Transmission Expansion Advisory Committee

May 12, 2011
Issues Tracking
Issues Tracking

- Open Issues
  - None

- New Issues
PJM Generation Scenario Analysis Update
Conceptual PJM Renewable Sourcing Zones

Legend

- Substations:
  - 345 kV
  - 500 kV
  - 765 kV

- Transmission Lines:
  - 345 kV
  - 500 kV
  - 765 kV

- Capacity Classes:
  - > 40%
  - 35% - 40%
  - 30% - 35%
  - 25% - 30%
  - < 25%

Regions:
- External North
- External South
- Appalachian
- Offshore

Map showing the conceptual PJM Renewable Sourcing Zones with various symbols and colors indicating substations, transmission lines, and capacity classes.
Solar Participation Re-Considered

- Queue data used to determine solar participation
- Load offset approach instead of discrete high voltage injections
- Updated Solar Participation by TO Zone
  - AEC – 23%
  - AEP – 5%
  - APS – 14%
  - DPL – 7%
  - JCPL – 32%
  - METED – 5%
  - PENELEC – 3%
  - PPL – 4%
  - PSEG – 7%

Table 1: Previously Recommended Discrete Solar Injection Points

<table>
<thead>
<tr>
<th>Location</th>
<th>Zone</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branchburg</td>
<td>PJM500</td>
<td>500</td>
</tr>
<tr>
<td>New Freedom</td>
<td>PJM500</td>
<td>500</td>
</tr>
<tr>
<td>Hunterstown</td>
<td>PJM500</td>
<td>500</td>
</tr>
<tr>
<td>Vienna</td>
<td>DP&amp;L</td>
<td>230</td>
</tr>
<tr>
<td>Oak Grove</td>
<td>PEPCO</td>
<td>230</td>
</tr>
<tr>
<td>Cashie</td>
<td>DVP</td>
<td>230</td>
</tr>
<tr>
<td>Beatty</td>
<td>AEP</td>
<td>345</td>
</tr>
<tr>
<td>Elwood</td>
<td>ComED</td>
<td>345</td>
</tr>
</tbody>
</table>
## Capacity Requirements

### 2021

<table>
<thead>
<tr>
<th></th>
<th>Solar</th>
<th>Wind</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Installed Nameplate based on State Targets*</td>
<td>7,000</td>
<td>32,000</td>
<td>39,000</td>
</tr>
<tr>
<td>Forecast Restricted Demand** (2011 PJM Load Forecast)</td>
<td>166,560</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed Reserve Margin</td>
<td>20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed Capacity Needed</td>
<td>199,872</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed Capacity Credit***</td>
<td>2,660</td>
<td>4,800</td>
<td>7,460</td>
</tr>
<tr>
<td>Current Installed Capacity</td>
<td>185,544</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Non-Renewable Capacity Needed</td>
<td>6,868</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2026

<table>
<thead>
<tr>
<th></th>
<th>Solar</th>
<th>Wind</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Installed Nameplate based on State Targets</td>
<td>11,000</td>
<td>41,000</td>
<td>52,000</td>
</tr>
<tr>
<td>Forecast Restricted Demand** (2011 PJM Load Forecast)</td>
<td>172,904</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed Reserve Margin</td>
<td>20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed Capacity Needed</td>
<td>207,485</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed Capacity Credit***</td>
<td>4,180</td>
<td>6,150</td>
<td>10,330</td>
</tr>
<tr>
<td>Current Installed Capacity</td>
<td>185,544</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Non-Renewable Capacity Needed</td>
<td>11,611</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Assumes 30% capacity factor for Wind and 12% capacity factor for solar
** Assumes 10,000 MW of DR
*** Assumes 38% for solar and 15% for wind
Sufficient solar resources will be located in each state to meet the state’s solar requirements.

Note: 11,611 of Gas and Nuclear will be added based on the PJM queue.
Sufficient solar resources will be located in each state to meet the state’s solar requirements.

