Transmission Expansion Advisory Committee

June 9, 2011
Issues Tracking
• Open Issues
  – None

• New Issues
PJM Generation Scenario Analysis Update
• Flowgates were identified as part of the reliability deliverability analysis
• All three offshore wind scenarios were analyzed
• Flowgates identified using results from all three simulations
• Input assumption for Market Efficiency analysis
• Approximately 150 Flowgates
• Study year: 2026
• Market Efficiency Assumptions Consistent with 2011 RTEP Assumptions:
  – PROMOD IV model from Ventyx
  – Underlying input data contained in PROMOD Powerbase (February 2011 update)
  – Ventyx Input Data updated with the following
    • PJM January 2011 Load Forecast
    • PJM assumptions on emissions prices
    • Monitoring additions based on NERC Book of Flowgates, Planning contingency analysis results and historical PJM congestion
Renewable Integration Study – Status and Next Steps

- Three scenarios developed
  - 4,000 MW offshore wind
  - 10,000 MW offshore wind
  - 20,000 MW offshore wind
- Base power flow case complete
- Market efficiency analysis is in-progress
  - Modeling complete
  - Benchmarking 2016 system
- Once benchmarking is complete, production cost simulations of 2026 for each scenario will begin
Interregional Planning Update
• Update of Coordinated modeling of PJM/NY/NE market efficiency
  – 2015 model projection
  – NE is using a zonal model
  – PJM is updating previous work using Promod
  – Input date is coordinated
  – Results of zonal LMP and energy exchanges will be benched and projected
  – Webex scheduled 6/27/2011 – See the PJM IPSAC page for registration details
• Supporting MISO MTEP11 analyses
  – MISO’s Multi Value Project (MVP) analysis
  – MISO’s Congested Flowgate analysis
  – Providing load flow and market efficiency data support as required. Coordinated models should benefit future PJM/MISO JOA analysis
• 8 Stakeholder Selected Generation Expansion Scenarios and approximately 80 sensitivities are complete

• Macro-economic analysis of each using CRA model

• PA’s will provide requested high level costs for transmission build-outs specified by stakeholders

• By year end Stakeholders will choose 3 scenarios to pursue in Phase II

• Phase II transmission expansion methods being developed
Nuclear Plant Interface Requirements Analysis
• NUC-001-2 Nuclear Plant Interface Requirements
  – Plant specific Transmission Planning studies are underway
  – Study results for plant specific criteria are communicated directly to TO and GO
  – Study results and recommendations for applicable PJM criteria will be reviewed with the TEAC
### 2011 NPIR Study Status

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Baseline Reliability Update
• Since the last meeting, PJM staff has been working on baseline, generation deliverability and load deliverability testing.

• Baseline analysis complete
• Generation deliverability analysis complete
  – Some issues identified
• Load deliverability testing in-progress
  – Many areas complete without any problems (noted throughout the following slides)
  – Testing continues in other areas

• Validating potential issues and testing reinforcements
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All CETO calculations are based on the 2011 RTEP assumptions
• No potential Load Deliverability violations identified

• No potential generation deliverability violations identified

• A number of potential common mode outage violations identified
• Common Mode Outage Procedure
• Overload on S121 Tap – Central North 69 kV circuit for several contingencies
• Proposed Solution: Replace terminal equipments
• Estimated Project Cost: $TBD
• Expected IS Date: 6/1/2016
• Common Mode Outage Procedure
• Overload on Central North – Shieldalloy 69 kV circuit for tower-line contingency loss of the BL England – Lewis 138 kV circuits
• Proposed Solution: Replace terminal equipments at Central North 69 kV substation
• Estimated Project Cost: $ TBD
• Expected IS Date: 6/1/2016
• Common Mode Outage Procedure
• Overload on Sherman Ave. – Carl"s Corner 69 kV circuit for several contingencies
• Proposed Solution: Reconductor the Sherman Ave. – Carl"s Corner 69 kV circuit.
• Estimated Project Cost: $ TBD
• Expected IS Date: 6/1/2016
• No Load Deliverability violations identified

• Potential generation deliverability violations identified

• Potential baseline violations identified
### Potential Violations:

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## Potential Violations:

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• No Load Deliverability violations identified

• Potential generation deliverability violations identified

• Potential baseline violations identified
## Potential Violations:

<table>
<thead>
<tr>
<th>Name</th>
<th>Name</th>
<th>CKT</th>
<th>KVs</th>
<th>Cont Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLACK OAK</td>
<td>BLACK OAK</td>
<td>2</td>
<td>138/500</td>
<td>single</td>
</tr>
<tr>
<td>WILLIAMSTOWN</td>
<td>05SW289T</td>
<td>1</td>
<td>23/23</td>
<td>breaker</td>
</tr>
<tr>
<td>WEST RUN</td>
<td>LAKE LYNN</td>
<td>1</td>
<td>138/138</td>
<td>Single, breaker</td>
</tr>
<tr>
<td>COLLINS F</td>
<td>WEST RUN</td>
<td>1</td>
<td>138/138</td>
<td>Single, breaker</td>
</tr>
<tr>
<td>OLD CHAPEL</td>
<td>MILLVILLE</td>
<td>1</td>
<td>138/138</td>
<td>single</td>
</tr>
<tr>
<td>OSAGE</td>
<td>COLLINS F</td>
<td>1</td>
<td>138/138</td>
<td>Single, breaker</td>
</tr>
<tr>
<td>05BELMON</td>
<td>BELMONT</td>
<td>1</td>
<td>765/500</td>
<td>breaker</td>
</tr>
</tbody>
</table>
Potential Violations:

