PJM Regional Transmission Expansion Planning (RTEP) Process

IPSAC
December 10, 2018
• Planning Committee (PC)
  • http://www.pjm.com/committees-and-groups/committees/pc.aspx
• Transmission Expansion Advisory Committee (TEAC)
  • http://www.pjm.com/committees-and-groups/committees/teac.aspx
• Interregional Planning
  • http://www.pjm.com/planning/interregional-planning.aspx
• Services and Requests
  • http://www.pjm.com/planning/services-requests.aspx
• RTEP Development
  • http://www.pjm.com/planning/rtep-development.aspx
• Manual 14B
  • http://www.pjm.com/-/media/documents/manuals/m14b.ashx
PJM RTEP Planning Cycles
PJM’s 2-year Reliability

Cycle 1
- Yr -1
  - Develop assumptions
  - Reliability criteria analysis for years 5 - 15
  - Identify and evaluate solution options
  - Review with TEAC and approval by the PJM Board
- Yr 0
  - Develop assumptions and build Year 7 base case
  - Perform criteria analysis for years 8 - 15
  - Perform reliability and market efficiency analysis for Year 8 - 15
  - Identify proposed solutions
  - 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 (Year 1 and Year 5)

Cycle 2

PJM’s 2-year Market Efficiency

Planning Cycles

Year 0
- 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)
- Analysis of market solutions and support of benefits of reliability solutions (Year 0, Year 4, Year 2, Year 10, Year 14)
- Independent consultant reviews of buildability
- Adjustments to solution options by PJM based on analysis
- Develop assumptions (Year 1, Year 5)
- Market Efficiency Analysis (Year 1, Year 5) accelerations and modifications
- Identify and evaluate solution options
- Adjustments and Modifications
- Final review with TEAC and approval by the PJM Board

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

12-month cycle

24-month cycle

12-month cycle
2018 Proposal Window Update
Overview of 2023 Results

Total of 160 flowgates identified

- 3 included in the window
  - 1 in West region
  - 2 in the South region

- 157 flowgates excluded
  - 126 due to Immediate Need (PJM OA 1.5.8(m)) (Includes Retired Generator related)
  - 26 Below 200kV (PJM OA 1.5.8(n))
  - 5 Substation Equipment (PJM OA 1.5.8(p))
2018 RTEP Proposal Window 1 - Statistics

• Timeline
  – Window Opened: July 2, 2018
  – Window Closed: August 31, 2018
    • Proposal definitions, simulation data and detailed cost data all due at this time
• 7 Proposals received from 2 entities addressing 2 target zones
  – All Transmission Owner Upgrade
  – No greenfield
## 2018 RTEP Proposal Window 1 - Proposals