Note: 11,611 of Gas and Nuclear will be added based on the PJM queue.
20,000 MW Offshore Wind Scenario

<table>
<thead>
<tr>
<th>Renewable Sources</th>
<th>Solar Distribution</th>
<th>2026 Installed MW Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>100%</td>
<td>11,000</td>
</tr>
<tr>
<td>External North</td>
<td></td>
<td>Future Study</td>
</tr>
<tr>
<td>External South</td>
<td>43%</td>
<td>9,030</td>
</tr>
<tr>
<td>PJM - Illinois</td>
<td>30%</td>
<td>6,300</td>
</tr>
<tr>
<td>PJM - Indiana</td>
<td>17%</td>
<td>3,570</td>
</tr>
<tr>
<td>PJM - Ohio</td>
<td>10%</td>
<td>2,100</td>
</tr>
<tr>
<td>PJM - Appalachian Mountains</td>
<td>20,000</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL**

<table>
<thead>
<tr>
<th>Other Sources to meet IRM</th>
<th>Natural Gas</th>
<th>Nuclear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8,611</td>
<td>3,000</td>
</tr>
</tbody>
</table>

Sufficient solar resources will be located in each state to meet the state’s solar requirements

Note: 11,611 of Gas and Nuclear will be added based on the PJM queue
• All three offshore wind scenarios were analyzed
• Flowgates identified using results from all three simulations
Summary of Identified Flowgates / Monitored Facilities

• Flowgates were identified as part of the reliability deliverability analysis
• Input assumption for Market Efficiency analysis
• Approximately 150 Flowgates
Map of Identified Flowgates / Monitored Facilities

Legend:
- Substations Identified
- Subs >=230 kV
- Trans Lines >=230 kV
- PJM Zones
• The flowgates are a primary input to the market efficiency analysis

• Market efficiency analysis will examine 2026
  – MWH produced by the renewable resources
  – MWH consumed by TO zone
  – Identify potential areas of congestion
Next Steps

- Determine transmission overlay to accommodate state RPS requirements

- Input to PJM Renewable Integration Study (PRIS)
PJM At-Risk Generation Update
Overview: Policy Environment and Issues Facing PJM and its Members

• Policy Environment
  – Four US EPA rulemakings with effective dates between 2011 and 2015
  – State environmental rules (IL, MD, NJ among others)
  – Renewable portfolio standards (RPS) or voluntary targets (11 of 14 PJM jurisdictions)
  – Coal units are to be the most impacted, but not the only fuel or technology types

• Issues: What resources are at risk for retirement? Is there a resource adequacy problem in the future?
  – Many rules would require costly environmental retrofits or effectively force units to retire
  – RPS puts downward pressure on energy market revenues used to recover costs of retrofits for existing units, and cost of new entry
  – Impacts will be first seen in the upcoming 2014/2015 capacity market auction in May 2011
  – How many units will retire, repower, or retrofit?
  – What are the prospects for retaining existing resources and new entry?
<table>
<thead>
<tr>
<th>Pollutant or target issue</th>
<th>GHG Tailoring Rule</th>
<th>Clean Air Transport Rule</th>
<th>HAP MACT</th>
<th>CWA 316(b)</th>
<th>High Electricity Demand Day</th>
<th>Renewable Portfolio Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ and other GHG</td>
<td>SO₂ and NOₓ</td>
<td>Mercury and Acid Gases</td>
<td>Cooling water intake structures</td>
<td>Ozone formation from NOₓ on hot days</td>
<td>Ensure a certain percentage of renewables</td>
<td></td>
</tr>
<tr>
<td>All fossil units</td>
<td>All fossil units</td>
<td>Coal and oil, primarily coal</td>
<td>All existing units</td>
<td>Oil and gas peaking</td>
<td>All units</td>
<td></td>
</tr>
<tr>
<td>BACT case-by-case, state-by-state</td>
<td>Limited cap &amp; trade. Use of FGD and SCR likely</td>
<td>MACT to be defined, likely FGD, ACI, fabric filter</td>
<td>BTA to be defined, likely not once thru cooling</td>
<td>NOₓ rate standard. Use of SCR and other controls likely</td>
<td>Mandated percentage of electricity sales from renewables</td>
<td></td>
</tr>
<tr>
<td>Mostly fixed costs</td>
<td>Fixed and variable costs</td>
<td>Mostly fixed costs</td>
<td>Mostly fixed costs</td>
<td>Mostly fixed costs</td>
<td>Mostly fixed costs</td>
<td>Reduced net energy market revenues</td>
</tr>
</tbody>
</table>
Resource Adequacy in the Face of Environmental Rules