<table>
<thead>
<tr>
<th>Fr Name</th>
<th>To Name</th>
<th>CKT</th>
<th>KVs</th>
<th>Cont Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAKE LYNN</td>
<td>WEST RUN</td>
<td>1</td>
<td>138/138</td>
<td>Single, Line_FB</td>
</tr>
<tr>
<td>WEST RUN</td>
<td>COLLINS F</td>
<td>1</td>
<td>138/138</td>
<td>Single, Line_FB</td>
</tr>
<tr>
<td>OSAGE</td>
<td>COLLINS F</td>
<td>1</td>
<td>138/138</td>
<td>Single, Line_FB</td>
</tr>
<tr>
<td>MILLVILLE</td>
<td>OLD CHAPEL</td>
<td>1</td>
<td>138/138</td>
<td>Single, Tower, Bus, Line_FB</td>
</tr>
<tr>
<td>BLACK OAK</td>
<td>BLACK OAK</td>
<td>2</td>
<td>138/500</td>
<td>Single</td>
</tr>
</tbody>
</table>
Potential Violations:

Voltage Magnitude

None

Voltage Drop

<table>
<thead>
<tr>
<th>Name</th>
<th>KV</th>
<th>Area</th>
<th>ContVolt</th>
<th>BaseVolt</th>
<th>Vdrop(%)</th>
<th>Violation</th>
<th>Cont Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOUBS</td>
<td>500</td>
<td>201</td>
<td>0.9704</td>
<td>1.0211</td>
<td>5.07</td>
<td>D</td>
<td>Line_FB</td>
</tr>
<tr>
<td>RIDGWAY</td>
<td>138</td>
<td>201</td>
<td>0.8147</td>
<td>0.9869</td>
<td>17.22</td>
<td>LD</td>
<td>Line_FB</td>
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<tr>
<td>ELKO</td>
<td>138</td>
<td>201</td>
<td>0.8356</td>
<td>0.9922</td>
<td>15.66</td>
<td>LD</td>
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<tr>
<td>POTTER</td>
<td>115</td>
<td>201</td>
<td>0.8372</td>
<td>0.9969</td>
<td>15.97</td>
<td>LD</td>
<td>Line_FB</td>
</tr>
</tbody>
</table>
ATSI Zone

• Load Deliverability testing is in-progress

• Potential generation deliverability violations identified

• Potential baseline violations identified
Potential Violations:

<table>
<thead>
<tr>
<th>From Bus Name</th>
<th>To Bus Name</th>
<th>CKT</th>
<th>KVs</th>
<th>Cont Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>02GM MAN</td>
<td>02ONTARIO</td>
<td>1</td>
<td>138/138</td>
<td>Single, Tower, breaker</td>
</tr>
<tr>
<td>02GALION</td>
<td>02GM MAN</td>
<td>1</td>
<td>138/138</td>
<td>Tower, breaker</td>
</tr>
<tr>
<td>02ONTARIO</td>
<td>02CAIRNS</td>
<td>1</td>
<td>138/138</td>
<td>Tower, breaker</td>
</tr>
<tr>
<td>02BRKSID</td>
<td>02WELNGT</td>
<td>1</td>
<td>138/138</td>
<td>Bus, breaker</td>
</tr>
<tr>
<td>02CAIRNS</td>
<td>02ARM+BU</td>
<td>1</td>
<td>138/138</td>
<td>breaker</td>
</tr>
<tr>
<td>02ARM+BU</td>
<td>02LNGVEW</td>
<td>1</td>
<td>138/138</td>
<td>breaker</td>
</tr>
<tr>
<td>02STAR</td>
<td>02BRBRTN</td>
<td>2</td>
<td>138/138</td>
<td>tower</td>
</tr>
</tbody>
</table>
Potential Violations:

<table>
<thead>
<tr>
<th>Fr Name</th>
<th>To Name</th>
<th>CKT</th>
<th>KVs</th>
<th>Cont Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>02GM MAN</td>
<td>02ONTARO</td>
<td>1</td>
<td>138/138</td>
<td>Single, Tower, Bus, Line_FB</td>
</tr>
<tr>
<td>02GALION</td>
<td>02GM MAN</td>
<td>1</td>
<td>138/138</td>
<td>Tower, Line_FB</td>
</tr>
<tr>
<td>02CAIRNS</td>
<td>02ONTARO</td>
<td>1</td>
<td>138/138</td>
<td>Tower, Line_FB</td>
</tr>
<tr>
<td>02CAIRNS</td>
<td>02ARM+BU</td>
<td>1</td>
<td>138/138</td>
<td>Line_FB</td>
</tr>
<tr>
<td>02LNGVEW</td>
<td>02ARM+BU</td>
<td>1</td>
<td>138/138</td>
<td>Line_FB</td>
</tr>
</tbody>
</table>
Potential Violations:

Voltage Magnitude

<table>
<thead>
<tr>
<th>Name</th>
<th>KV</th>
<th>Cont Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>02WASHREC</td>
<td>138</td>
<td>Line_FB</td>
</tr>
<tr>
<td>02WELNGT</td>
<td>138</td>
<td>Bus, Line_FB</td>
</tr>
<tr>
<td>02KNOX</td>
<td>138</td>
<td>Line_FB</td>
</tr>
</tbody>
</table>

Voltage Drop

<table>
<thead>
<tr>
<th>Name</th>
<th>KV</th>
<th>Cont Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>02WASHREC</td>
<td>138</td>
<td>Line_FB</td>
</tr>
<tr>
<td>02KNOX</td>
<td>138</td>
<td>Line_FB</td>
</tr>
</tbody>
</table>
• No potential Load Deliverability violations identified

• Potential generation deliverability violations identified
BGE Transmission Zone

