Market Efficiency Results

• 2010 project review updates
  – COMED Area
  – PPL, METED, and PENELEC Area
  – Dominion and AEP Areas
Market Efficiency Projects

COMED AREA
## COMED Area Proposed Projects

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Description</th>
<th>Expected ISD</th>
<th>Voltage</th>
<th>Estimated Costs ($ millions)</th>
<th>Benefit/Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP-A-1</td>
<td>Byron-Cherry Valley-Pleasant Valley 345 KV</td>
<td>2016</td>
<td>345</td>
<td>112.5</td>
<td>0.75</td>
</tr>
<tr>
<td>MEP-A-2</td>
<td>Byron-Pleasant Valley 345 KV</td>
<td>2016</td>
<td>345</td>
<td>105</td>
<td>0.96</td>
</tr>
<tr>
<td>MEP-A-3</td>
<td>Cherry Valley - Pleasant Valley 345 KV</td>
<td>2016</td>
<td>345</td>
<td>67.5</td>
<td>2.74</td>
</tr>
<tr>
<td>MEP-A-5</td>
<td>Byron - Wayne 345 KV</td>
<td>2016</td>
<td>345</td>
<td>175</td>
<td>0.41</td>
</tr>
</tbody>
</table>

MEP-A-3 project moves congestion to Byron-Cherry Valley 345 KV Ckt.
Next Steps

- Independent Cost Review currently being conducted
- Coordination with Light Load study
- Coordination with Regional Planning Process Task Force (RPPTF) developments
Market Efficiency Projects

METED, PPL, PENELEC Area
Market Efficiency New Proposed Project: METED Area

- Project MEP-B-6: Hunterstown – Jackson
  - New Single 230 KV circuit from Hunterstown to Jackson
  - New transformer at Hunterstown 500/230 KV.

- Project creates reliability and market concerns on lower voltage system
  - Hunterstown 230/115 KV transformer

- Modified project to add additional 230/115 KV transformer at Hunterstown.

- Expected ISD: 6/1/2016
- Estimated project Costs.
  - $75 million
- Results:
  - Benefit/Cost ratio=.85
  - .85 <1.25 - Fail
<table>
<thead>
<tr>
<th>Project Number</th>
<th>Description</th>
<th>Expected ISD</th>
<th>Voltage</th>
<th>Estimated Costs ($ millions)</th>
<th>Benefit/Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP-A-6</td>
<td>New Hunterstown 500 kV Tx, New single circuit Hunterstown-Conewago 230 kV line, New Conewago 230 kV substation connecting the Jackson - Three Mile Island 230 kV and West Shore - Brunner Island 230 kV transmission lines near their intersection in York County</td>
<td>2016</td>
<td>230</td>
<td>99.4</td>
<td>1.09</td>
</tr>
<tr>
<td>MEP-A-7</td>
<td>Two new Hunterstown 500 kV Tx, New Double circuit Hunterstown-Conewago 230 kV line, New Conewago 230 kV substation connecting the Jackson - Three Mile Island 230 kV and West Shore - Brunner Island 230 kV transmission lines near their intersection in York County</td>
<td>2016</td>
<td>230</td>
<td>134.1</td>
<td>0.74</td>
</tr>
<tr>
<td>MEP-A-8</td>
<td>New 230 kV transmission line from Keystone to Shawville</td>
<td>2015</td>
<td>230</td>
<td>137.5</td>
<td>0.34</td>
</tr>
<tr>
<td>MEP-B-6</td>
<td>New 500/230 Transformer at Hunterstown with a new Hunterstown to Jackson 230 kV circuit plus a new 230/115 transformer at Hunterstown.</td>
<td>2016</td>
<td>230</td>
<td>75</td>
<td>0.85</td>
</tr>
</tbody>
</table>
Next Steps

- Independent Cost Review currently being conducted
Market Efficiency Projects

Dominion and AEP Area
Market Efficiency New Proposed Project: AEP/Dominion Area

• Project MEP-B-1
  • Install a 765/500 kV transformer at Joshua Falls station and construct an approximately 85-mile 500 kV line from Joshua Falls station to the existing Dooms - Elmont 500 kV line. Construct an approximately 30-mile 500 kV line from the Dooms - Elmont 500 KV line to Ladysmith station. Split the Dooms - Elmont 500 kV line to create separate Joshua Falls - Elmont and Dooms - Ladysmith 500 kV circuits.