- Resource Adequacy:
  - Resources can only be attracted and maintained if there are deemed to be sufficient revenues to cover costs plus a return on investment
  - This includes the costs of any retrofits to meet environmental rules or the cost of new entry of resources without the same environmental liabilities
  - What are the transmission security/reliability implications of retirement and new entry decisions?
  - How much will achieving resource adequacy cost?
  - How many units will choose deactivation over retrofit?
### Rough Range of Estimates for Environmental Retrofits and New Entry Gas

<table>
<thead>
<tr>
<th></th>
<th>FGD</th>
<th>SCR</th>
<th>ACI and FF Baghouse</th>
<th>Cooling Towers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Cost ($/kW)</strong></td>
<td>$400-$800</td>
<td>$150-$260</td>
<td>$70-$100</td>
<td>$200-$300</td>
</tr>
</tbody>
</table>

Sources: EPA for FGD, SCR, and ACI and FF. Brattle Group for cooling towers

<table>
<thead>
<tr>
<th></th>
<th>Combined Cycle</th>
<th>Combustion Turbine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Cost ($/kW)</strong></td>
<td>$1000-$1150</td>
<td>$665-$975</td>
</tr>
</tbody>
</table>

Sources: PJM and EIA
SCREENING FOR UNITS AT RISK FOR DEACTIVATION DUE TO ENVIRONMENTAL RULES
Characteristics of Coal-fired Capacity in PJM by Age and Size: A Screen for Units at Risk

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>2009 Capacity Factor</th>
<th>2009 Gross Heat rate (btu/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal ≤ 40 years</td>
<td>49.25%</td>
<td>9,783</td>
</tr>
<tr>
<td>Coal &gt; 40 years</td>
<td>42.4%</td>
<td>10,109</td>
</tr>
<tr>
<td>Coal &lt; 400 MW</td>
<td>33.2%</td>
<td>10,367</td>
</tr>
<tr>
<td>Coal ≥ 400 MW</td>
<td>69.7%</td>
<td>9,387</td>
</tr>
</tbody>
</table>

Source: PJM EIA-411 Submittal as of January 1, 2009 and United States Environmental Protection Agency Database of Unit Characteristics

- Coal ≥ 400 MW (2/3 of coal capacity) runs at highest capacity factors and is most efficient. These units are likely candidates on average for environmental retrofits.

- Older, smaller coal units run less often and are not as efficient and are candidates on average to be retired, or repowered to gas.
## Composition of Coal-fired Capacity in PJM
(MW of Summer Net Dependable Capacity)

<table>
<thead>
<tr>
<th></th>
<th>PJM RTO</th>
<th>MAAC</th>
<th>Rest of PJM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Coal</td>
<td>66,098</td>
<td>19,722</td>
<td>46,367</td>
</tr>
<tr>
<td>Coal &gt; 40 years</td>
<td>36,107</td>
<td>13,822</td>
<td>22,286</td>
</tr>
<tr>
<td>Coal &lt; 400 MW</td>
<td>22,475</td>
<td>8,644</td>
<td>13,831</td>
</tr>
<tr>
<td>Coal &gt; 40 years, &lt; 400 MW</td>
<td>18,417</td>
<td>7,257</td>
<td>11,160</td>
</tr>
</tbody>
</table>

Source: PJM EIA-411 Submittal as of January 1, 2009
2009 SO2 Emissions versus Proposed 2014 State SO2 Emissions Caps in PJM States under CATR
### Composition of Coal-fired Capacity in PJM without Limestone FGD or Fluidized Bed Combustion for controlling SO$_2$ Emissions

<table>
<thead>
<tr>
<th></th>
<th>PJM RTO</th>
<th>MAAC</th>
<th>Rest of PJM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Coal</strong></td>
<td>30,156</td>
<td>8,873</td>
<td>21,283</td>
</tr>
<tr>
<td>Coal &gt; 40 years</td>
<td>23,601</td>
<td>8,199</td>
<td>15,402</td>
</tr>
<tr>
<td>Coal &lt; 400 MW</td>
<td>17,387</td>
<td>6,651</td>
<td>10,736</td>
</tr>
<tr>
<td>Coal &gt; 40 years,</td>
<td>16,830</td>
<td>6,407</td>
<td>10,423</td>
</tr>
<tr>
<td>&lt; 400 MW</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: PJM EIA-411 Submittal as of January 1, 2009 and United States Environmental Protection Agency Database of Unit Characteristics. MW of Net Dependable Summer Capacity.
2009 NOx Emissions versus Proposed 2014 State NOx Emissions Caps in PJM States under CATR

![Bar chart showing 2009 NOx Emissions versus Proposed 2014 State NOx Emissions Caps in PJM States under CATR.](chart.png)

- **State**: Delaware, District of Columbia, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia.