- Baseline analysis / Generation Deliverability:
- Overload on Center – Erdman 115 kV circuits for several contingencies
- Proposed Solution: BGE is working on a solution
- Estimated Project Cost: $ TBD
- Expected IS Date: 6/1/2016
• Load Deliverability testing is in-progress

• Potential generation deliverability violations identified

• Potential baseline violations identified
• N-1-1 Thermal Violation
• The existing Garfield-Taylor lines are overloaded at normal system conditions for the loss of 345 kV line 1311 or 1312 from Goodings Grove to Crawford
• Advance B1301 IS Date from 6/1/2015 to 6/1/2014
## Potential Violations:

<table>
<thead>
<tr>
<th>From Bus Name</th>
<th>To Bus Name</th>
<th>CKT</th>
<th>KV</th>
<th>Cont Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRESD; B</td>
<td>DRESD;1M</td>
<td>1</td>
<td>345/138</td>
<td>tower</td>
</tr>
<tr>
<td>DRESD; R</td>
<td>DRESD;3M</td>
<td>1</td>
<td>345/138</td>
<td>breaker</td>
</tr>
<tr>
<td>Lisle; R</td>
<td>Lisle; R</td>
<td>1</td>
<td>345/345</td>
<td>single</td>
</tr>
<tr>
<td>Plano; B</td>
<td>Plano 81</td>
<td>1</td>
<td>345/1</td>
<td>Bus, breaker</td>
</tr>
<tr>
<td>CROS; R</td>
<td>CROS;9R</td>
<td>2</td>
<td>138/138</td>
<td>breaker</td>
</tr>
<tr>
<td>Dev;6R</td>
<td>Dev;9B</td>
<td>1</td>
<td>138/138</td>
<td>single</td>
</tr>
<tr>
<td>Dev;3R</td>
<td>Dev;3R</td>
<td>1</td>
<td>138/138</td>
<td>single</td>
</tr>
<tr>
<td>Dev;0B</td>
<td>Dev;0B</td>
<td>1</td>
<td>138/138</td>
<td>single</td>
</tr>
<tr>
<td>ELMHU;3I</td>
<td>F PAR; B</td>
<td>1</td>
<td>138/138</td>
<td>tower</td>
</tr>
<tr>
<td>ELMHU;0I</td>
<td>F PAR; R</td>
<td>1</td>
<td>138/138</td>
<td>breaker</td>
</tr>
<tr>
<td>KANKE;RT</td>
<td>BRAD; B</td>
<td>1</td>
<td>138/138</td>
<td>Bus, breaker</td>
</tr>
<tr>
<td>KEWAN;3</td>
<td>KEWAN;2</td>
<td>1</td>
<td>138/138</td>
<td>Bus, breaker</td>
</tr>
<tr>
<td>Lisle;1B</td>
<td>York;BT</td>
<td>1</td>
<td>138/138</td>
<td>Single, tower, bus, breaker</td>
</tr>
<tr>
<td>Lisle; RT</td>
<td>York;RT</td>
<td>1</td>
<td>138/138</td>
<td>Bus, breaker</td>
</tr>
<tr>
<td>Rock; B</td>
<td>HUMBO; B</td>
<td>1</td>
<td>138/138</td>
<td>Tower, breaker</td>
</tr>
<tr>
<td>Rock; R</td>
<td>HUMBO; R</td>
<td>2</td>
<td>138/138</td>
<td>tower</td>
</tr>
<tr>
<td>Rock; R</td>
<td>HUMBO; R</td>
<td>1</td>
<td>138/138</td>
<td>tower</td>
</tr>
<tr>
<td>SILE; R</td>
<td>CRYST; R</td>
<td>1</td>
<td>138/138</td>
<td>tower</td>
</tr>
<tr>
<td>Sline;3B</td>
<td>Sline;2S</td>
<td>1</td>
<td>138/138</td>
<td>single</td>
</tr>
<tr>
<td>Sline;2S</td>
<td>Washi; B</td>
<td>1</td>
<td>138/138</td>
<td>single</td>
</tr>
<tr>
<td>Wauke; B</td>
<td>Gurne; B</td>
<td>1</td>
<td>138/138</td>
<td>tower</td>
</tr>
<tr>
<td>Wloop; Y</td>
<td>CROS;9R</td>
<td>1</td>
<td>138/138</td>
<td>breaker</td>
</tr>
<tr>
<td>DRES;3M</td>
<td>DRES; B</td>
<td>1</td>
<td>138/138</td>
<td>breaker</td>
</tr>
<tr>
<td>Plano 81</td>
<td>Plano 1I</td>
<td>1</td>
<td>1/138</td>
<td>Bus, breaker</td>
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</tbody>
</table>
### Potential Violations:

<table>
<thead>
<tr>
<th>From Bus</th>
<th>To Bus</th>
<th>Ckt</th>
<th>To/From Voltage</th>
<th>Contgency Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLYBO;9R</td>
<td>WLOOP; Y</td>
<td>1</td>
<td>138/138</td>
<td>Single</td>
</tr>
<tr>
<td>ELMHU;3I</td>
<td>F PAR; B</td>
<td>1</td>
<td>138/138</td>
<td>Tower</td>
</tr>
<tr>
<td>GURNE;B</td>
<td>WAUKE; B</td>
<td>1</td>
<td>138/138</td>
<td>Tower</td>
</tr>
<tr>
<td>LISLE;1B</td>
<td>YORK; BT</td>
<td>1</td>
<td>138/138</td>
<td>Single, Tower, Bus, Line_FB</td>
</tr>
<tr>
<td>SLINE;3B</td>
<td>SLINE;2S</td>
<td>1</td>
<td>138/138</td>
<td>Single</td>
</tr>
<tr>
<td>SLINE;2S</td>
<td>WASHI; B</td>
<td>1</td>
<td>138/138</td>
<td>Single</td>
</tr>
<tr>
<td>DEVON;0B</td>
<td>NORTH; B</td>
<td>1</td>
<td>138/138</td>
<td>Single</td>
</tr>
<tr>
<td>ELMHU;0I</td>
<td>F PAR; R</td>
<td>1</td>
<td>138/138</td>
<td>Line_FB</td>
</tr>
<tr>
<td>DEVON;9B</td>
<td>ROSEH;BT</td>
<td>1</td>
<td>138/138</td>
<td>Single</td>
</tr>
<tr>
<td>DEVON;3R</td>
<td>ROSEH;RT</td>
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<td>138/138</td>
<td>Single</td>
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<td>DEVON;6R</td>
<td>NORTH; R</td>
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<td>138/138</td>
<td>Single</td>
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<tr>
<td>PLANO;B</td>
<td>PLANO 81</td>
<td>1</td>
<td>345/138</td>
<td>Bus, Line_FB</td>
</tr>
<tr>
<td>PLANO;1I</td>
<td>PLANO 81</td>
<td>1</td>
<td>138/138</td>
<td>Bus, Line_FB</td>
</tr>
</tbody>
</table>
– Three category C contingencies do not converge in voltage test.
• Generator Deliverability
  – Complete

• Basecase Analysis
  – The initial results were sent to Dayton on 4/11/2011
  – Dayton proposed new projects for the 2015 N-1-1 voltage issues. New projects will have an impact on the Basecase Analysis results
  – PJM is reviewing the current proposal
• N-1-1 Voltage Violation
• Replace the project B1063, B1064, and B1066, which are not feasible due to the space limitation; Low voltage at Springcreek and Hal Terman 138kV buses for the loss of the Sidney – Shelby 138kV line and the loss of the Miami – Eldean 138kV line
• Construct a new 138kV line from West Milton to Eldean (B1572)
• Estimated Cost: $16 M
• Required IS Date: 6/1/2014
• **N-1-1 Voltage Violation**
• **Cancel project B1068**
• **The voltage violation that drove the need for B1068 is no longer an issue due to updated transmission topology**
• Generator Deliverability
  – Complete – no potential violations

• Basecase Analysis
  – Complete – no potential violations
• Generator Deliverability Test
  – Complete – no potential violations

• Basecase Analysis
  – Complete – no potential violations
• No potential Load Deliverability violations identified

• Potential generation deliverability violations identified

• Potential common mode outage violations identified
• Baseline analysis / Generation Deliverability:

• Overload on Reybold – Motiva 138 kV circuit for pre-contingency and for the loss of Reybold 138/69 transformer single contingency.

• Proposed Solution: DPL is working on a solution

• Estimated Project Cost: $ TBD

• Expected IS Date: 6/1/2016
DPL Transmission Zone

- Baseline analysis / Generation Deliverability:
- Proposed Solution: DPL is working on a solution
- Estimated Project Cost: $ TBD
- Expected IS Date: 6/1/2016
- Common Mode Outage Procedure
- Proposed Solution: DPL is working on a solution
- Estimated Project Cost: $ TBD
- Expected IS Date: 6/1/2016
• No Load Deliverability violations identified

• Potential generation deliverability violations identified

• Potential baseline violations identified
Dominion Transmission Zone

- Generation Deliverability
- Overload on Loudoun – Brambleton 500 kV circuit for the outage of Mt. Storm – Doubs 500 kV
- Potential Solution:
  - Rebuild Loudoun – Brambleton 500 kV
- Potential IS Date: May 2016
Dominion Transmission Zone

- Gen Deliv and Cat C Violations
- Overload on Possum Pt – Woodbridge-Occoquan – Ox 230 kV or the Possum Pt – Lake Ridge 230 kV circuit for the outage of various other 230 kV circuits out of Possum Pt. 230 kV.
- Potential Solution(s):
  - Option A Build a Ox – Idylwood 500 kV Line and install 500/230 kV Transformer
  - Option B Rebuild 230 kV existing Tower Lines out of Possum Pt
- Potential IS Date: May 2016
• Gen Deliv and Cat C Violations
• Overload on Idylwood 230 kV bus for the outage of line #2035 and various other 230 kV circuits in the area. Potential Solution(s):
  • Install a Breaker and a Half Scheme at Idylwood 230 kV
• Potential IS Date: May 2016
Dominion Transmission Zone

- Gen Deliv and Cat C Violations
- Overload on Clark – Idylwood 230 kV circuit for the outage of Loudoun – Brambleton 500 kV and various other 500 kV and 230 kV circuits.
- Potential Solution:
  - Option A Build a 2nd Clark – Idylwood 230 kV Line
  - Option B Build a Idylwood – Spring Hill 230 kV Line
- Potential IS Date: May 2016
• Gen Deliv Violations
• Overload on Pleasant View 500/230 kV transformer for the outage of Brambleton 500/230 kV transformer.
• Potential Solution:
  • Install 2\textsuperscript{nd} Brambleton 500/230 kV transformer
• Potential IS Date: May 2016
Dominion Transmission Zone

- Gen Deliv Violations
- Overload on Pleasant View - Dickerson 230 kV for the outage of Possum Pt – Burches Hill 500 kV
- Potential Solution:
  - Reconfigure Line #203 to feed Edwards Ferry sub radial from Pleasant View 230 kV and install new breaker bay at Pleasant View Sub.
- Potential IS Date: May 2016
Dominion Transmission Zone