• Expected ISD: 6/1/2017
• Estimated project Costs.
  ➢ $300 million
• Results:
  ➢ Benefit/Cost ratio= -.13
  ➢ -.13 <1.25 - Fail
Market Efficiency New Proposed Project: AEP/Dominion Area

- Project MEP-B-2
- Install a 765/500 kV transformer at Joshua Falls station and construct a new 500 kV station on the existing Dooms - Elmont 500 kV line. Construct an approximately 85-mile 500 kV line from Joshua Falls station to the new station. Construct an approximately 30-mile 500 kV line from the new station to Ladysmith station.

- Expected ISD: 6/1/2017
- Estimated project Costs.
  - $330 million
- Results:
  - Benefit/Cost ratio = -0.13
  - -0.13 < 1.25 - Fail
• Project MEP-B-3

• Install a 765/500 kV transformer at Joshua Falls station and construct an approximately 50-mile 500 kV line from Joshua Falls station to Clover station.

• Expected ISD: 6/1/2017
• Estimated project Costs.
  ➢ $170 million
• Results:
  ➢ Benefit/Cost ratio = -0.07
  ➢ -0.07 <1.25 - Fail
• **Project MEP-B-4 (MEP-B-1/MEP-B-3)**
  - Install a 765/500 kV transformer at Joshua Falls station and construct an approximately 85-mile 500 kV line from Joshua Falls station to the existing Dooms - Elmont 500 kV line. Construct an approximately 30-mile 500 kV line from the Dooms - Elmont 500 KV line to Ladysmith station. Split the Dooms - Elmont 500 kV line to create separate Joshua Falls - Elmont and Dooms - Ladysmith 500 kV circuits.
  - Install a 765/500 kV transformer at Joshua Falls station and construct an approximately 50-mile 500 kV line from Joshua Falls station to Clover station.

• **Expected ISD: 6/1/2017**

• **Estimated project Costs.**
  - $410 million

• **Results:**
  - Benefit/Cost ratio = -.03
  - -.03 < 1.25 - Fail
Market Efficiency New Proposed Project: AEP/Dominion Area

- Project MEP-B-5 (MEP-B-2/MEP-B-3)
- Install a 765/500 kV transformer at Joshua Falls station and construct a new 500 kV station on the existing Dooms - Elmont 500 kV line. Construct an approximately 85-mile 500 kV line from Joshua Falls station to the new station. Construct an approximately 30-mile 500 kV line from the new station to Ladysmith station.

- Install a 765/500 kV transformer at Joshua Falls station and construct an approximately 50-mile 500 kV line from Joshua Falls station to Clover station

- Expected ISD: 6/1/2017
- Estimated project Costs: $440 million

- Results:
  - Benefit/Cost ratio = -0.25
  - -0.25 < 1.25 - Fail
Market Efficiency New Proposed Project: AEP/Dominion Area

- Project MEP-B-7
- Install a 765/500 kV transformer at Joshua Falls station and construct a 500 kV line from Joshua Falls to Cunningham Station.

- Expected ISD: 6/1/2017
- Estimated project Costs.
  - $375 million
- Results:
  - Benefit/Cost ratio = 0.01
  - 0.01 < 1.25 - Fail
Market Efficiency New Proposed Project: AEP/Dominion Area

- Project MEP-B-8
  - Install a 765/230 kV transformer at Joshua Falls Station and construct a 230 kV line from Joshua Falls to Midlothian Station via Buckingham Station.

