Market Efficiency Update

Transmission Expansion Advisory Committee
April 13, 2017
Market Efficiency Timeline

Year 0

- Develop Assumptions (Y1, Y5)
- Market Efficiency Analysis (Y1, Y5) (Accelerations and Modifications)
- Identify and evaluate Solution Options (Accelerations and Modifications)

Year 1

- Final Review with TEAC and approval by Board
- Develop Assumptions (Y1, Y5, Y8, Y11, Y15)
- Market Efficiency Criteria Analysis (Y1, Y5, Y8, Y11, Y15)
- Market Efficiency Analysis (Y1, Y5, Y8, Y11, Y15)

12-month cycle

- Identify proposed solutions
- Update significant assumptions (Y0, Y4, Y7, Y10, Y14)
- Independent Consultant reviews of buildability
- Adjustments to solution options by PJM on analysis

24-month cycle

- Develop Assumptions (Y1, Y5)
- Market Efficiency Analysis (Y1, Y5) (Accelerations and Modifications)
- Identify and evaluate Solution Options (Accelerations and Modifications)
- Final Review with TEAC and approval by Board
2016-2017  24-Month Market Efficiency Cycle

• Long term proposal window:  Nov 2016 - Feb 2017

• Mid-cycle update of major assumptions:  Jan 2017 – Apr 2017
  • Load forecast, Demand forecast, Fuel prices, Generation expansion, Network topology
  • Only updating the most significant changes, not full update.

• Analysis of proposed solutions:  May 2017 - Oct 2017
  • Independent consultant review of cost and ability to build
  • Review of analysis with TEAC: Jun 2017 - Nov 2017

• Determination of final projects:  Dec 2017
  • Final review with TEAC and Board approval
  • Projects may be approved earlier if analysis and review complete
Mid-Cycle Update: Key Input Parameters

• Updated Load Forecast

• Generation expansion Update:
  • Includes new major ISA units
  • Includes deactivations that impact forecasted congestion

• Updated Transmission Topology
  • significant RTEP upgrades that may impact congestion drivers

• Updated Fuel Prices:
  • Gas Forecast, Coal Forecast
PJM zonal peak and energy forecast from 2017 Load Forecast Report

<table>
<thead>
<tr>
<th>Load</th>
<th>2017</th>
<th>2021</th>
<th>2024</th>
<th>2027</th>
<th>2031</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak (MW)</td>
<td>152,999</td>
<td>153,384</td>
<td>154,142</td>
<td>155,773</td>
<td>157,513</td>
</tr>
<tr>
<td>Energy (GWh)</td>
<td>814,838</td>
<td>820,415</td>
<td>827,522</td>
<td>835,137</td>
<td>845,602</td>
</tr>
</tbody>
</table>

Notes: 1.) Peak and energy values from PJM Load Forecast Report Table B-1 and Table E-1, respectively.
2.) Model inputs are at the zonal level, to the extent zonal load shapes create different diversity - modeled PJM peak load may vary.
Comparison 2016 and 2017 Load Forecasts

PJM Load Forecasts Comparison 2016 vs. 2017
Annual Peak (MW)
Model zonal demand resources consistent with Table B-7 of the 2017 Load Forecast Report

<table>
<thead>
<tr>
<th>Demand Resource (MW)</th>
<th>2017</th>
<th>2021</th>
<th>2024</th>
<th>2027</th>
<th>2031</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9,120</td>
<td>6,169</td>
<td>6,187</td>
<td>6,237</td>
<td>6,290</td>
</tr>
</tbody>
</table>
Mid-Cycle Update: Future Generation

PJM Market Efficiency Reserve Margin - Preliminary

Note: Generation Includes existing and projected PJM internal capacity resources. Model informed by 2022 Machines List. http://www.pjm.com/~media/committees-groups/committees/teac/20170112/20170112-2022-list-of-machines.ashx
Mid-Cycle Update: Gas Forecast

Natural Gas Price Forecast (2016 vs. 2017)
Henry Hub
Mid-Cycle Update: Coal Forecast

Coal Forecast (2016 vs. 2017)
Average PJM Coal

$/MMBtu


2016 Values
2017 Values
Market Efficiency Long Term Proposal Window
Proposed Projects
2016-2017 Long Term Window – Projects Received

- 96 market Efficiency Proposals
  - 52 Greenfield
    - $15.8M - $371.3M
  - 44 Upgrades
    - $0 - $192.07M

- 20 proposing entities (including 6 combinations of joint proposals)

- 8 Interregional proposals
  - 5 Greenfield
  - 3 Upgrades
2016-2017 Long Term Window Proposals - BGE
2016-2017 Long Term Window Proposals – PPL
2016-2017 Long Term Window Proposals – APS/DOM
2016-2017 Long Term Window Proposals – AEP
2016-2017 Long Term Window Proposals – AEP/APS
2016-2017 Long Term Window Proposals – COMED
2016/17 Long Term Proposal Window – Study Approach

- **Step 1:** Review projects (step in-progress)
  - PJM will contact proposer if need clarification of modeling.
  - Approved base line reliability and supplemental projects may eliminate congestion drivers.

- **Step 2:** First pass of project evaluations assuming proposer supplied data.

- **Step 3:** Determine if there are any obvious optimal projects in focused areas.
  - Areas with quick fixes or lower cost reinforcements

- **Step 4:** Detailed Analysis in areas with many project submissions
## Milestone Schedule 2016 - 2017

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reevaluation approved Market Efficiency projects</td>
<td>February – May 2017</td>
</tr>
<tr>
<td>Base Case Mid-Cycle Update Significant Assumptions</td>
<td>January – April 2017</td>
</tr>
<tr>
<td>Analyze Submitted Proposals</td>
<td>May – October 2017</td>
</tr>
<tr>
<td>Acceleration Analysis</td>
<td>May – October 2017</td>
</tr>
<tr>
<td>Final TEAC Review and Board Approval</td>
<td>December 2017</td>
</tr>
</tbody>
</table>
Appendix A
2016/17 Long Term Window Proposals
### Project ID: 201617_1-1A

**Proposed by:** WPPI

**Proposed Solution:**
Provide a second New Carlisle-Olive 138 kV circuit.

<table>
<thead>
<tr>
<th>kV Level: 138 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M): $1</td>
</tr>
<tr>
<td>In-Service Date: 2019</td>
</tr>
<tr>
<td>Target Zone: AEP</td>
</tr>
</tbody>
</table>

**ME Constraints:**
OLIVE - BOSSERMAN 138 kV

**Notes:** See supplemental project Olive – Bosserman discussion in the Reliability Update presentation at April TEAC.
**Project ID: 201617_1-2A**

Proposed by: PPL

Proposed Solution:
Reconductor the Susquehanna - Harwood 230 kV DCT line and replace a limited number of structures as necessary to accommodate the heavier conductor.