• Gen Deliv Violations
• Overload on Gainsville 230/115 kV #3 transformer for the outage of Gainsville – Loudoun 115 kV line #124 or the Gainsville – Loudoun 230 kV line # 2030
• Potential Solution:
  • Option A Install an additional 230/115 kV transformer at Gainsville Substation
  • Option B Install a 230/115 kV transformer at a new substation in the area
• Potential IS Date: May 2016
Dominion Transmission Zone

- Gen Deliv Violations
- Overload on Fredericksburg – Cranes Corner 230 kV for the outage of Ladysmith – Possum Point 500 kV.
- Potential Solution:
  - Reconductor Fredericksburg – Cranes Corner 230 kV
- Potential IS Date: May 2016
• No potential Load Deliverability violations identified

• No potential generation deliverability violations identified

• Potential common mode outage violations identified
PECO Transmission Zone

- Common Mode Outage Procedure:
- Overload on the Richmond – Waneeta 230 kV circuit for the a bus and line fault stuck breaker contingencies loss of Chichester buses.

- Proposed Solution:
PECO is working on the solution

- Estimated Project Cost: $ TBD

- Expected IS Date: 6/1/2011
PEPCO Transmission Zone

- No potential Load Deliverability violations identified

- No potential generation deliverability violations identified

- Potential common mode outage violations identified
• Common Mode Outage Procedure
• Overload on Oak Grove - Bowie 230 kV „23045“ circuit for the tower-line outage of the Chalk Point – Bowie „23054“ and Oak Grove – Burtonsville „23042“ 230 kV circuits.
• Proposed Solution: Reconduct the Oak Grove – Bowie 230 kV „23045“ circuit and upgrade terminal equipments at Oak Grove and Bowie 230 kV substations
• Estimated Project Cost: $ TBD
• Expected IS Date: 6/1/2016
• Common Mode Outage Procedure
• Overload on Oak Grove - Bowie 230 kV „23042“ circuit for the tower-line outage of the Chalk Point – Bowie „23065“ and Oak Grove – Burtonsville „23045“ 230 kV circuits.

• Proposed Solution:
Reconductor the Oak Grove – Bowie 230 kV „23042“ circuit and upgrade terminal equipments at Oak Grove and Bowie 230 kV substations
• Estimated Project Cost:
$ TBD
• Expected IS Date:
6/1/2016
• Common Mode Outage Procedure
• Overload on Bowie – Burtonsville 230 kV "23045" circuit for the tower-line outage of the Chalk Point – Bowie "23054" and Oak Grove – Burtonsville "23042" 230 kV circuits.
• Proposed Solution: Reconductor the Bowie - Burtonsville 230 kV "23045" circuit and upgrade terminal equipments at Bowie and Burtonsville 230 kV substations
• Estimated Project Cost: $ TBD
• Expected IS Date: 6/1/2016
• Common Mode Outage Procedure
• Overload on Bowie – Burtonsville 230 kV “23042” circuit for the tower-line outage of the Chalk Point – Bowie “23065” and Oak Grove – Burtonsville “23045” 230 kV circuits.
• Proposed Solution: Reconductor the Bowie – Burtonsville 230 kV “23042” circuit and upgrade terminal equipments at Oak Grove and Burtonsville 230 kV substations
• Estimated Project Cost: $ TBD
• Expected IS Date: 6/1/2016
PEPCO Transmission Zone

- Common Mode Outage Procedure
- Overload on Dickerson station “H” – Quince Orchard 230 kV “23032” circuit for the tower-line outage of the Dickerson station “D” – Quince Orchard 230 kV circuits “23033” & “23035”.
- Proposed Solution: Reconductor the Dickerson station “H” – Quince Orchard 230 kV “23032” circuit and upgrade terminal equipments at Dickerson station “H” and Quince Orchard 230 kV substations.
- Estimated Project Cost: $ TBD
- Expected IS Date: 6/1/2016
• **Common Mode Outage Procedure**

• **Overload on Oak Grove - Aquasco 230 kV „23062“ circuit** for the tower-line outage of the Chalk Point – Bowie „23063“ „23065“ 230 kV circuits.

• **Proposed Solution:**
  Reconductor the Oak Grove - Aquasco 230 kV „23062“ circuit and upgrade terminal equipments at Oak Grove and Aquasco 230 kV substations

• **Estimated Project Cost:**
  $ TBD

• **Expected IS Date:**
  6/1/2016
• No potential Load Deliverability violations identified

• No potential generation deliverability violations identified

• Potential baseline and common mode outage violations identified
• Basecase Category C:
  Voltage drop violation on several 138 kV PPL substations for a line fault on Alburtis – Breinigsville 500 kV circuit and stuck breaker at Breinigsville 500 kV substation.

• Proposed Solution:
  Add two 500 kV breakers at Breinigsville 500 kV substation

• Estimated Project Cost:
  $ TBD

• Expected IS Date:
  6/1/2016
Baseline analysis:
Voltage drop violation on Elimsport, Clinton and Lycoming 230 kV substations for towerline outage of the Montour – Elimsport and Montour – Clinton 230 kV circuits

Proposed Solution:
Re-configure the Elimsport 230 kV substation to breaker and half scheme and install 80 MVAR capacitor.

Estimated Project Cost:
$ TBD

Expected IS Date:
6/1/2016
• No potential Load Deliverability violations identified

• Potential generation deliverability violations identified

• Potential baseline and common mode outage violations identified
• Generation Deliverability:
  • Overload on the Eagle Point – Gloucester 230 kV circuit #1 and #2. Loss of one circuit overloads the other circuit.