<table>
<thead>
<tr>
<th>Project ID</th>
<th>Upgrade/Greenfield</th>
<th>Proposing Entity</th>
<th>Project Cost ($M)</th>
<th>Target Zone(s)</th>
<th>kv Level(s)</th>
<th>Analysis Type</th>
<th>FG#</th>
<th>Major Components/Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Upgrade</td>
<td>DEOK</td>
<td>$ 0.377</td>
<td>DEOK</td>
<td>138kV</td>
<td>Summer N-1 Load Drop</td>
<td>N1-SLD1</td>
<td>Add redundant relaying to Port Union 138kV Bus 2 to eliminate the contingency driving the reliability criteria violation.</td>
</tr>
<tr>
<td>2A</td>
<td>Upgrade</td>
<td>Dominion</td>
<td>-</td>
<td>Dominion</td>
<td>69kV</td>
<td>Summer N-1 High Voltage</td>
<td>N1-SVH1, N1-SVH2</td>
<td>This is an operational solution that will remotely open Pentagon TX#1 breaker L122, immediately following the breaker-failure event (2036T2142) at Radnor Substation thus resolving the post contingency high voltage.</td>
</tr>
<tr>
<td>2B</td>
<td>Upgrade</td>
<td>Dominion</td>
<td>$ 0.481</td>
<td>Dominion</td>
<td>230/69kV</td>
<td>Summer N-1 High Voltage</td>
<td>N1-SVH1, N1-SVH2</td>
<td>Move the existing 230/69kV TX#4 to the vacant 230/69kV TX#2 spot at Pentagon Substation</td>
</tr>
<tr>
<td>2C</td>
<td>Upgrade</td>
<td>Dominion</td>
<td>$ 0.597</td>
<td>Dominion</td>
<td>230/69kV</td>
<td>Summer N-1 High Voltage</td>
<td>N1-SVH1, N1-SVH2</td>
<td>Move spare 230/69kV transformer from Jefferson Street Substation to the vacant Transformer #2 bay at Pentagon Substation</td>
</tr>
<tr>
<td>2D</td>
<td>Upgrade</td>
<td>Dominion</td>
<td>$ 13.493</td>
<td>Dominion</td>
<td>230kV</td>
<td>Summer N-1 High Voltage</td>
<td>N1-SVH1, N1-SVH2</td>
<td>Construct a 230kV four (4) breaker GIS ring bus in Pentagon Substation and terminate existing Line 2037 and Line 2121.</td>
</tr>
<tr>
<td>2E</td>
<td>Upgrade</td>
<td>Dominion</td>
<td>$ 3.161</td>
<td>Dominion</td>
<td>69kV</td>
<td>Summer N-1 High Voltage</td>
<td>N1-SVH1, N1-SVH2</td>
<td>Install a 50 MVAR fixed shunt reactor at Pentagon Substation on the 69kV bus</td>
</tr>
<tr>
<td>2F</td>
<td>Upgrade</td>
<td>Dominion</td>
<td>$ 12.732</td>
<td>Dominon</td>
<td>230kV</td>
<td>Summer N-1 High Voltage</td>
<td>N1-SVH1, N1-SVH2</td>
<td>A new substation called Cloverleaf with a 230kV variable shunt reactor with a new 230kV underground line roughly 300 ft extending from Cloverleaf Substation to Pentagon substation terminating at the 230kV bus</td>
</tr>
</tbody>
</table>
Generation Deactivation Notification Update
(as of Nov 1, 2018)
Generation Deactivations for 2018
<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>Buggs Island 1&amp;2 (138 MW)</td>
<td>Dominion</td>
<td>Deactivated on 4/9/2018</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Bremo 3&amp;4 (227 MW)</td>
<td>Dominion</td>
<td>Deactivated on 4/16/2018</td>
<td>Reliability analysis complete. New baseline upgrade was issued to resolve the identified issue.</td>
</tr>
<tr>
<td>Bellemeade CC 1 (265.7 MW)</td>
<td>Dominion</td>
<td>Deactivated on 4/16/2018</td>
<td>Reliability analysis complete. New baseline upgrade was issued to resolve the identified issue.</td>
</tr>
<tr>
<td>Possum Point 3&amp;4 (317.7 MW)</td>
<td>Dominion</td>
<td>12/1/2018</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Chesterfield 3&amp;4 (262.1 MW)</td>
<td>Dominion</td>
<td>12/1/2018</td>
<td>Reliability analysis complete. New baseline upgrade was issued to resolve the identified issue.</td>
</tr>
<tr>
<td>Unit(s)</td>
<td>Transmission Zone</td>
<td>Requested Deactivation Date</td>
<td>PJM Reliability Status</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------</td>
<td>------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Brunner Island Diesels (8.1 MW)</td>
<td>PPL</td>
<td>Deactivated on 2/25/2018</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Dixon Lee LF (3.6 MW)</td>
<td>ComEd</td>
<td>Deactivated on 1/10/2018</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Pleasants Power Station U1 &amp; U2 (1278 MW total)</td>
<td>APS</td>
<td>1/1/2019</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Morris Landfill Generator (1.9 MW)</td>
<td>ComEd</td>
<td>Deactivated on 5/31/2018</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
<tr>
<td>Reichs Ford Road Landfill Generator (1.7 MW)</td>
<td>APS</td>
<td>Deactivated on 5/31/2018</td>
<td>Reliability analysis complete. No impacts identified.</td>
</tr>
</tbody>
</table>
# Deactivation Status

<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>Davis Besse Unit 1 (896 MW)</td>
<td>ATSI</td>
<td>5/31/2020</td>
<td>Reliability analysis complete. New and existing baselines resolve identified impacts. Units can retire as scheduled. Operational flexibility allows to bridge any delays with the transmission upgrades.</td>
</tr>
<tr>
<td>Perry Unit 1 (1247 MW)</td>
<td>ATSI</td>
<td>5/31/2021</td>
<td></td>
</tr>
<tr>
<td>Beaver Valley Unit 1 (909 MW)</td>
<td>DUQ</td>
<td>5/31/2021</td>
<td></td>
</tr>
<tr>
<td>Beaver Valley Unit 2 (902 MW)</td>
<td>DUQ</td>
<td>10/31/2021</td>
<td></td>
</tr>
<tr>
<td>Unit(s)</td>
<td>Transmission Zone</td>
<td>Requested Deactivation Date</td>
<td>PJM Reliability Status</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------</td>
<td>------------------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>Cumberland County Landfill (1.6 MW)</td>
<td>ACE</td>
<td>1/1/2019</td>
<td>Reliability analysis complete. No impacts</td>
</tr>
<tr>
<td>Barbados AES Battery (2 MW)</td>
<td>PECO</td>
<td>Deactivated on 7/29/2018</td>
<td>Reliability analysis complete. No impacts</td>
</tr>
<tr>
<td>Hurt NUG (83 MW)</td>
<td>Dominion</td>
<td>Deactivated on 7/24/2018</td>
<td>Reliability analysis complete. No impacts</td>
</tr>
</tbody>
</table>
## Deactivation Status