<table>
<thead>
<tr>
<th>KV Level</th>
<th>230 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M)</td>
<td>$13.13</td>
</tr>
<tr>
<td>In-Service Date</td>
<td>2021</td>
</tr>
<tr>
<td>Target Zone</td>
<td>PPL</td>
</tr>
</tbody>
</table>

ME Constraints:
SUSQUEHANNA - HARWOOD 230 kV

Notes:

PJM TEAC 04/13/2017
Proposed Solution: Reconductor the Susquehanna - Harwood 230 kV DCT line and replace a limited number of structures as necessary to accommodate the heavier conductor. Update protection settings at Susquehanna, Harwood, and Sugarloaf 230 kV substations to accommodate the new line ratings.

kV Level: 230 kV
In-Service Cost ($M): $13.01
In-Service Date: 2021
Target Zone: PPL

ME Constraints: SUSQUEHANNA - HARWOOD 230 kV

Notes:
Project ID: 201617_1-2C

Proposed by: PPL

Proposed Solution:
Route existing Susquehanna - Wescosville 500 kV line in and out of new Siegfried 500 kV bus station. Install a new 500/230 kV Siegfried transformer. Connect low side of new transformer to Siegfried 230 kV West Bus.

kV Level: 230/500 kV
In-Service Cost ($M): $18.32
In-Service Date: 2021
Target Zone: PPL

ME Constraints:
SUSQUEHANNA - HARWOOD 230 kV

Notes:
Project ID: 201617_1-3A

Proposed by: ComEd

Proposed Solution:
Upgrade capacity on 345 kV E. Frankfort - University Park line.

kV Level: 345 kV
In-Service Cost ($M): $0.84
In-Service Date: 2021
Target Zone: ComEd

ME Constraints:
E. FRANKFORT - UNIVERSITY PARK 345 kV + RPM Benefits

Notes:

PJM TEAC 04/13/2017
Proposed by: ComEd

Proposed Solution:
Upgrade equipment at Pontiac Midpoint station to increase capacity on 345kV Pontiac-Brokaw line.

kV Level: 345 kV
In-Service Cost ($M): $5.62
In-Service Date: 2021
Target Zone: ComEd

ME Constraints:
PONTIAC - BROKAW 345 kV + RPM Benefits

Notes:
**Proposed by:** First Energy

**Proposed Solution:**
Connect existing on-site spare 500-138kV transformer at Belmont Substation as TR4, in parallel with TR3. Relocate the termination of two 138 kV lines to provide 138 kV termination for TR4.

**kV Level:** 138/500 kV  
**In-Service Cost ($M):** $2.79  
**In-Service Date:** 2019  
**Target Zone:** APS

**ME Constraints:**
BELMONT TR 500/138 KV

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**Notes:**

PJM TEAC 04/13/2017
**Project ID: 201617_1-4B**

**Proposed by:** First Energy

**Proposed Solution:**
Replace relaying and replace wave traps at both terminal ends to raise the circuit rating to the line conductor limit.

**kV Level:** 138 kV

**In-Service Cost ($M):** $0.48

**In-Service Date:** 2018

**Target Zone:** ATSI

**ME Constraints:**
HOYTDALE - MAPLE 138 kV

**Notes:**

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*Map showing locations of Hoytdale and Maple.*

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PJM TEAC 04/13/2017
Project ID: 201617_1-5A

Proposed by: BGE

Proposed Solution:
Increase capacity on existing towers by reconductoring the Conastone to Graceton 2323 & 2324 230kV circuits.

kV Level: 230 kV
In-Service Cost ($M): $5.97
In-Service Date: 2020
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON 230 kV

Notes:
PJM TEAC 04/13/2017
**Project ID: 201617_1-5B**

**Proposed by:** BGE

**Proposed Solution:**
Increase capacity on existing towers by adding additional conductors to the Graceton-Bagley-Raphael Road 230kV circuits.

<table>
<thead>
<tr>
<th>kV Level: 230 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M): $14.20</td>
</tr>
<tr>
<td>In-Service Date: 2021</td>
</tr>
<tr>
<td>Target Zone: BGE</td>
</tr>
</tbody>
</table>

**ME Constraints:**
GRACETON - BAGLEY 230 kV

**Notes:**
**Project ID: 201617_1-5C**

**Proposed by:** BGE

**Proposed Solution:**
Increase capacity on existing towers by reconductoring the Conastone to Graceton 230kV, adding additional/bundled conductors to the Graceton-Bagley-Raphael Road 230kV.

**kV Level:** 230 kV  
**In-Service Cost ($M):** $20.30  
**In-Service Date:** 2021  
**Target Zone:** BGE

**ME Constraints:**  
CONASTONE - GRACETON - BAGLEY 230 kV

**Notes:**

PJM TEAC 04/13/2017
Project ID: 201617_1-5D

Proposed by: BGE

Proposed Solution:
Increase capacity on existing towers by reconductoring the Conastone to Graceton 230 kV circuits, adding additional conductors to the Graceton-Bagley-Raphael Road 230 kV circuits and removing substation ratings limitation on Windy Edge to Glenarm.

kV Level: 115/230 kV
In-Service Cost (SM): $20.40
In-Service Date: 2021
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:

PJM TEAC 04/13/2017
Project ID: 201617_1-5E

Proposed by: BGE

Proposed Solution:
Increase capacity on existing towers by reconductoring the Conastone to Graceton 230kV circuits, adding additional conductors to the Graceton-Bagley-Raphael Road 230 kV circuits, reconductoring the Raphael Road to Northeast, and removing substation ratings limitation on Windy Edge to Glenarm.

kV Level: 115/230 kV
In-Service Cost ($M): $25.40
In-Service Date: 2021
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
**Project ID: 201617_1-6F**

**Proposed by:** BGE PECO

**Proposed Solution:**
Expand existing Graceton substation to 500/230 kV by tapping the existing Conastone 500 kV, constructing a 500 kV station to accommodate new line configuration and new 500/230 kV transformer, increase capacity on existing towers by adding/bundle additional conductors to the Graceton-Bagley-Raphael Road 230 kV circuits, reconductoring the Raphael Road to Northeast, removing substation ratings limitation on Windy Edge to Glenarm.

<table>
<thead>
<tr>
<th>KV Level: 115/230/500 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M): $49.20</td>
</tr>
<tr>
<td>In-Service Date: 2021</td>
</tr>
<tr>
<td>Target Zone: BGE</td>
</tr>
</tbody>
</table>

**ME Constraints:**
CONASTONE - GRACETON - BAGLEY 230 kV

**Notes:**

PJM TEAC 04/13/2017
Project ID: 201617_1-6G

Proposed by: BGE PECO

Proposed Solution:
Expand existing Graceton substation to 500/230 kV by tapping the existing Conastone 500 kV located at Graceton substation, constructing a 500 kV station to accommodate new line configuration and new 500/230kV transformer, increase capacity on existing towers by adding/bundle additional conductors to the Graceton-Bagley-Raphael Road 230kV circuits, reconductoring the Raphael Road to Northeast, removing substation ratings limitation on Windy Edge to Glenarm.

kV Level: 115/230/500 kV
In-Service Cost ($M): $56.00
In-Service Date: 2021
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
PJM TEAC 04/13/2017
Project ID: 201617_1-6L

Proposed by: BGE PECO

Proposed Solution:
Increase capacity on existing towers by reconductoring the Conastone to Graceton 230 kV circuits, adding/bundle additional conductors to the Graceton-Bagley-Raphael Road 230 kV circuits, reconductoring the Raphael Road to Northeast circuits, removing substation ratings limitation on Windy Edge to Glenarm adding new circuit between Peach Bottom 230 kV and existing Cooper 230 kV with series reactor, reconductoring existing Graceton-Cooper circuit, adding circuit breakers and replacing terminal equipment at Peach Bottom and Cooper.

kV Level: 115/230 kV

In-Service Cost ($M): $41.70

In-Service Date: 2021

Target Zone: BGE PECO

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:

PJM TEAC 04/13/2017
Proposed by: BGE PECO

Proposed Solution:
Expand existing Graceton substation to 500/230kV, constructing a 500 kV station to accommodate new line configuration and new 500/230kV transformer, increase capacity on existing towers by adding/bundle additional conductors to the Graceton-Bagley-Raphael Road 230kV circuits, reconductoring the Raphael Road to Northeast circuits, removing substation ratings limitation on Windy Edge to Glenarm circuit adding new circuit between Peach Bottom 230kV and existing Cooper 230kV, reconductoring existing Graceton-Cooper circuit, replacing terminal equipment at Peach Bottom and Cooper.