• Proposed Solution:
PSEG is working on the solution

• Estimated Project Cost:
  $ TBD

• Expected IS Date:
  6/1/2011
Common Mode Outage Procedure


Proposed Solution:
PSEG is working on the solution

Estimated Project Cost:
$ TBD

Expected IS Date:
6/1/2011
• Common Mode Outage Procedure:
• Overload on the Camden – Richmond 230 kV circuit for the loss of several bus and line fault stuck breaker contingencies.
• Proposed Solution: PSEG/PECO are working on the solution
• Estimated Project Cost: $ TBD
• Expected IS Date: 6/1/2011
B0472 upgrade scope change:
- The B0472 upgrade is to increase the emergency rating of Saddle Brook – Athenia 230 kV by 25% by adding forced cooling, and the upgrade will be replaced by reconductor the Saddle Brook – Athenia 230 kV circuit.

Estimated Project Cost (Old):
- $25 M

Estimated Project Cost (New):
- $16 M

Expected IS Date:
- 6/1/2012
• No potential Load Deliverability violations identified

• No potential generation deliverability violations identified

• No potential baseline and common mode outage violations identified
Duke Integration Studies
DEOK Baseline Overview

• DEOK - Duke Energy Ohio Kentucky

• Integration anticipated 1/1/2012

• The following DEOK upgrades have been identified to bring the DEOK system in compliance with applicable PJM and other criteria for the 2014 study year

• PJM will continue to review potential and proposed upgrades in the DEOK transmission zone with the TEAC

• PJM Board approval will not be sought until after Duke integration into PJM
DEOK Transmission Zone

- Common Mode Outage Procedure
- Todhunter 345/138KV transformers 15 & 17 are overloaded (102.12% and 100.95% respectively) for breaker failure operation of the Todhunter 345kV Breaker 1385 or Breaker 1387
- The Todhunter 345kV ring bus will be reconfigured (B1573)
- Estimated Project Cost: $1.4M
- Projected IS date: 6/1/2014
• Common Mode Outage Procedure
• The Port Union - Dimmick 138kV circuit (#5483) and Dimmick – Cornell Tap 138kV circuit are overloaded (125.72% and 112.09%) for several multiple facility contingencies at the Foster 138kV bus
• The circuits will be re-conductored for 6 miles with the 954 ACSR conductor (B1574)
• Estimated Project Cost: $3.5M
• Projected IS date: 6/1/2014
• Common Mode Outage Procedure
• the Red Bank - Oakley 138kV circuit (#885) is overloaded (104.13%) for the tower contingency of losing both circuits #1885 and #886
• The metering equipments will be replaced (B1575)
• Estimated Project Cost: $0.2M
• Projected IS date: 6/1/2012
• Common Mode Outage Procedure
• The Todhunter - Trenton 138kV circuit (#3284) is overloaded (105.27%) for the several multiple facility contingencies.
• The circuit will be re-conducted for 5 miles with 954 ACSR conductor (B1576)
• Estimated Project Cost: $0.2M
• Projected IS date: 6/1/2013
DEOK Transmission Zone

- Common Mode Outage Procedure
- The Beckjord - Tobasco 138kV circuit (#1885) is overloaded (100.82%) for the tower contingency of losing both circuit #3881 and circuit #6984
- The metering equipments will be replaced (B1577)
- Estimated Project Cost: $0.2M
- Projected IS date: 6/1/2012
Short Circuit Upgrades
The Corridor 138 kV breakers „106C“, „104S“, and „104C“ are overstressed

Significant Driver: Build a new “Vassel” 765/345/138 kV Station to the North of Columbus, OH at the intersection of Kammer – Maliszewski 765 kV line and the Hyatt – Corridor 345 kV line

Proposed Solution: Replace the Corrid 138 kV breakers „106C“, „104S“, and 104C“ (s0251.6 – s0251.8)

Estimated Project Cost: $1.448 M per breaker

Expected IS Date: 5/1/2014
AEP Transmission Zone

- The Hyatt 138 kV breaker "104C" is overstressed
- Significant Driver: Build a new “Vassel” 765/345/138 kV Station to the North of Columbus, OH at the intersection of Kammer – Maliszewski 765 kV line and the Hyatt – Corridor 345 kV line
- Proposed Solution: Replace the Hyatt 138 kV breaker "104C" (s0251.9)
- Estimated Project Cost: $1.1 M
- Expected IS Date: 5/1/2014
- The Acca 115 kV breaker "6072" is overstressed
- Proposed Solution: Replace the Acca 115 kV breaker "6072" with 40 kA (b1571)
- Estimated Project Cost: $150 K
- Expected IS Date: 6/1/2015
PSEG Transmission Zone

- Fault levels are near 63 kA at the Burlington 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 Burlington 230 kV substation to 80 kA (b1156.20)
- Estimated Project Cost: $5 M
- Expected IS Date: 6/1/2014
ATSI Baseline Overview
• ATSI Integration Complete

• The following ATSI baseline upgrades have been previously reviewed at the TEAC

• PJM staff will request that the PJM Board approve the following upgrades for inclusion in the RTEP at the July PJM Board meetings
ATSI Transmission Zone