<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>Kimberly Clark (9.4 MW)</td>
<td>PECO</td>
<td>08/01/2019</td>
<td>Reliability analysis underway</td>
</tr>
<tr>
<td>Monmouth NUG landfill (6.7 MW)</td>
<td>JCPL</td>
<td>05/31/2019</td>
<td>Reliability analysis complete</td>
</tr>
<tr>
<td>Northeastern Power (51 MW)</td>
<td>PPL</td>
<td>11/27/2018</td>
<td>Reliability analysis complete</td>
</tr>
<tr>
<td>Bruce Mansfield 1, 2 &amp; 3 (2490 MW)</td>
<td>ATSI</td>
<td>06/01/2021</td>
<td>Reliability analysis complete. New and existing baselines resolve identified impacts. Units can retire as scheduled.</td>
</tr>
<tr>
<td>Eastlake 6 (24 MW)</td>
<td>ATSI</td>
<td>06/01/2021</td>
<td></td>
</tr>
<tr>
<td>Sammis Diesel (13 MW)</td>
<td>ATSI</td>
<td>06/01/2021</td>
<td></td>
</tr>
<tr>
<td>Sammis 5, 6 &amp; 7 (1491 MW)</td>
<td>ATSI</td>
<td>06/01/2022</td>
<td></td>
</tr>
</tbody>
</table>
2018 RTEP Projects Electrically Near the PJM-NYISO Interface As of November 2018
**Problem Statement (Scope and Need/Drivers):**

*RECO Planning Criteria (N-1 Criteria Violation)*

- Loss of Line #75 (Orangeburg - West Nyack 69 kV) overloads the Line # 46 (Closter - Harings Corner 69 kV)
- To get below normal rating, over 9,000 customers would need to be shed.

**Recommended Solution:**

- Install 69 kV underground transmission line from Harings Corner Station terminating at Closter Station (about 3 miles). (B3029)
- Reconfigure Closter Station to accommodate the UG transmission line from Harings Corner Station.
- The existing Line 751 will be terminated at Closter station while the rest of the line will continue to feed Cresskill Substation in parallel with the existing Line 61

**RECO already have municipal approval of the underground line route.**

**Estimated Project Cost: $ 22M**

**Required IS date: 05/31/2020**

**Status: Planning and Engineering**
Problem Statement: Generation Deliverability
• Glade - Warren 230 kV, Warren - Corry East 115 kV and Corry East - Four Mile 115 kV lines are overloaded for the single contingency for loss of the Erie South East - Warren 230 kV line.

Recommended Solution:
• Rebuild the Glade - Warren 230 kV line with 1033 ACSS (b3017.1, b3017.2, b3017.3: SN 855 MVA / SE 984 MVA).
• Replace terminal equipment on the Warren - Corry East 115 kV line (b3024: SN 202 MVA / SE 245 MVA).
• Replace terminal equipment on the Corry East - Four Mile 115 kV line (b3016 SN 202 MVA / SE 245 MVA).

Estimated Project Cost: $33.5M
Required IS Date: 06/01/2021
Projected IS Date: 06/01/2021
Problem Statement:
*Equipment Material Condition, Performance and Risk*
- Enhance system reliability and performance.
- Upgrade equipment due to degraded equipment performance, material condition, and obsolescence.

*Operational Flexibility and Efficiency*
- Improve long-term overall system reliability and performance of the system.
- Improve operational flexibility during maintenance, outage, and restoration.
- Reduce amount of potential local load loss under contingency conditions

**Selected Solution:**
Rebuild Seward-Glory-Piney 115 kV line. *(S1672)*
- Rebuild ~66 miles of 115 kV line using double circuit 230 kV construction.
- Install 1033 ACSR conductor (six-wired) energized at 115 kV.

**Estimated Project Cost:** $150M - $200M (subject to detailed design)

**Expected In-Service:** 12/01/2023

**Status:** Conceptual
Problem Statement:
Operational Flexibility and Efficiency
- Planning analysis identifies concerns related to loss of an existing transformer at a specific voltage level.
- Loss of substation bus adversely impact transmission system performance
- Improve operational flexibility during maintenance and restoration efforts.
- Eliminate the simultaneous outages to three or more system elements.