kV Level: 115/230/500 kV
In-Service Cost ($M): $65.49
In-Service Date: 2021
Target Zone: BGE PECO

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV
Project ID: 201617_1-7H

Proposed by: PECO

Proposed Solution:
Install a new 230 kV transmission line connecting Peach Bottom substation to Cooper substation. Reconductor the Graceton-Cooper 230 kV line. Bundle the existing conductors on the Graceton-Bagley-Raphael Rd. 230 kV lines. Reconductor the Raphael Road to Northeast, remove substation ratings limitation on Windy Edge to Glenarm circuit.

kV Level: 115/230 kV

In-Service Cost ($M): $35.60

In-Service Date: 2021

Target Zone: BGE PECO

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV
CONASTONE - PEACH BOTTOM 500 kV

Notes:
Project ID: 201617_1-7I

Proposed by: PECO

Proposed Solution:
Install a new 230 kV transmission line connecting Peach Bottom substation to Cooper substation. Rebuild the 220-93 Graceton-Cooper 230 kV line. Bundle the existing conductors on the Graceton-Bagley-Raphael Road 230 kV lines. Reconductor the Raphael Road to Northeast, remove substation ratings limitation on Windy Edge to Glenarm.

kV Level: 115/230 kV

In-Service Cost (SM): $59.80

In-Service Date: 2021

Target Zone: BGE PECO

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV
CONASTONE - PEACH BOTTOM 500 kV

Notes:
PJM TEAC 04/13/2017
<table>
<thead>
<tr>
<th>Proposed by: PECO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install a new 230 kV transmission line connecting Peach Bottom substation to Graceton substation. Bundle the existing conductors on the Graceton-Bagley-Raphael Road 230 kV lines. Reconductor the Raphael Road to Northeast, remove substation ratings limitation on Windy Edge to Glenarm.</td>
</tr>
</tbody>
</table>

**kV Level:** 115/230 kV  
**In-Service Cost (SM):** $68.10  
**In-Service Date:** 2022  
**Target Zone:** BGE PECO

**ME Constraints:**  
CONASTONE - GRACETON - BAGLEY 230 kV  
CONASTONE - PEACH BOTTOM 500 kV

**Notes:**

PJM TEAC 04/13/2017
Project ID: 201617_1-7K

Proposed by: PECO

Proposed Solution:
Install two new 500-230 kV transformers at Peach Bottom substation.
Install a new double circuit 230 kV transmission line connecting Peach Bottom substation to Graceton substation. Bundle the existing conductors on the Graceton-Bagley-Raphael Road 230 kV lines.
Reconductor Raphael Road to Northeast, remove substation ratings limitation on Windy Edge to Glenarm.

kV Level: 115/230/500 kV

In-Service Cost (SM): $191.40

In-Service Date: 2022

Target Zone: BGE PECO

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV
CONASTONE - PEACH BOTTOM 500 kV

Notes:

PJM TEAC 04/13/2017
**Project ID: 201617_1-8A**

**Proposed by:** Dominion

**Proposed Solution:**
Build one (1) 230 kV shunt capacitor bank at DVP's Belvoir substation.

- **kV Level:** 230 kV
- **In-Service Cost ($M):** $3.73
- **In-Service Date:** 2021
- **Target Zone:** Dominion

**ME Constraints:**
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230 kV
PEACH BOTTOM - CONASTONE 500 kV

**Notes:**

PJM TEAC 04/13/2017
Project ID: 201617_1-8B

Proposed by: Dominion

Proposed Solution:
This is proposed by Dominion Virginia Power to build one (1) 230 kV shunt capacitor bank at DVP’s Bull Run substation.

- **kV Level:** 230 kV
- **In-Service Cost ($M):** $4.14
- **In-Service Date:** 2021
- **Target Zone:** Dominion

**ME Constraints:**
- I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
- CONASTONE - GRACETON - BAGLEY 230 kV
- BOSSERMAN - Olive 138 kV
- SUSQUEHANNA - HARWOOD 230 kV
- OAKBAY - NORTH RVR 230 kV
- PEACH BOTTOM - CONASTONE 500 kV

**Notes:**

PJM TEAC 04/13/2017
**DOMINION 1-8C**

**Project ID: 201617_1-8C**

Proposed by: Dominion

**Proposed Solution:**
This is proposed by Dominion Virginia Power to build one (1) 230 kV shunt capacitor bank at DVP's Cannon Branch substation.

- **kV Level:** 230 kV
- **In-Service Cost ($M):** $1.82
- **In-Service Date:** 2021
- **Target Zone:** Dominion

**ME Constraints:**
- I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
- CONASTONE - GRACETON - BAGLEY 230 kV
- BOSERMAN - Olive 138 kV
- SUSQUEHANNA - HARWOOD 230 kV
- OAKBAY - NORTH RVR 230 kV
- PEACH BOTTOM - CONASTONE 500 kV

**Notes:**

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PJM TEAC 04/13/2017

**Legend:**
- Substations: 69 kV, 115 kV, 120 kV, 138 kV, 161 kV, 230 kV, 345 kV, 500 kV, 765 kV
- Transmission Lines: 69 kV, 115 kV, 120 kV, 138 kV, 161 kV, 230 kV, 345 kV, 500 kV, 765 kV

**Identified Proposals:**
- Cannon Branch

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Project ID: 201617_1-8D

Proposed by: Dominion

Proposed Solution:
Build one (1) 230 kV shunt capacitor bank at DVP's Edwards Ferry substation.

kV Level: 230 kV
In-Service Cost ($M): $6.11
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230 kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:
PJM TEAC 04/13/2017
Proposed by: Dominion

Proposed Solution:
Build one (1) 230 kV shunt capacitor bank at DVP's Greenway substation.

kV Level: 230 kV
In-Service Cost ($M): $3.79
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230 kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:

PJM TEAC 04/13/2017
**Project ID: 201617_1-8F**

**Proposed by:** Dominion Virginia Power  
**Proposed Solution:** 
Build four (4) 230 kV shunt capacitor banks at four (4) DVP's substations.  

<table>
<thead>
<tr>
<th>kV Level</th>
<th>In-Service Cost ($M)</th>
<th>In-Service Date</th>
<th>Target Zone</th>
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</thead>
<tbody>
<tr>
<td>230 kV</td>
<td>$15.45</td>
<td>2021</td>
<td>Dominion</td>
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</tbody>
</table>

**ME Constraints:**  
I: AP SOUTH, I: AEP-DOM, I: 5004/5005, I: CENTRAL  
CONASTONE - GRACETON - BAGLEY 230 kV  
BOSSERMAN - Olive 138 kV  
SUSQUEHANNA - HARWOOD 230 kV  
OAKBAY - NORTH RVR 230 kV  
PEACH BOTTOM - CONASTONE 500 kV

**Notes:**

PJM TEAC 04/13/2017
**Project ID: 201617_1-8G**

**Proposed by:** Dominion

**Proposed Solution:**
Build three (3) 230 kV shunt capacitor banks at three (3) DVP's substations.

<table>
<thead>
<tr>
<th>kV Level</th>
<th>230 kV</th>
</tr>
</thead>
</table>

| In-Service Cost ($M) | $10.68 |

| In-Service Date | 2021 |

| Target Zone | Dominion |

**ME Constraints:**
- I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
- CONASTONE - GRACETON - BAGLEY 230 kV
- BOSSERMAN - Olive 138 kV
- SUSQUEHANNA - HARWOOD 230 kV
- OAKBAY - NORTH RVR 230 kV
- PEACH BOTTOM - CONASTONE 500 kV