- **Y-axis**: Tons of NOx per year.

- **Legend**:
  - 2014 State NOx Caps
  - 2009 NOx Emissions

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5/12/2011

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### Composition of Coal-fired Capacity in PJM without Limestone FGD or Fluidized Bed Combustion for SO₂ and No SCR for Controlling NOₓ Emissions

<table>
<thead>
<tr>
<th></th>
<th>PJM RTO</th>
<th>MAAC</th>
<th>Rest of PJM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Coal</td>
<td>22,849</td>
<td>6,326</td>
<td>16,523</td>
</tr>
<tr>
<td>Coal &gt; 40 years</td>
<td>17,724</td>
<td>5,652</td>
<td>12,072</td>
</tr>
<tr>
<td>Coal &lt; 400 MW</td>
<td>15,237</td>
<td>5,338</td>
<td>9,899</td>
</tr>
<tr>
<td>Coal &gt; 40 years, &lt; 400 MW</td>
<td>14,680</td>
<td>5,094</td>
<td>9,586</td>
</tr>
</tbody>
</table>

Source: PJM EIA-411 Submittal as of January 1, 2009 and United States Environmental Protection Agency Database of Unit Characteristics

MW of Summer Net Dependable Capacity
Composition of Coal-fired Capacity in PJM without Limestone FGD and Baghouses for Expected Mercury Controls under HAP MACT

<table>
<thead>
<tr>
<th></th>
<th>PJM RTO</th>
<th>MAAC</th>
<th>Rest of PJM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Coal</td>
<td>28,227</td>
<td>7,084</td>
<td>21,143</td>
</tr>
<tr>
<td>Coal &gt; 40 years</td>
<td>21,577</td>
<td>6,400</td>
<td>15,177</td>
</tr>
<tr>
<td>Coal &lt; 400 MW</td>
<td>15,458</td>
<td>4,862</td>
<td>10,596</td>
</tr>
<tr>
<td>Coal &gt; 40 years, &lt; 400 MW</td>
<td>14,806</td>
<td>4,608</td>
<td>10,198</td>
</tr>
</tbody>
</table>

Source: PJM EIA-411 Submittal as of January 1, 2009 and United States Environmental Protection Agency Database of Unit Characteristics MW of Summer Net Dependable Capacity
## Composition of Capacity in PJM
### Employing Once Through Cooling

<table>
<thead>
<tr>
<th></th>
<th>PJM RTO</th>
<th>MAAC</th>
<th>Rest of PJM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil and Gas</td>
<td>4,271</td>
<td>3,070</td>
<td>1,201</td>
</tr>
<tr>
<td>Nuclear</td>
<td>11,930</td>
<td>4,658</td>
<td>7,271</td>
</tr>
<tr>
<td>Coal</td>
<td>28,167</td>
<td>9,498</td>
<td>18,669</td>
</tr>
<tr>
<td>Coal &gt; 40 years</td>
<td>25,554</td>
<td>8,878</td>
<td>16,676</td>
</tr>
<tr>
<td>Coal &lt; 400 MW</td>
<td>17,470</td>
<td>6,947</td>
<td>10,523</td>
</tr>
<tr>
<td>Coal &gt; 40 years, &lt; 400 MW</td>
<td>17,157</td>
<td>6,947</td>
<td>10,210</td>
</tr>
</tbody>
</table>


MW of Summer Net Dependable Capacity
Composition of Capacity in PJM
Employing Once Through Cooling

• Oil and Gas Units:
  – All identified operated at a capacity factor of 7% or less in 2009
  – All but approximately 100 MW are located east of major west to east constraints
  – Approximately 550 MW have requested deactivation by the end of 2011
  – Average age 48.5 years

