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Harwood to Susquehanna #1 230 kV</td>
<td>PPL</td>
<td>Line</td>
<td>$4,587,972</td>
<td>$16,157,914</td>
<td>Yes</td>
</tr>
<tr>
<td>1</td>
<td>Harwood to Susquehanna #2 230 kV</td>
<td>(Susq. Group)</td>
<td>Line</td>
<td>$1,466,849</td>
<td>$3,290,309</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cumberland to Juniata 230 kV</td>
<td>PPL</td>
<td>Line</td>
<td>$3,516,896</td>
<td>$6,368,984</td>
<td>Yes</td>
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<tr>
<td>2</td>
<td>Dauphin to Juniata 230 kV</td>
<td></td>
<td>Line</td>
<td>$-</td>
<td>$472,479</td>
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<tr>
<td>2</td>
<td>Juniata #1 500/230 kV</td>
<td>XFRM</td>
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<td>$-</td>
<td>$46,886</td>
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<tr>
<td>2</td>
<td>Juniata #2 500/230 kV</td>
<td>XFRM</td>
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<td>$-</td>
<td>$2,836,659</td>
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<tr>
<td>3</td>
<td>Plymouth Meeting to Whitpain #3 230 kV</td>
<td>PECO</td>
<td>Line</td>
<td>$1,572,531</td>
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<tr>
<td>3</td>
<td>Plymouth Meeting to Whitpain #4 230 kV</td>
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<td>4</td>
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<tr>
<td>4</td>
<td>Jct. to French's Mill 138 kV</td>
<td>Line</td>
<td></td>
<td>$116,952</td>
<td>$345,506</td>
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<tr>
<td>4</td>
<td>Gore to Stonewall 138 kV</td>
<td>APS</td>
<td>Line</td>
<td>$818,902</td>
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<td>4</td>
<td>Messick Road to Morgan 138 kV</td>
<td>Line</td>
<td></td>
<td>$263,290</td>
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<tr>
<td>4</td>
<td>Messick Road to Ridgeley 138 kV</td>
<td>Line</td>
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<td>$1,704,272</td>
<td>$462,027</td>
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<tr>
<td>5</td>
<td>Kammer North (Bus 1 &amp; 3) to Natrium 138 kV</td>
<td>AEP</td>
<td>Line</td>
<td>$178,984</td>
<td>$36,523</td>
<td>Yes</td>
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<tr>
<td>6</td>
<td>Quad Cities to Rock Creek 345 kV</td>
<td>CE-ALTW</td>
<td>M2M</td>
<td>$896,048</td>
<td>$427,688</td>
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<tr>
<td>7</td>
<td>Muskingum River to Beverly 345 kV</td>
<td>AEP</td>
<td>Line</td>
<td>$-</td>
<td>$-</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>Muskingum River to Waterford 345 kV</td>
<td>AEP</td>
<td>Line</td>
<td>$-</td>
<td>$-</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: Historical 2019 and 2020 Day Ahead Congestion values are in thousands of dollars.
2020/21 Long-Term Window Schedule (Year 2020)

Jan. – April
Develop PJM assumptions

May – Aug.
Build/update PROMOD model

Sept. – Nov.
Identify eligible congestion drivers

Aug.
Post preliminary market efficiency base case

Sept. – Oct.
Interregional data update

Nov.
Post sensitivity scenarios

Dec.
Post window materials:
- Problem Statement
- Eligible Congestion Drivers
- Modeling Data
2020/21 Long-Term Window Schedule (Year 2021)

Jan. – April
- Open long-term window
- Mid-cycle update

May – Sept.
Analysis of proposed solutions

Oct. – Nov.
TEAC Reviews: first and second reads

June – Aug.
Independent cost/constructability review

Dec.
PJM Board approval of selected solutions
Questions?