**Notes:**
- PJM TEAC 04/13/2017
- DVP - Distribution Voltage Point
- ME - Modifier Element
Project ID: 201617_1-8H

Proposed by: Dominion

Proposed Solution:
Build one (1) 230 kV shunt capacitor bank at DVP's Loudoun substation.

kV Level: 230 kV

In-Service Cost ($M): $4.81

In-Service Date: 2021

Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230 kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:
**Project ID: 201617_1-8I**

**Proposed by:** Dominion

**Proposed Solution:**
Build one (1) 230 kV shunt capacitor bank at DVP's Reston substation.

**kV Level:** 230 kV

**In-Service Cost ($M):** $5.00

**In-Service Date:** 2021

**Target Zone:** Dominion

**ME Constraints:**

**Notes:**
PJM TEAC 04/13/2017
Project ID: 201617_1-8J

Proposed by: Dominion

Proposed Solution:
Build one (1) 500 kV Thyristor Controlled Series Capacitor (TCSC) at DVP’s Morrisville substation on the Front Royal - Morrisville (Line 541) transmission line.

kV Level: 500 kV
In-Service Cost ($M): $44.11
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230 kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:
Project ID: 201617_1-8K

Proposed by: Dominion

Proposed Solution:
Reconductor the Pleasant View - Ashburn - Beaumeade 230 kV transmission line, replace limiting equipment along Line 274, and build one (1) 230 kV Thyristor Controlled Series Capacitor at DVP's Pleasant View substation on the Pleasant View - Beaumeade transmission line.

kV Level: 230 kV

In-Service Cost ($M): $49.25

In-Service Date: 2021

Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230kV
PEACH BOTTOM - CONASTONE 500 kV
Project ID: 201617_1-8L

Proposed by: Dominion
Proposed Solution:
Install a new 500/230 kV transformer at the Goose Creek 500kV bus and connect the low side to the 230 kV by looping into the 2180 line.

kV Level: 500/230 kV
In-Service Cost ($M): $31.74
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:
Project ID: 201617_1-8M

Proposed by: Dominion

Proposed Solution:
Reconductor Dooms - Crozet - Barracks Rd - Hydraulic Rd - Charlottesville 230kV line (Line 233) and replace limiting equipment along the line.

kV Level: 230 kV
In-Service Cost ($M): $32.39
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:
Project ID: 201617_1-8N

Proposed by: Dominion

Proposed Solution:
Reconductor Pleasant View - Ashburn - Beaumeade 230 kV line (Line 274) and replace limiting equipment along the line.

kV Level: 230 kV
In-Service Cost ($M): $5.18
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230 kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:

PJM TEAC 04/13/2017
Proposed by: Dominion

Proposed Solution: Reconductor a segment of Charlottesville - Proffit DP 230 kV line (Line 2054) and replace limiting equipment along the line.

kV Level: 230 kV
In-Service Cost ($M): $9.12
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:
Proposed by: Dominion

Proposed Solution:
Reconductor North Anna - Louisa - South Anna 230 kV line (Line 255), reconductor South Anna - Louisa CT 230 kV line (Line 2074), and replace limiting equipment along the lines.

kV Level: 230 kV

In-Service Cost ($M): $23.71

In-Service Date: 2021

Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSEMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:

PJM TEAC 04/13/2017
Proposed by: Dominion
Proposed Solution: Greenfield
Build a new 500kV station (Palmyra) by connecting and building a ring bus at the intersection of two (2) 500 kV lines including North Anna - Midlothian 500kV line (Line 576) and Cunningham - Elmont 500 kV line (Line 553) and add a 300MVAR capacitor bank.

kV Level: 500 kV
In-Service Cost ($M): $31.9
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I:AP SOUTH, I:AEP-DOM, I:5004/5005, I:CENTRAL
CONASTONE - GRACETON - BAGLEY 230 kV
BOSSERMAN - Olive 138 kV
SUSQUEHANNA - HARWOOD 230 kV
OAKBAY - NORTH RVR 230kV
PEACH BOTTOM - CONASTONE 500 kV

Notes:
<table>
<thead>
<tr>
<th>Project ID: NIPSCO 1-9A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed by: NIPSCO</td>
</tr>
</tbody>
</table>

**Proposed Solution:**
Reconductor existing NIPSCO line section between AEP Bosserman and Olive substation.

- **kV Level:** 138 kV
- **In-Service Cost ($M):** $8.00
- **In-Service Date:** 2019
- **Target Zone:** AEP NIPSCO

**ME Constraints:**
OLIVE - BOSSERMAN 138 kV

**Notes:** See supplemental project Olive – Bosserman discussion in the Reliability Update presentation at April TEAC.
### Proposed by: NIPSCO

**Proposed Solution:** Greenfield  
New NIPSCO line section between Thayer and Morrison substations.

- **kV Level:** 138 kV  
- **In-Service Cost ($M):** $42.50  
- **In-Service Date:** 2022  
- **Target Zone:** AML ComEd NIPSCO

**ME Constraints:**  
PAXTON - GIFFORD 138 kV

**Notes:**  
PJM TEAC 04/13/2017
Project ID: 201617_1-10A

Proposed by: Nextera

Proposed Solution: Greenfield
Build a new substation (Spring Hill) connecting an existing 230 kV substation and an existing 500 kV line in the area.

<table>
<thead>
<tr>
<th>kV Level: 230 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M): $33.8</td>
</tr>
<tr>
<td>In-Service Date: 2021</td>
</tr>
<tr>
<td>Target Zone: PPL</td>
</tr>
</tbody>
</table>

ME Constraints:
SUSQUEHANNA - HARWOOD 230 kV

Notes:

PJM TEAC 04/13/2017
**Project ID: 201617_1-10B**

**Proposed by:** Nextera

**Proposed Solution:** Greenfield

Build a new 345/138 kV substation (Rolling Prairie) connecting the following an existing 345 kV line to two existing 138 kV lines.

<table>
<thead>
<tr>
<th>kV Level: 138 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M): $19.2</td>
</tr>
<tr>
<td>In-Service Date: 2021</td>
</tr>
<tr>
<td>Target Zone: AEP</td>
</tr>
</tbody>
</table>

**ME Constraints:**

BOSSERMAN - OLIVE 138 kV

**Notes:**

PJM TEAC 04/13/2017
<table>
<thead>
<tr>
<th><strong>Project ID:</strong> 201617_1-10C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed by: Nextera</td>
</tr>
<tr>
<td>Proposed Solution: Greenfield</td>
</tr>
<tr>
<td>Build a new 230 kV line between existing Perryman and Conowingo substations.</td>
</tr>
<tr>
<td><strong>kV Level:</strong> 230 kV</td>
</tr>
<tr>
<td><strong>In-Service Cost ($M):</strong> $44.4</td>
</tr>
<tr>
<td><strong>In-Service Date:</strong> 2021</td>
</tr>
<tr>
<td><strong>Target Zone:</strong> BGE</td>
</tr>
<tr>
<td><strong>ME Constraints:</strong></td>
</tr>
<tr>
<td>GRACETON - BAGLEY 230 kV</td>
</tr>
<tr>
<td><strong>Notes:</strong></td>
</tr>
</tbody>
</table>

JPG TEAC 04/13/2017 66
Project ID: 201617_1-10D

Proposed by: Nextera

Proposed Solution: Greenfield
Build a new 230 kV transmission line between two existing 230 kV stations and build a new substation connecting an existing 230 kV substation to an existing 500 kV line.

kV Level: 230 kV
In-Service Cost ($M): $93.5
In-Service Date: 2021
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
PJM TEAC 04/13/2017
Proposed by: Nextera