• Coal Units:
  – Average unit size is 220 MW
  – Average capacity factor of 39%
Summary of Previous Work

• Previous Considerations
  – Revenue deficient per Market Monitor (confidential)
  – Units that didn’t clear in RPM (confidential)
  – Aging coal by size (older than 40 years AND less than 400 MW)

• Previous Work
  – Linear analysis of the 15 year planning horizon
  – Focused on known high voltage reliability issues
Potential Scope of Work for At-Risk Generation Study

• Methodology to determine at-risk
  – Market sensitive data
  – Regulatory
  – Economic

• Scope of analytical work
  – Full AC analysis
  – Similar to deactivation analysis
    • Generator Deliverability
    • Load Deliverability
    • N-1-1
2011 RTEP Analysis Update
• 2016 RTEP analysis status update
  – Generation deliverability analysis results sent to TOs
  – Basecase analysis results sent to TOs
  – Load deliverability analysis will start this week
• Next Steps
  – 2016 Load Deliverability Thermal & Voltage
    • Calculation of 2016 CETO values is underway
DAYTON Transmission Zone

- Common Mode, N-1-1 Thermal and Voltage Violation
- Staunton Tap – Eldean 138kV line overload for the Shebly – Miami 345kV line fault with stuck breaker at Shelby; Quincy – East Sidney – Shelby 138 kV line overload for loss of Darby 138/69 kV XFMR and Urbana 138/69 kV XFMR; Low voltage at several buses at North West area of DATYON due to various pairs of contingencies
- Proposed Solution:
  - add a 345/69kV transformer at AEP Marysville 345kV bus
  - add Marysville 69kV – Darby 69kV
  - add Marysville 69kV – Union REA 69kV
  - Reconductor Union REA 69kV
  - Honda MT 69kV
- Estimated Project Cost: $16 M
- Expected IS Date: 6/1/2014
Short Circuit Upgrades
The following breakers are overstressed:
- Bergen 138 kV breaker ‘30P’
- Bergen 138 kV breaker ‘80P’
- Bergen 138 kV breaker ‘70P’
- Bergen 138 kV breaker ‘90P’
- Bergen 138 kV breaker ‘50P’
- Bergen 230 kV breaker ‘12H’
- Bergen 230 kV breaker ‘21H’
- Bergen 230 kV breaker ‘11H’
- Bergen 230 kV breaker ‘20H’

Significant Driver: Install 230/138 kV transformer at Bergen (b1082)

Proposed Solution:
- Replace the Bergen 138 kV breaker ‘30P’ with 80 kA (b1082.1)
- Replace the Bergen 138 kV breaker ‘80P’ with 80 kA (b1082.2)
- Replace the Bergen 138 kV breaker ‘70P’ with 80 kA (b1082.3)
- Replace the Bergen 138 kV breaker ‘90P’ with 63 kA (b1082.4)
- Replace the Bergen 138 kV breaker ‘50P’ with 63 kA (b1082.5)
• Proposed Solution (cont’d):
  – Replace the Bergen 230 kV breaker '12H' with 80 kA (b1082.6)
  – Replace the Bergen 230 kV breaker '21H' with 80 kA (b1082.7)
  – Replace the Bergen 230 kV breaker '11H' with 80 kA (b1082.8)
  – Replace the Bergen 230 kV breaker '20H' with 80 kA (b1082.9)
• Estimated Project Cost:
  – TBD
• Expected IS Date:
  6/01/2014
The following breakers are overstressed:
- Branchburg 230 kV breaker ‘81H’
- Branchburg 230 kV breaker ‘72H’
- Branchburg 230 kV breaker ‘61H’
- Branchburg 230 kV breaker ‘41H’

Significant Driver: Build a new 230 kV circuit from Branchburg to Middlesex Sw. Rack (b1155)

Proposed Solution:
- Replace the Branchburg 230 kV breaker ‘81H’ with 63 kA (b1155.3)
- Replace the Branchburg 230 kV breaker ‘72H’ with 63 kA (b1155.4)
- Replace the Branchburg 230 kV breaker ‘61H’ with 63 kA (b1155.5)
- Replace the Branchburg 230 kV breaker ‘41H’ with 63 kA (b1155.6)