- Expected ISD: 6/1/2017
- Estimated project Costs.
  - $220 million
- Results:
  - Benefit/Cost ratio = 1.07
  - 1.07 < 1.25 - Fail
• Project MEP-B-9
• Install a 765/230 kV transformer at Joshua Falls station and construct a 230 kV double circuit line from Joshua Falls to Midlothian station via Buckingham Station.

• Expected ISD: 6/1/2017
• Estimated project Costs.
  ➢ $280 million
• Results:
  ➢ Benefit/Cost ratio = 1.88
  ➢ 1.88 >1.25 - Pass
Market Efficiency New Proposed Project: AEP/Dominion Area

- Project MEP-B-10
- Install a 765/345kV transformer at Joshua Falls Station, Install a new 500/345 kV transformer at both Dooms and Morrisville stations. Construct an approximately 133-mile 345 kV line from Joshua Falls to Dooms to Morrisville stations.

- Expected ISD: 6/1/2017
- Estimated project Costs.
  - $533 million
- Results:
  - Benefit/Cost ratio = 1.68
  - 1.68 >1.25 - Pass
## 2011 Market Efficiency Analysis Results

### Dominion and AEP Area Proposed Upgrades (Table 1 of 2)

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Description</th>
<th>Expected ISD</th>
<th>Voltage</th>
<th>Estimated Costs ($ millions)</th>
<th>Benefit/Cost</th>
<th>15 year Net Present Value of Benefit ($ millions)</th>
<th>Below 500 KV Method 15 year Net Present Value of Benefit ($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP-A-9</td>
<td>Install a 500/345 kV transformer at Bath County station and construct a 345 kV line from Kanawha River station to Bath County station.</td>
<td>2017</td>
<td>345</td>
<td>$260.5</td>
<td>4.03</td>
<td>$1,639.1</td>
<td>-</td>
</tr>
<tr>
<td>MEP-A-10</td>
<td>Install two 500/345 kV transformers at Bath County station and construct 345 kV line from Kanawha River station to Bath County station.</td>
<td>2017</td>
<td>345</td>
<td>$275</td>
<td>4.36</td>
<td>$1,869.6</td>
<td>-</td>
</tr>
<tr>
<td>MEP-A-11</td>
<td>Install two 500/345 kV transformers at Bath County station and construct a double circuit 345 kV line from Kanawha River station to Bath County station.</td>
<td>2017</td>
<td>345</td>
<td>$386.2</td>
<td>3.90</td>
<td>$2,349.1</td>
<td>-</td>
</tr>
<tr>
<td>MEP-B-1</td>
<td>Install a 765/500 kV transformer at Joshua Falls station and construct an approximately 85-mile 500 kV line from Joshua Falls station to the existing Dooms - Elmont 500 kV line. Construct an approximately 30-mile 500 kV line from the Dooms - Elmont 500 KV line to Ladysmith station. Split the Dooms - Elmont 500 kV line to create separate Joshua Falls - Elmont and Dooms - Ladysmith 500 kV circuits.</td>
<td>2017</td>
<td>500</td>
<td>$300</td>
<td>(0.13)</td>
<td>($61.0)</td>
<td>$956.1</td>
</tr>
<tr>
<td>MEP-B-2</td>
<td>Install a 765/500 kV transformer at Joshua Falls station and construct a new 500 kV station on the existing Dooms - Elmont 500 kV line. Construct an approximately 85-mile 500 kV line from Joshua Falls station to the new station. Construct an approximately 30-mile 500 kV line from the new station to Ladysmith station.</td>
<td>2017</td>
<td>500</td>
<td>$330</td>
<td>(0.13)</td>
<td>($66.8)</td>
<td>$1,024.7</td>
</tr>
<tr>
<td>MEP-B-3</td>
<td>Install a 765/500 kV transformer at Joshua Falls station and construct an approximately 50-mile 500 kV line from Joshua Falls station to Clover station.</td>
<td>2017</td>
<td>500</td>
<td>$170</td>
<td>(0.07)</td>
<td>($17.3)</td>
<td>$349.5</td>
</tr>
</tbody>
</table>
## Dominion and AEP Area Proposed Upgrades (Table 2 of 2)