Proposed Solution: Greenfield
Build two new 230 kV transmission lines connecting separately three existing 230 kV stations and build a new 500/230 kV substation connecting an existing 230 kV substation to an existing 500 kV line.

kV Level: 230/500 kV
In-Service Cost ($M): $105.7
In-Service Date: 2021
Target Zone: PPL

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV
**Project ID: 201617_1-11A**

**Proposed by:** AEP

**Proposed Solution:**
Claytor 138 kV Corridor Upgrades.

**kV Level:** 138 kV

**In-Service Cost ($M):** $3.35

**In-Service Date:** 2019

**Target Zone:** AEP

**ME Constraints:**
CHRIS - CLAYTOR 138 kV

**Notes:**

---

**Diagram:**

- **Legend:**
  - 69 kV
  - 115 kV
  - 120 kV
  - 138 kV
  - 345 kV
  - 500 kV
  - 765 kV

- **Substations:**
  - Wurno
  - Claytor
  - South Christiansburg

- **Transmission Lines:**
  - 69 kV

---

**Map:**

- **Major Locations:**
  - Wurno
  - Claytor
  - South Christiansburg

---

**Additional Information:**

- **PJM TEAC 04/13/2017**
**Project ID: 201617_1-11B**

**Proposed by:** AEP

**Proposed Solution:**
Accelerate the previously approved baseline project to reconductor the entire Dequine-Eugene 345 kV.

<table>
<thead>
<tr>
<th><strong>kV Level:</strong></th>
<th>345 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In-Service Cost ($M):</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>In-Service Date:</strong></td>
<td>2019</td>
</tr>
<tr>
<td><strong>Target Zone:</strong></td>
<td>AEP</td>
</tr>
</tbody>
</table>

**ME Constraints:**
EUGENE - DEQUIN 345 kV + RPM Benefits

**Notes:**

PJM TEAC 04/13/2017
Project ID: 201617_1-11C

Proposed by: AEP

Proposed Solution:
Accelerate the previously approved baseline project to reconductor the entire Dequine - Meadow Lake 345 kV.

kV Level: 345 kV
In-Service Cost ($M): 0
In-Service Date: 2019
Target Zone: AEP

ME Constraints:
DEQUIN - MEADOW 345 kV + RPM Benefits

Notes:
PJM TEAC 04/13/2017
Project ID: 201617_1-12D

Proposed by: AEP NIPSCO

Proposed Solution:
Rebuild sections of the 34.5 kV line between New Carlisle and Silver Lake as double circuit 138 kV, operating one circuit as 34.5 kV while the other as 138 kV. Extend the 138 kV circuit to Liquid Carbonics by constructing a green field single circuit line. Rebuild the Michigan City-Trail Creek-Bosserman 138 kV.

kV Level: 138 kV
In-Service Cost ($M): $41.86
In-Service Date: 2021
Target Zone: AEP

ME Constraints:
OLIVE - BOSSERMAN 138 kV

Notes: See supplemental project Olive – Bosserman discussion in the Reliability Update presentation at April TEAC.
<table>
<thead>
<tr>
<th>Project ID: 201617_1-13A</th>
</tr>
</thead>
</table>

**Proposed by:** Transource  
**Proposed Solution:** Greenfield  
Construct a new Baldwin Road 500/230 kV station along the Peach Bottom - Rock Springs 500 kV line, just south of the existing Peach Bottom station. Add two 500/230 kV 1200/1500 MVA transformers at Baldwin Road, operated together.

**kV Level:** 230/500 kV  
**In-Service Cost ($M):** $345.92  
**In-Service Date:** 2024  
**Target Zone:** BGE

**ME Constraints:**  
CONASTONE - GRACETON - BAGLEY 230 kV

**Notes:**  
PJM TEAC 04/13/2017
<table>
<thead>
<tr>
<th>Project ID: 201617_1-13B</th>
</tr>
</thead>
</table>

Proposed by: Transource

Proposed Solution: Greenfield
Construct a 230 kV line between Conastone 230 Station and a new Dulaney Valley 230/115 Station.

<table>
<thead>
<tr>
<th>kV Level: 230 kV</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>In-Service Cost ($M): $51.54</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>In-Service Date: 2022</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Target Zone: BGE</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ME Constraints:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONASTONE - GRACETON - BAGLEY 230 kV</td>
</tr>
</tbody>
</table>

Notes:

PJM TEAC 04/13/2017
Project ID: 201617_1-13C

Proposed by: Transource

Proposed Solution: Greenfield
Construct a 230 kV line between Conastone to a new Long Green 230/115 Station.

kV Level: 230 kV
In-Service Cost ($M): $169.27
In-Service Date: 2022
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:

PJM TEAC 04/13/2017
**Project ID: 201617_1-13D**

**Proposed by:** Transource

**Proposed Solution:** Greenfield

Construct a 230 kV line between Conastone to a new Long Green 230/115 Station and another 230 kV line from the new Long Green Station to Raphael Road 230 Station.

<table>
<thead>
<tr>
<th>kV Level</th>
<th>230 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M)</td>
<td>$183.00</td>
</tr>
<tr>
<td>In-Service Date</td>
<td>2022</td>
</tr>
<tr>
<td>Target Zone</td>
<td>BGE</td>
</tr>
</tbody>
</table>

**ME Constraints:**

CONASTONE - GRACETON - BAGLEY 230 kV

**Notes:**

PJM TEAC 04/13/2017
**Project ID: 201617_1-13E**

**Proposed by:** Transource

**Proposed Solution:** Greenfield

Construct a 230 kV line between a new Hereford 500/230 Station and a new Dulaney Valley 230/115 Station.

**kV Level:** 115/230/500 kV

**In-Service Cost ($M):** $149.23

**In-Service Date:** 2022

**Target Zone:** BGE

**ME Constraints:**
CONASTONE - GRACETON - BAGLEY 230 kV

**Notes:**

PJM TEAC 04/13/2017
Project ID: 201617_1-13F

Proposed by: Transource

Proposed Solution: Greenfield
Construct a 230 kV line between a new Love Run 500/230 Station and Perryman 230 Station.

kV Level: 230/500 kV
In-Service Cost ($M): $371.30
In-Service Date: 2024
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
PJM TEAC 04/13/2017
### Project ID: 201617_1-13G

**Proposed by:** Transource

**Proposed Solution:**

<table>
<thead>
<tr>
<th>kV Level:</th>
<th>115/230 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M):</td>
<td>$192.07</td>
</tr>
<tr>
<td>In-Service Date:</td>
<td>2022</td>
</tr>
<tr>
<td>Target Zone:</td>
<td>BGE</td>
</tr>
</tbody>
</table>

**ME Constraints:**
CONASTONE - GRACETON - BAGLEY 230 kV

**Notes:**

PJM TEAC 04/13/2017
Proposed by: Transource

Proposed Solution: Greenfield
Tap the Tanners Creek - Losantville 345 kV line and build a single circuit line to a new 345/138 kV station (Coyote) next to Wiley.

kV Level: 138/345 kV
In-Service Cost ($M): $71.89
In-Service Date: 2021
Target Zone: DEOK

ME Constraints:
TANNERS CREEK - MIAMI FORT 345 kV

Notes:

PJM TEAC 04/13/2017
**Project ID: 201617_1-14A**

Proposed by: ATC

Proposed Solution: Greenfield

Build a new 230 kV line from Furnace Run - Perryman. The second portion of the proposed project adds a series reactor to each of the Conastone-Graceton 230 kV lines (two total). The third portion of the proposed project will rebuild the 115 kV line from Glen Arm to Windy Edge.