Estimated Project Cost:
- TBD

Expected IS Date:
6/01/2014
The following breakers are overstressed:
- Camden 230 kV breaker ‘22H’
- Camden 230 kV breaker ‘32H’
- Camden 230 kV breaker ‘21H’

Significant Driver: Convert the Burlington, Camden, and Cuthbert Blvd 138 kV substations from 138 kV to 230 kV (b1156)

Proposed Solution:
- Replace the Camden 230 kV breaker ‘22H’ with 80 kA (b1156.13)
- Replace the Camden 230 kV breaker ‘32H’ with 80 kA (b1156.14)
- Replace the Camden 230 kV breaker ‘21H’ with 80 kA (b1156.15)

Estimated Project Cost: TBD

Expected IS Date: 6/01/2014
• Fault levels are above 63 kA at the Camden 230 kV substation.

• Significant Driver: Convert the Burlington, Camden, and Cuthbert Blvd 138 kV substations from 138 kV to 230 kV (b1156)

• Proposed Solution:
  – Rebuild the Camden 230 kV substation to 80 kA (b1156.19)

• Estimated Project Cost:
  – TBD

• Expected IS Date:
  6/01/2014
The following breakers are overstressed:
- New Freedom 230 kV breaker ‘50H’
- New Freedom 230 kV breaker ‘41H’
- New Freedom 230 kV breaker ‘51H’

Significant Driver: Convert the Burlington, Camden, and Cuthbert Blvd 138 kV substations from 138 kV to 230 kV (b1156)

Proposed Solution:
- Replace the New Freedom 230 kV breaker ‘50H’ with 63 kA (b1156.16)
- Replace the New Freedom 230 kV breaker ‘41H’ with 63 kA (b1156.17)
- Replace the New Freedom 230 kV breaker ‘51H’ with 63 kA (b1156.18)

Estimated Project Cost:
- TBD

Expected IS Date:
6/01/2014
• The following breakers are overstressed:
  – South Waterfront 230 kV breaker ‘12H’
  – South Waterfront 230 kV breaker ‘22H’
  – South Waterfront 230 kV breaker ‘32H’
  – South Waterfront 230 kV breaker ‘52H’
  – South Waterfront 230 kV breaker ‘62H’
  – South Waterfront 230 kV breaker ‘72H’
  – South Waterfront 230 kV breaker ‘82H’

• Significant Driver: Build second 230 kV underground cable from Hudson to South Waterfront (b1304.4)

• Proposed Solution:
  – Replace the South Waterfront 230 kV breaker ‘12H’ with 80 kA (b1304.7)
  – Replace the South Waterfront 230 kV breaker ‘22H’ with 80 kA (b1304.8)
  – Replace the South Waterfront 230 kV breaker ‘32H’ with 80 kA (b1304.9)
  – Replace the South Waterfront 230 kV breaker ‘52H’ with 80 kA (b1304.10)
  – Replace the South Waterfront 230 kV breaker ‘62H’ with 80 kA (b1304.11)
• Proposed Solution (cont’d):
  – Replace the South Waterfront 230 kV breaker ‘72H’ with 80 kA (b1304.12)
  – Replace the South Waterfront 230 kV breaker ‘82H’ with 80 kA (b1304.13)

• Estimated Project Cost:
  – TBD

• Expected IS Date:
  6/01/2015
The following breakers are overstressed:
- Essex 230 kV breaker ‘20H’
- Essex 230 kV breaker ‘21H’
- Essex 230 kV breaker ‘10H’
- Essex 230 kV breaker ‘11H’
- Essex 230 kV breaker ‘11HL’

Significant Driver: Convert the existing 'D1304' and 'G1307' 138 kV circuits between Roseland - Kearny-Hudson to 230 kV operation (b1304.1)

Proposed Solution:
- Replace the Essex 230 kV breaker '20H' with 80 kA (b1304.14)
- Replace the Essex 230 kV breaker '21H' with 80 kA (b1304.15)
- Replace the Essex 230 kV breaker '10H' with 80 kA (b1304.16)
- Replace the Essex 230 kV breaker '11H' with 80 kA (b1304.17)
• Proposed Solution (cont’d):
  – Replace the Essex 230 kV breaker '11HL' with 80 kA (b1304.18)