- Common Mode Outage Procedure
- The General Mills – Jackman 138 kV circuit is overloaded for the breaker failure operation of the Bayshore 138 kV BK-13254, BK-13256, BK-13252, BUS-K, or BK-KM breakers
- Recommended Solution: Replace Substation conductor on General Mills Powertrain 138 kV exit (replace 636 ACSR with 1590 AAC or ACSR) (B1194)
- Estimated Cost: $0.0185M
- Expected In-Service Date: 6/1/2013
• N-1-1 Voltage violation
• Low Voltage magnitude and Voltage drop at Airpark, Clark, East Spring, and London 138kV buses for various contingency combinations
• Proposed Solution: Install a 25 MVAR cap bank at Airpark 138kV substation (b1341)
• Estimated Project Cost: $1.5 M
• Expected IS Date: 6/1/2015
- N-1-1 Voltage violation
- Low voltage magnitude at Maysville, Sharon, Sharpsville, Winner 138kV buses for the loss of the Hoytdale – Shenango 345kV line and the Highland - Shenango 345kV line
- Proposed Solution: Install a 50 MVAR cap bank at Sharon 138kV substation (b1342)
- Estimated Project Cost: $1.32 M
- Expected IS Date: 6/1/2015
ATSI Transmission Zone

- Load Deliverability Voltage Violation
- Voltage collapse for various contingencies
- Proposed Solution: Build new Hayes 345/138kV substation (B1281)
  - 138kV lines to Greenfield #1
  - 138kV lines to Greenfield #2
  - 138kV line to Avery
- Estimated Project Cost: $33 M
- Expected IS Date: 6/1/2015
ATSI Transmission Zone

- Load Deliverability Voltage Violation
- Voltage collapse for various contingencies
- Proposed Solution: Build Beaver – Hayes – Davis-Besse #2 345kV line (B1282)
- Estimated Project Cost: $34.65 M
- Expected IS Date: 6/1/2015
ATSI Transmission Zone

- Load Deliverability Voltage Violation
- Voltage collapse for various contingencies
- Proposed Solution: Loop the Chamberlin - Mansfield 345kV line into the Hanna 345kV Substation (B1283)
- Estimated Project Cost: $9.075 M
- Expected IS Date: 6/1/2015
• Baseline Voltage Study Violation
• Low voltage at several 138kV substations for various contingencies
• Proposed Solution: Install 50.0 MVAR capacitor bank at the Lime City 138kv Substation (B1284)
• Estimated Project Cost: $2.35 M
• Expected IS Date: 6/1/2015
ATSI Transmission Zone

- N-1-1 Thermal Violation
- Barberton – Star 138kV line is overloaded for the loss of Star-Wadsworth 138kV line and the loss of the Start – Barberton #2 138kV line
- Replace Barberton-Star 138kV #1 wavetrap, CFZ relay, and line exit conductor at Barberton (B1285)
- Estimated Cost : $ 0.075 M
- Required IS Date : 6/1/2015
N-1-1 Thermal Violation

The Hanna - W.Ravenna 138kV #1 line is overloaded for the loss of the Hanna – W. Ravenna #2 138kV line and the loss of the Hanna – E. Akron 138kV line

Proposed Solution: Reconductor

Hanna - W.Ravenna 138kV #1 (4.7 miles) with 636 ACSS conductor (B1286)

Estimated Project Cost: $2.05 M

Expected IS Date: 6/1/2015
• N-1-1 Thermal Violation
• The Hanna - W. Ravenna 138kV #2 line is overloaded for the loss of and the loss of Hanna – W. Ravenna #1 138kV line and the loss of the Hanna – E. Akron 138kV line
• Proposed Solution: Reconductor Hanna - W.Ravenna 138kV #2 (4.7 miles) with 636 ACSS conductor (B1287)
• Estimated Project Cost: $2.05 M
• Expected IS Date: 6/1/2015
N-1-1 Thermal Violation
The Masury - Crossland 138kV line is over the normal rating following the loss of Masury – Shenango 138KV line even after system adjustments
Proposed Solution: Replace Masury - Crossland 138kV terminal equipment at Masury (B1288)
Estimated Project Cost: $0.01 M
Expected IS Date: 6/1/2015
• N-1-1 Thermal Violation
• The Evergreen - Niles 138kV line is overload for various N-1-1 contingencies
• Proposed Solution:
  – Replace terminal equipment at Evergreen on the Evergreen – Niles 138kV circuit
  – Reconductor Evergreen-Niles 138kV (3.0 miles) with 477 ACSS (B1289)
• Estimated Project Cost: $0.87 M
• Expected IS Date: 6/1/2015
• N-1-1 Thermal Violation
• The Niles – Salt Springs – Highland 138kV line is overloaded for various of combination of single contingencies
• Proposed Solution: Build new Niles-Salt Springs #2 138kV - 795 ACSR wire (B1290)
• Estimated Project Cost: $2.89 M
• Expected IS Date: 6/1/2015
• N-1-1 Thermal Violation
• The Eastlake - Q-12 138kV line is over the normal rating following the loss of Eastlake - Q-13 138kV line with system re派遣
• Proposed Solution: Replace substation equipment at Eastlake on the Q-12 138kV line exit (B1291)
• Estimated Project Cost: $0.0207 M
• Expected IS Date: 6/1/2015
• N-1-1 Thermal Violation
• The Eastlake - Q-13 138kV line is overloaded for the normal rating after the loss of Eastlake - Q-12 138kV line with system re-dispatch
• Proposed Solution: Replace substation equipment at Eastlake on the Q-13 138kV line exit (B1292)
• Estimated Project Cost: $0.0207 M
• Expected IS Date: 6/1/2015
ATSI Transmission Zone