<table>
<thead>
<tr>
<th>kV Level: 115/230 kV</th>
<th>In-Service Cost ($M): $114.80</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Date: 2023</td>
<td>Target Zone: BGE</td>
</tr>
</tbody>
</table>

ME Constraints:

- CONASTONE - GRACETON - BAGLEY 230 kV
- CONASTONE - PEACH BOTTOM 500 kV

Notes:

PJM TEAC 04/13/2017
Proposed by: ATXI East PPL

Proposed Solution: Greenfield

A new double circuit 230 kV line from Conastone to a new 230/115 substation (Baldwin). Baldwin will have two 230/115 XFMR. The Sub will break up the Five Forks - Windy Edge 115 kV lines. From Baldwin to Windy Edge the 115 kV lines will need to be rebuilt. Also a new double circuit 230 kV line from Baldwin to Raphael Road will be constructed.

kV Level: 115/230 kV

In-Service Cost ($M): $138.53

In-Service Date: 2022

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:

PJM TEAC 04/13/2017

PJM©2017
Proposed by: ATXI East PPL

Proposed Solution: Greenfield

A new double circuit 230 kV line from Peachbottom to Otter Point, a new double circuit line from Raphael Road to a new substation (Baldwin). Baldwin will have two 230/115 XFMR that step down into a breaker and a half 115 kV sub. The sub will break up the Five Forks - Windy Edge 115 kV line. From Baldwin to Windy Edge the 115 kV lines will need to be rebuilt. The double circuit line from Otter Point to Raphael Road and Raphael Road to Northeast will need to have the conductor replaced.

kV Level: 230 kV

In-Service Cost ($M): $178.30

In-Service Date: 2022

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
Project ID: 201617_1-16A

Proposed by: PSEG

Proposed Solution: Greenfield
New 230kV Circuit from Peach Bottom to Otter Point.

kV Level: 230 kV
In-Service Cost ($M): $70.5
In-Service Date: 2021
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
PJM TEAC 04/13/2017
Proposed by: PSEG

Proposed Solution: Greenfield
New 230kV circuit from Peach Bottom to Raphael Road.

kV Level: 230 kV
In-Service Cost ($M): $92.2
In-Service Date: 2021
Target Zone: BGE

ME Constraints: CONASTONE - GRACETON - BAGLEY 230 kV

Notes:

PJM TEAC 04/13/2017
**Project ID: 201617_1-16C**

**Proposed by:** PSEG

**Proposed Solution:** Greenfield  
New 230kV circuit from Conastone to Raphael Road.

<table>
<thead>
<tr>
<th>kV Level:</th>
<th>230 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M):</td>
<td>$87.2</td>
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<tr>
<td>In-Service Date:</td>
<td>2021</td>
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<tr>
<td>Target Zone:</td>
<td>BGE</td>
</tr>
</tbody>
</table>

**ME Constraints:**  
CONASTONE - GRACETON - BAGLEY 230 kV

**Notes:**  
PJM TEAC 04/13/2017
**Proposed by:** PSEG

**Proposed Solution:** Greenfield
New 230kV circuit from Conastone to Northeast.

**kV Level:** 230 kV

**In-Service Cost (SM):** $105.1

**In-Service Date:** 2021

**Target Zone:** BGE

**ME Constraints:**
CONASTONE - GRACETON - BAGLEY 230 kV

**Notes:**

PJM TEAC 04/13/2017
<table>
<thead>
<tr>
<th>Proposed by:</th>
<th>PSEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Solution:</td>
<td>Greenfield</td>
</tr>
<tr>
<td>New 230kV circuit from Peach Bottom to Northeast.</td>
<td></td>
</tr>
<tr>
<td>kV Level:</td>
<td>230 kV</td>
</tr>
<tr>
<td>In-Service Cost ($M):</td>
<td>$109.3</td>
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<tr>
<td>In-Service Date:</td>
<td>2021</td>
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<tr>
<td>Target Zone:</td>
<td>BGE</td>
</tr>
<tr>
<td>ME Constraints:</td>
<td>CONASTONE - GRACETON - BAGLEY 230 kV</td>
</tr>
</tbody>
</table>

**Notes:**

PJM TEAC 04/13/2017
Project ID: 201617_1-17A

Proposed by: AEP Exelon

Proposed Solution: Greenfield
Install a new substation at TSS 142 Cottage Grove and additional upgrades at TSS 179 Bloom and TSS 177 Burnham.

kV Level: 345 kV
In-Service Cost ($M): $66.90
In-Service Date: 2021
Target Zone: ComEd

ME Constraints:
E. FRANKFORT - UNIVERSITY PARK 345 kV + RPM Benefits

Notes:
Project ID: 201617_1-17B

Proposed by: AEP Exelon

Proposed Solution: Greenfield
Meadow Lake – Pike Creek 345 kV Double Circuit Greenfield Line and Pike Creek 345 kV Station.

kV Level: 345 kV
In-Service Cost ($M): $197.97
In-Service Date: 2021
Target Zone: ComEd

ME Constraints:
OLIVE - BOSSERMAN 138 kV + RPM Benefits

Notes: See supplemental project Olive – Bosserman discussion in the Reliability Update presentation at April TEAC.
Project ID: 201617_1-18A

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield

Build a double circuit 230 kV line from the existing Graceton substation to a new substation ("Robinson Run") interconnecting the existing Peach Bottom - Delta Power Plant (York) 500 kV line.


kV Level: 115/230/500 kV

In-Service Cost ($M): $119.8

In-Service Date: 2021

Target Zone: BGE

ME Constraints:

CONASTONE - GRACETON - BAGLEY 230 kV

CONASTONE - PEACH BOTTOM 500 kV

Notes:

PJM TEAC 04/13/2017
Proposed by: Northeast Transmission Development
Proposed Solution: Greenfield
Build a double circuit 230 kV line from the existing Graceton substation to a new substation ("Bookers Run") interconnecting the existing Peach Bottom - Three Mile Island 500 kV line. Upgrade the Graceton - Northeast double circuit 230 kV circuits and the Five Forks - Windy Edge 115 kV circuits.

kV Level: 115/230/500 kV
In-Service Cost ($M): $126.1
In-Service Date: 2021
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV
CONASTONE - PEACH BOTTOM 500 kV

Notes:
Project ID: 201617_1-18C

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield

Build a double circuit 230 kV line from the existing Otter Point substation to a new substation ("Robinson Run") interconnecting the existing Peach Bottom - Delta Power Plant (York) 500 kV line. Upgrade the Raphael Road - Northeast double circuit 230 kV circuits.

kV Level: 230/500 kV

In-Service Cost ($M): $142.4

In-Service Date: 2021

Target Zone: BGE

ME Constraints:

CONASTONE - GRACETON - BAGLEY 230 kV
CONASTONE - PEACH BOTTOM 500 kV

Notes:

Notes:

PJM TEAC 04/13/2017
Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield

Build a double circuit 230 kV line from the existing Otter Point substation to a new substation ("Slate") interconnecting the existing Peach Bottom - Rock Springs 500 kV line. Upgrade the Raphael Road - Northeast double circuit 230 kV circuits. Build a 230/115 kV substation ("Pumpkin Run") interconnecting the Raphael Road - Northeast 230 kV circuits and Crane - Windy Edge 115 kV circuits.

kV Level: 115/230/500 kV

In-Service Cost ($M): $157.9

In-Service Date: 2021

Target Zone: BGE

ME Constraints:

CONASTONE - GRACETON - BAGLEY 230 kV
CONASTONE - PEACH BOTTOM 500 kV

Notes:

PJM TEAC 04/13/2017
Project ID: 201617_1-18E

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Build a double circuit 230 kV line from the existing Otter Point substation to a new substation ("Slate") interconnecting the existing Peach Bottom - Rock Springs 500 kV line. Upgrade the Raphael Road - Northeast double circuit 230 kV circuits and both Rock Ridge - Windy Edge 115 kV circuits.

kV Level: 115/230/500 kV

In-Service Cost ($M): $145.4

In-Service Date: 2021

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV
CONASTONE - PEACH BOTTOM 500 kV

Notes:

PJM TEAC 04/13/2017
**Project ID: 201617_1-18F**

Proposed by: Northeast Transmission Development

**Proposed Solution:** Greenfield

Build a double circuit 230 kV line from the existing Conastone substation to a new substation ("F Fitzhugh Run") interconnecting the existing Shawan Road - Summerfield 115 kV transmission lines and Windy Edge - Texas 115 kV transmission lines.