• Estimated Project Cost:
  – TBD

• Expected IS Date:
  6/01/2015
The following breakers are overstressed:
- Athenia 230 kV breaker '21H'
- Athenia 230 kV breaker '41H'

Significant Driver: Build second 230 kV underground cable from Bergen to Athenia (b1304.3)

Proposed Solution:
- Replace the Athenia 230 kV breaker '21H' with 80 kA (b1304.5)
- Replace the Athenia 230 kV breaker '41H' with 80 kA (b1304.6)

Estimated Project Cost:
- TBD

Expected IS Date:
6/01/2015
PSE&G Transmission Zone

• Fault levels are above 63 kA at the Athenia 230 kV substation.

• Significant Driver: Build second 230 kV underground cable from Bergen to Athenia (b1304.3)

• Proposed Solution:
  – Rebuild the Athenia 230 kV substation to 80 kA (b1304.20)

• Estimated Project Cost:
  – TBD

• Expected IS Date:
  6/01/2015
• Fault levels are above 63 kA at the Bergen 230 kV substation.

• Significant Driver: Build second 230 kV underground cable from Bergen to Athena (b1304.3)

• Proposed Solution:
  – Rebuild the Bergen 230 kV substation to 80 kA (b1304.21)

• Estimated Project Cost:
  – $0 M
  – The cost for this upgrade has already been captured in the cost estimate for b1304.1 and b1304.2.

• Expected IS Date:
  6/01/2015
The following breaker is overstressed:
- Newport R 230 kV breaker ‘23H’

Significant Driver: Build second 230 kV underground cable from Hudson to South Waterfront (b1304.4)

Proposed Solution:
- Replace the Newport R 230 kV breaker ‘23H’ with 63 kA (b1304.19)

Estimated Project Cost:
- TBD

Expected IS Date:
6/01/2015
The following breakers are overstressed:
- Gloucester 230 kV breaker ‘21H’
- Gloucester 230 kV breaker ‘51H’
- Gloucester 230 kV breaker ‘56H’
- Gloucester 230 kV breaker ‘26H’
- Gloucester 230 kV breaker ‘71H’

Significant Driver: Build two new parallel underground circuits from Gloucester to Camden (via Cuthbert Blvd) (b1398)

Proposed Solution:
- Replace the Gloucester 230 kV breaker ’21H’ with 63 kA (b1398.15)
- Replace the Gloucester 230 kV breaker ’51H’ with 63 kA (b1398.16)
- Replace the Gloucester 230 kV breaker ’56H’ with 63 kA (b1398.17)
- Replace the Gloucester 230 kV breaker ’26H’ with 63 kA (b1398.18)
• Proposed Solution (cont’d):
  – Replace the Gloucester 230 kV breaker '71H' with 63 kA (b1398.19)

• Estimated Project Cost:
  – TBD

• Expected IS Date:
  6/01/2015
The following breakers are overstressed:
- Tosco 230 kV breaker ‘CB1’
- Tosco 230 kV breaker ‘CB2’

Proposed Solution:
- Replace the Tosco 230 kV breaker ‘CB1’ with 63 kA (b1539)
- Replace the Tosco 230 kV breaker ‘CB2’ with 63 kA (b1540)

Estimated Project Cost:
- TBD

Expected IS Date:
6/01/2015
• Fault levels are above 80 kA at the Hudson 230 kV substation.

• Significant Drivers: BRH alternative upgrades (b1304)

• Proposed Solution:
  – Create baseline upgrade to ensure the Hudson bus tie is open
  – Open the Hudson 230 kV bus tie (b1541)

• Estimated Project Cost:
  – $0 M

• Expected IS Date: 6/01/2015
• The following breakers are overstressed:
  – Sewaren 138 kV breaker '31P'
  – Sewaren 138 kV breaker '1PL'

• Significant Driver: Replace the Sewaren 230/138 kV transformer (s0260)

• Proposed Solution:
  – Replace the Sewaren 138 kV breaker '31P’ with 63 kA (s0260.2)
  – Replace the Sewaren 138 kV breaker '1PL’ with 63 kA (s0260.3)

• Estimated Project Cost:
  – TBD

• Expected IS Date: 6/01/2013
Email RTEP@pjm.com with any comments or questions
Next Steps
Review Issues Tracking