Selected Solution:
Wayne Substation
- Install a second 345/115 kV 168/224 MVA transformer. Convert the 115 kV yard to a 4 breaker ring bus. (S1646)

Estimated Project Cost: $5.8 M
Projected IS date: 6/1/2019
Status: Engineering
Problem Statement (Scope and Need/Drivers):
*Operational Flexibility and Efficiency*
- Improve operational flexibility during maintenance and restoration efforts.
- Reduce amount of potential local load loss under contingency conditions.
- Eliminate the simultaneous outages to three or more system elements

**Selected Solution:**
North Meshoppen Substation
- Expand the existing 115 kV yard to a breaker-and-a-half configuration. (S1729)

**Estimated Project Cost:** $17.6M

**Projected IS date:** 12/31/2020

**Status:** Conceptual
Problem Statement (Scope and Need/Drivers): Operational Flexibility and Efficiency
• Improve operational flexibility during maintenance and restoration efforts.
• Reduce amount of potential local load loss under contingency conditions.
• Eliminate the simultaneous outages to three or more system elements.

Selected Solution: Erie West Substation
• Convert the Erie West 115 kV substation into a five (5) breaker ring bus. (S1731)

Estimated Project Cost: $4.8M
Projected IS date: 12/31/2019
Status: Conceptual
Market Efficiency Update
2018/19 Long Term Window
Problem Statement and Eligible Congestion Drivers posted on the Competitive Planning Process web page

Modeling data and supporting documentation posted on the Market Efficiency web page

Long Term Proposal window opened on November 2nd, 2018

Long Term Proposal window will close on March 1st, 2019
Congestion Drivers
## Recommended Congestion Drivers

### 2018/19 RTEP Market Efficiency Window Eligible Congestion Drivers

<table>
<thead>
<tr>
<th>Constraint</th>
<th>FROM AREA</th>
<th>TO AREA</th>
<th>2023 Simulated Year</th>
<th>2026 Simulated Year</th>
<th>2023 Simulated Year</th>
<th>2026 Simulated Year</th>
<th>Comment</th>
<th>Potential Upgrades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunterstown to Lincoln 115 kV</td>
<td>METED</td>
<td>METED</td>
<td>$7.45</td>
<td>$10.56</td>
<td>865</td>
<td>1010</td>
<td>Internal Flowgate</td>
<td></td>
</tr>
<tr>
<td>Monroe 1&amp;2 to Wayne 345 kV</td>
<td>MISOE</td>
<td>MISOE</td>
<td>$4.38</td>
<td>$9.51</td>
<td>148</td>
<td>271</td>
<td>M2M</td>
<td></td>
</tr>
<tr>
<td>He Hubbell to Sunman Weisburg 138 kV</td>
<td>MISOC</td>
<td>MISOC</td>
<td>$3.19</td>
<td>$3.20</td>
<td>122</td>
<td>110</td>
<td>M2M</td>
<td></td>
</tr>
<tr>
<td>E Frankfort (R) to Goodings (R) 345 kV</td>
<td>COMED</td>
<td>COMED</td>
<td>$0.56</td>
<td>$1.46</td>
<td>58</td>
<td>145</td>
<td>M2M</td>
<td></td>
</tr>
<tr>
<td>Cumberland TR2 to Juniata Bus 1 230 kV</td>
<td>PLGRP</td>
<td>PLGRP</td>
<td>$8.99</td>
<td>$13.10</td>
<td>357</td>
<td>316</td>
<td>Internal Flowgate</td>
<td></td>
</tr>
<tr>
<td>Marblehead North Bus 1 138/161</td>
<td>MISOC</td>
<td>MISOC</td>
<td>$0.95</td>
<td>$0.60</td>
<td>160</td>
<td>118</td>
<td>M2M</td>
<td></td>
</tr>
<tr>
<td>Bosserman to Trail Creek 138 kV</td>
<td>AEP</td>
<td>MISOE</td>
<td>$7.04</td>
<td>$9.79</td>
<td>265</td>
<td>340</td>
<td>M2M</td>
<td></td>
</tr>
</tbody>
</table>

A PJM/MISO TMEP has been proposed for this facility.
• RTEP@pjm.com is retired as of September 1, 2018
• If you have any RTEP related questions, ask through the Planning Community
• Registration for the Planning Community can be found on the Planning, Planning Committee, and TEAC pages of PJM.com
• https://www.pjm.com/committees-and-groups/committees/teac.aspx