**kV Level:** 115/230 kV

**In-Service Cost ($M):** $90.50

**In-Service Date:** 2021

**Target Zone:** BGE

**ME Constraints:**

CONASTONE - GRACETON - BAGLEY 230 kV

CONASTONE - PEACH BOTTOM 500 kV

**Notes:**

PJM TEAC 04/13/2017
<table>
<thead>
<tr>
<th>Proposed by: Northeast Transmission Development</th>
</tr>
</thead>
</table>

**Proposed Solution:** Greenfield  
Build a 500/230 kV substation ("Fells Creek") interconnecting the existing Susquehanna - Wescosville 500 kV line and the existing Siegfried 230 kV substation.

<table>
<thead>
<tr>
<th><strong>kV Level:</strong> 230/500 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In-Service Cost ($M):</strong> $31.20</td>
</tr>
<tr>
<td><strong>In-Service Date:</strong> 2021</td>
</tr>
<tr>
<td><strong>Target Zone:</strong> PJM PPL</td>
</tr>
</tbody>
</table>

**ME Constraints:**  
SUSQUEHANNA - HARWOOD 230 kV

**Notes:**  
PJM TEAC 04/13/2017
Project ID: 201617_1-18H

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Build a single circuit 138 kV line from the existing Grand Point 138 kV substation to a new substation ("Green Ridge") interconnecting the planned Rice - Ringgold 230 kV transmission line.

kV Level: 138/230 kV
In-Service Cost ($M): $16.30
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I: AP SOUTH

Notes:
Project ID: 201617_1-18I

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Build a single circuit 138 kV line from the existing Grand Point 138 kV substation to a new substation ("Green Ridge") interconnecting the existing Conemaugh - Hunterstown 500 kV transmission line.

kV Level: 138/500 kV
In-Service Cost ($M): $31.40
In-Service Date: 2021
Target Zone: Dominion

ME Constraints:
I: AP SOUTH

Notes:
PJM TEAC 04/13/2017
Project ID: 201617_1-18J

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield

Build a single circuit 230 kV line from the existing Hunterstown substation to a new 230 kV switchyard ("Green Valley") interconnecting the Carroll - Mt. Airy 230 kV transmission line.

kV Level: 230 kV
In-Service Cost ($M): $40.20
In-Service Date: 2021

Target Zone:

ME Constraints:
I: AP SOUTH, CENTRAL
RINGGOLD - OLD FARM
GERMANTOWN - STRABAN

Notes:
**Project ID: 201617_1-18K**

**Proposed by:** Northeast Transmission Development

**Proposed Solution:** Greenfield Build 600 MVAR Static VAR Compensation ("James Creek") interconnected to Brighton 500 kV Substation.

- **kV Level:** 500 kV
- **In-Service Cost ($M):** $39.70
- **In-Service Date:** 2021

**Target Zone:**

**ME Constraints:**
- I:BC_PEP

**Notes:**

PJM TEAC 04/13/2017
Project ID: 201617_1-18L

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Build 600 MVAR Static VAR Compensation ("Limestone Ridge") interconnected to Juniata 500 kV Substation.

kV Level: 500 kV
In-Service Cost ($M): $38.60
In-Service Date: 2021
Target Zone:

ME Constraints: 1:5004/5005, CENTRAL

Notes:

PJM TEAC 04/13/2017
**Project ID: 201617_1-18M**

Proposed by: Northeast Transmission Development  
Proposed Solution: Greenfield

Build a single circuit 345 kV line from the existing Marysville 345 kV substation to the existing Miami 345 kV substation with a new intermediate substation ("Bull Branch") interconnecting to the existing Urbana 138 kV substation. Build a new 138 kV transmission line interconnecting the existing Crown 138 kV substation to a new 345/138 kV substation ("Spring Run") interconnecting the existing West Milton - Miami Fort 345 kV transmission line.

<table>
<thead>
<tr>
<th>kV Level</th>
<th>138/345 kV</th>
</tr>
</thead>
</table>

In-Service Cost ($M): $117.30  
In-Service Date: 2021  
Target Zone: AEP

ME Constraints:  
Dayton LDA RPM Benefits

**Notes:**
Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Build a single circuit 345 kV line from the existing Marysville 345 kV substation to the existing Miami 345 kV substation with a new intermediate substation ("Bull Branch") interconnecting to the existing Urbana 138 kV substation.

kV Level: 138/345 kV
In-Service Cost ($M): $97.70
In-Service Date: 2021
Target Zone: AEP

ME Constraints:
Dayton LDA RPM Benefits

Notes:
**Project ID: 201617_1-18O**

**Proposed by:** Northeast Transmission Development

**Proposed Solution:** Greenfield

Build a double circuit 138 kV line from the existing Glen Lyn 138 kV substation to a new substation ("Smith Branch") interconnecting the existing Kanawha River - Matt Funk 345 kV transmission line.

**kV Level:** 138/345 kV

**In-Service Cost ($M):** $23.90

**In-Service Date:** 2021

**Target Zone:** Dominion

**ME Constraints:**

I: AEP-DOM

**Notes:**

PJM TEAC 04/13/2017
Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Build a new 138 kV transmission line interconnecting the existing Crown 138 kV substation to a new 345/138 kV substation ("Spring Run") interconnecting the existing West Milton - Miami Fort 345 kV transmission line.

<table>
<thead>
<tr>
<th>kV Level: 138/345 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M): $19.70</td>
</tr>
<tr>
<td>In-Service Date: 2021</td>
</tr>
<tr>
<td>Target Zone: Dayton</td>
</tr>
</tbody>
</table>

ME Constraints:
Dayton LDA RPM Benefits

Notes:

PJM TEAC 04/13/2017
Project ID: 201617_1-18Q

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Construct a single circuit 230 kV line from the existing Harwood substation to a new switching station ("Trexler Run") interconnecting the Catawissa - Frackville 230 kV transmission line.

kV Level: 230 kV
In-Service Cost ($M): $32.00
In-Service Date: 2021
Target Zone: PPL

ME Constraints:
SUSQUEHANNA - HARWOOD 230 kV

Notes:

PJM TEAC 04/13/2017
Project ID: 201617_1-18R

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Build a 500 kV switching station ("Turkey Creek") interconnecting the Cunningham to Elmont 500 kV transmission line and the North Anna to Midlothian 500 kV transmission line.

<table>
<thead>
<tr>
<th>kV Level</th>
<th>500 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M)</td>
<td>$19.30</td>
</tr>
<tr>
<td>In-Service Date</td>
<td>2021</td>
</tr>
<tr>
<td>Target Zone</td>
<td>Dominion</td>
</tr>
</tbody>
</table>

ME Constraints:
I: AEP-DOM

Notes:

PJM TEAC 04/13/2017
Project ID: 201617_1-18S

Proposed by: Northeast Transmission Development

Proposed Solution: Greenfield
Build a 345/138 kV substation ("Coffee Creek") interconnecting the Green Acres to Olive 345 kV line and the Flint Lake to Luchtman Road 138 kV line.

kV Level: 138/345 kV
In-Service Cost ($M): $17.4
In-Service Date: 2021
Target Zone: AEP

ME Constraints:
OLIVE - BOSSERMAN 138 kV

Notes: See supplemental project Olive – Bosserman discussion in the Reliability Update presentation at April TEAC.
**Proposed by:** Dominion Pepco

**Proposed Solution:**
This is a joint proposal by Dominion Virginia Power and Pepco to upgrade their existing tie-line. Reconductor and double circuit the existing Pleasant View - Dickerson 230kV Line (Line 203).