• N-1-1 Thermal Violation
• The Tangy – Bellepoint 138kV line is overloaded for the loss of Greene 345/138kV transformer #2, the Greene – Clark 138KV line, and the loss of Urbana – Clark 138KV line
• Proposed Solution: Replace substation equipment at the Tangy sub on the E.Springfield – Tangy line (B1293)
• Estimated Project Cost: $0.014 M
• Expected IS Date: 6/1/2015
• N-1-1 Thermal Violation
• The Brookside – Longview #2 138kV line is overloaded for the loss of Madison-Brookside 138kV Line and the loss of Galion-GM Mansfield 138kV Line
• Proposed Solution: Modify the Brookside - Longview #2 138kV CT ratio and correct the design temperature (B1294)
• Estimated Project Cost: $0.025 M
• Expected IS Date: 6/1/2011
• N-1-1 Thermal Violation
• The Brookside – Madison - Longview 138kV line is overloaded for the loss of the Longview - Brookside 138kV Line and the loss of Galion - GM Mansfield 138kV Line

• Proposed Solution:
  – Modify the Brookside - Longview #1 138kV CT ratio + correct the design temperature (Longview-Madison ) (B1295.1)
  – Estimated Project Cost: $0.025 M
  – Modify the Brookside-Longview #1 138kV CT ratio + correct the design temperature (Brookside-Madsion) (B1295.2)
  – Estimated Project Cost: $0.025 M

• Expected IS Date: 6/1/2011
• N-1-1 Thermal Violation
• The BG tap – Lemoyne 138KV line is overload for various combination of single contingencies
• Proposed Solution:
  – Reconductor BG line exit conductor at Lemoyne Sub (B1296.1)
  – Estimated Project Cost: $0.01 M
  – Change the CT ratio at Lemoyne B13213 towards Brim Tap to increase line loadability (B1296.2)
  – Estimated Project Cost: $0.01 M
• Expected IS Date: 6/1/2015
• N-1-1 Thermal Violation
• The Fort Industries – BP Oil 138kV line and the General Mill – Jackman 138kV lines are overloaded for the loss of the Allen 345/138kV transformer and the loss of the Bayshore – Jeep 138kV line
• Proposed Solution: Install a new Fulton 345/138kV substation (B1297)
• Estimated Project Cost: $23 M
• Expected IS Date: 6/1/2015
N-1-1 Thermal Violation

The UT - Vulcan 138kV line is overloaded for the loss of the Allen Junction – Silica 138KV line and the Jackman – Vulcan 138kV line

Proposed Solution: Add SCADA control and motor operators to switches 13153 and 13154 near Silica (B1299)

Estimated Project Cost: $0.55 M

Expected IS Date: 6/1/2015
• Common Mode Outage Procedure
• Overload on the Masury – Shenango 138kV circuit for the tower outage of the Crossland – Shenango #1 138kV and Crossland – Shenango #2 138kV lines
• Proposed Solution: Replace the circuit terminal and sections of substation bus conductor at Shenango 138kV substation with either 795 ACSR conductor or equivalent Copper wire (B1229)
• Cost Estimate: $0.247 M
• Expected IS Date: 6/1/2013

*This upgrade was presented at a previous TEAC
Common Mode Outage Procedure

The Lemonyne – Maclean 138 kV circuit is overloaded for breaker failure operation of Bayshore 138 kV BK-JL Breaker

Recommended Solution: Reconductor Lemonyne – Maclean with 954 ACSS conductor (B1190)

Estimated Cost: $4.3M

Expected In-Service Date: 6/1/2013
• Common Mode Outage Procedure

• The Shenango – Crossland 138 kV circuit #2 is overloaded for breaker failure operation of Shenango138 kV BK-18 Breaker

• Recommended Solution: Replace the meter at Crossland with a higher rated meter (B1191)

• Estimated Cost: $0.015M

• Expected In-Service Date: 6/1/2013
• Common Mode Outage Procedure
• The Bayshore – Chevy 138 kV circuit is overloaded for breaker failure operation of the Bayshore 138 kV BK-3K, BK-13254, BK-13256, BUS-K, BK-13252 or BK-KM breakers
• Recommended Solution: Reconductor Bayshore – Chevy 138 kV with 636 ACSS conductor (B1192)
• Estimated Cost: $4.3M
• Expected In-Service Date: 6/1/2013
ATSI Transmission Zone

- Common Mode Outage Procedure
- The Hanna – East Akron 138 kV circuit is overloaded for breaker failure operation of West Ravenna 138 kV BK-15K and the tower outage of the Hanna – West Ravenna #1 and the Hanna – West Ravenna #2 138 kV lines
- Recommended Solution: Replace the 800 Amp wavetrap at East Akron with a 1200 Amp wavetrap (B1193)
- Estimated Cost: $0.052M
- Expected In-Service Date: 6/1/2013
ATSI Transmission Zone

- Generator Deliverability Violation
- The Lakeview – Greenfield 138kV line is overloaded for loss of the Beaver – Davis Besse 345KV line
- Reconduct the Lakeview – Greenfield 138kV line – Replace 4/0 Cu with 336.4 ACSR, maintain 6-wire arrangement (B1547)
- Estimated Cost: $2.8M
- Expected IS Date: 12/31/2012
ATSI Transmission Zone

- Generator Deliverability Violation
- The Ottawa – Lakeview 138kV line is overloaded for the loss of the Beaver – Davis Besse 345KV line
- Reconducto the Ottawa – Lakeview 138kV line – Replace 4/0 Cu with 336.4 ACSR, maintain 6-wire arrangement (B1548)
- Estimated Cost: $2.1M
- Expected IS Date: 12/31/2012
Next Steps
2011 RTEP Baseline Analysis Next Steps

• 2016 N-1-1 Thermal and Voltage Testing

• Develop solutions to the identified problems

• Retool Work
  – Stakeholders have requested retools of a number of previously approved projects including Emory Grove and a number of FirstEnergy projects
  – Retool work will begin following completion of the 2016 analysis
    • Probably starting in the third quarter
Email RTEP@pjm.com with any comments or questions
Review Issues Tracking