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Description</th>
<th>Expected ISD</th>
<th>Voltage</th>
<th>Estimated Costs ($ millions)</th>
<th>Benefit/Cost</th>
<th>15 year Net Present Value of Benefit ($ millions)</th>
<th>Below 500 KV Method 15 year Net Present Value of Benefit ($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP-B-4</td>
<td>Project MEP-B-1 and MEP-B-3</td>
<td>2017</td>
<td>500</td>
<td>$410</td>
<td>(0.03)</td>
<td>($18)</td>
<td>$971.9</td>
</tr>
<tr>
<td>MEP-B-5</td>
<td>Project MEP-B-2 and MEP-B-3</td>
<td>2017</td>
<td>500</td>
<td>$440</td>
<td>(0.25)</td>
<td>($173)</td>
<td>$897.1</td>
</tr>
<tr>
<td>MEP-B-7</td>
<td>Install a 765/500 kV transformer at Joshua Falls station and construct a 500 kV line from Joshua Falls to Cunningham Station.</td>
<td>2017</td>
<td>500</td>
<td>$375</td>
<td>0.01</td>
<td>$3.2</td>
<td>$393.2</td>
</tr>
<tr>
<td>MEP-B-8</td>
<td>Install a 765/230 kV transformer at Joshua Falls Station and construct a 230 kV line from Joshua Falls to Midlothian Station via Buckingham Station.</td>
<td>2017</td>
<td>230</td>
<td>$220</td>
<td>1.07</td>
<td>$366.5</td>
<td></td>
</tr>
<tr>
<td>MEP-B-9</td>
<td>Install a 765/230 kV transformer at Joshua Falls station and construct a 230 kV double circuit line from Joshua Falls to Midlothian station via Buckingham Station.</td>
<td>2017</td>
<td>230</td>
<td>$280</td>
<td>1.88</td>
<td>$822.4</td>
<td></td>
</tr>
<tr>
<td>MEP-B-10</td>
<td>Install a 765/345kV transformer at Joshua Falls Station, Install a new 500/345 kV transformer at both Dooms and Morrisville stations. Construct an approximately 133-mile 345 kV line from Joshua Falls to Dooms to Morrisville stations.</td>
<td>2017</td>
<td>345</td>
<td>$533</td>
<td>1.68</td>
<td>$1,395.4</td>
<td></td>
</tr>
</tbody>
</table>
• Several Projects show Large Market Benefits

• Benefit calculated different depending on type of project.

Annual Benefit = (.7)(Δ System Production Cost)+(.3)(Δ Load Energy Payment)

- Δ System Production Cost is change in system generation variable cost (fuel costs, variable O&M costs and emissions costs) associated with total PJM energy production
- Δ Load Energy Payment is change in net load energy payment (change in gross load payment minus change in transmission right credit

- For projects that have costs allocated regionally (500 kV and up), the load energy payment for all PJM zones is considered
- For projects that have costs allocated using a flow-based methodology (below 500 kV), the load energy payment for only those PJM zones that show a decrease in load energy payment is considered.

• Proposed Market Efficiency Regional Projects difficult to pass 1.25 Benefit/Cost Threshold
  – Projects that provide large Net Benefits may be dismissed because of type of project (Regional vs. below 500 KV)
  – Consider changing calculation for regional to be same as below 500 KV projects.

  • Zones in which project shows no load benefit or increase in net load energy payments have no cost allocation
  • Zones in which project shows load benefit or decrease in net load energy payments will have a cost allocation
Next Steps

– Independent Cost Review currently being conducted

– Incorporate pending reliability baseline projects
  • Rerun Studies as appropriate

– Reliability Analysis review for all passing projects

– Sensitivity analysis for Key input assumptions

– Variations to be considered