<table>
<thead>
<tr>
<th>kV Level</th>
<th>230 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M)</td>
<td>$39.63</td>
</tr>
<tr>
<td>In-Service Date</td>
<td>2021</td>
</tr>
<tr>
<td>Target Zone</td>
<td>Dominion</td>
</tr>
</tbody>
</table>

**ME Constraints:**
- I:AP SOUTH, AEP-DOM, 5004/5005, CENTRAL
- CONASTONE - GRACETON - BAGLEY 230 kV
- BOSSERMAN - Olive 138 kV
- SUSQUEHANNA - HARWOOD 230 kV
- OAKBAY - NORTH RVR 230kV
- PEACH BOTTOM - CONASTONE 500 kV

**Notes:**
Project ID: 201617_1-20A

Proposed by: ITC
Proposed Solution: Greenfield

Construct a new 230 kV switchyard (Old Post) cutting-in the Raphael Road - Otter Point 230 kV line. Extend 230 kV from the new 230 kV switchyard to the existing Peach Bottom 230 kV substation. Upgrade the existing Peach Bottom 230 kV substation to accomodate the new 230 kV line.

kV Level: 230 kV
In-Service Cost ($M): $73.60
In-Service Date: 2021
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
<table>
<thead>
<tr>
<th>Project ID: 201617_1-20B</th>
</tr>
</thead>
</table>

**Proposed by:** ITC  

**Proposed Solution:** Greenfield  
Construct a new 230 kV single circuit line between the existing Conastone and existing Raphael Road 230 kV substations. Upgrade the existing Conastone and Raphael Road 230 kV substations to accommodate the new 230 kV line.  

<table>
<thead>
<tr>
<th>kV Level: 230 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Service Cost ($M): $63.00</td>
</tr>
<tr>
<td>In-Service Date: 2021</td>
</tr>
<tr>
<td>Target Zone: BGE</td>
</tr>
</tbody>
</table>

**ME Constraints:**  
CONASTONE - GRACETON - BAGLEY 230 kV  

**Notes:**
Proposed by: ITC

Proposed Solution: Greenfield

Construct a new 230 kV single circuit line between the existing Conastone and existing Northeast 230 kV substations. Upgrade the existing Conastone and Northeast 230 kV substations to accommodate the new 230 kV line.

kV Level: 230 kV

In-Service Cost ($M): $135.78

In-Service Date: 2021

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
Proposed by: ITC

Proposed Solution: Greenfield

Construct a new 230 kV switchyard (Old Post) cutting-in the Raphael Road - Otter Point 230 kV line. Extend 230 kV from the new 230 kV switchyard to the existing Conastone 230 kV substation. Upgrade the existing Conastone 230 kV substation to accommodate the new 230 kV line.

kV Level: 230 kV

In-Service Cost ($M): $75.89

In-Service Date: 2021

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV
Proposed by: ITC

Proposed Solution: Greenfield

Construct a new 230 kV switchyard (Fallston) cutting-in the Graceton - Bagley 230 kV line. Construct a new 230 kV switchyard (Old Post) cutting-in the Raphael Road - Otter Point 230 kV line. Construct a new 230 kV switchyard (Pyle Rd). Construct 230 kV lines between the existing Peach Bottom 230 kV substation and the new Pyle Rd 230 kV switchyard, the new Fallston 230 kV switchyard and new Pyle Rd 230 kV switchyard, and the new Old Post 230 kV switchyard and the new Pyle Rd 230 kV switchyard. Upgrade the existing Peach Bottom 230 kV substation to accommodate the new 230 kV line.

kV Level: 230 kV

In-Service Cost ($M): $132.24

In-Service Date: 2021

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
PJM TEAC 04/13/2017
Proposed by: ITC

Proposed Solution: Greenfield

Construct a new 230 kV switchyard (Fallston) cutting-in the Graceton - Bagley 230 kV line. Construct a new 230 kV switchyard (Old Post) cutting-in the Raphael Road - Otter Point 230 kV line. Construct a new 230 kV switchyard (Pyle Rd). Construct 230 kV lines between the existing Conastone 230 kV substation and the new Pyle Rd 230 kV switchyard, the new Fallston 230 kV switchyard and new Pyle Rd 230 kV switchyard, and the new Old Post 230 kV switchyard and the new Pyle Rd 230 kV switchyard. Upgrade the existing Conastone 230 kV substation to accommodate the new 230 kV line.

kV Level: 230 kV

In-Service Cost ($M): $125.99

In-Service Date: 2021

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
Proposed by: ITC

Proposed Solution: Greenfield
Construct a new 230 kV single circuit line between the existing Peach Bottom and existing Northeast 230 kV substations. Upgrade the existing Peach Bottom and Northeast 230 kV substations to accommodate the new 230 kV line.

$kV$ Level: 230 kV

In-Service Cost ($M$): $151.51

In-Service Date: 2021

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:

PJM TEAC 04/13/2017
Proposed by: ITC
Proposed Solution: Greenfield
Construct a new 230 kV switchyard (Old Post) cutting-in the Raphael Road - Otter Point 230 kV line. Extend 230 kV from the new 230 kV switchyard to the existing Peach Bottom 230 kV substation. Upgrade the existing Peach Bottom 230 kV substation to accommodate the new 230 kV line. Install a transmission battery energy storage system at the Old Post switchyard.

kV Level: 230 kV
In-Service Cost ($M): $107.46
In-Service Date: 2021
Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:

PJM TEAC 04/13/2017
Proposed by: ITC

Proposed Solution: Greenfield
Construct a new 230 kV switchyard (Fallston) cutting-in the Graceton - Bagley 230 kV line. Construct a new 230 kV switchyard (Old Post) cutting-in the Raphael Road - Otter Point 230 kV line. Construct a new 230 kV switchyard (Pyle Rd). Construct 230 kV lines between the existing Peach Bottom 230 kV substation and the new Pyle Rd 230 kV switchyard, the new Fallston 230 kV switchyard and new Pyle Rd 230 kV switchyard, and the new Old Post 230 kV switchyard and the new Pyle Rd 230 kV switchyard. Upgrade the existing Peach Bottom 230 kV substation to accommodate the new 230 kV line. Install a transmission battery energy storage system at the Fallston switchyard.

kV Level: 230 kV

In-Service Cost ($M): $165.74

In-Service Date: 2021

Target Zone: BGE

ME Constraints:
CONASTONE - GRACETON - BAGLEY 230 kV

Notes:
• Revision History
  – V1 – 4/11/2017 – Original Version Posted to PJM.com
  – V2 – 4/12/2017
    • Slide #84, correction on the Cost ($70.5 instead of $64.32 )
    • Slide #85, correction on the Cost ($92.2 instead of $84.2 )
    • Slide #86, correction on the Cost ($87.2 instead of $79.76)
    • Slide #87, correction on the Cost ($105.1 instead of $96.11 )
    • Slide #88, correction on the Cost ($109.3 instead of $99.9 )
    • Slide #99, added kV Level: 138/500 kV
    • Slide #109, correction on the Cost ($17.4 instead of $15.8 )