Issues Tracking
Closed Issues:

<table>
<thead>
<tr>
<th>Owner</th>
<th>Requestor</th>
<th>Issue ID</th>
<th>Issue Title</th>
<th>Issue Description</th>
<th>Issue Status</th>
<th>Stakeholder Body</th>
<th>Date Created</th>
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<tbody>
<tr>
<td>PJM</td>
<td>Patty Esposito / NRG</td>
<td>Raised at May 12 TEAC</td>
<td>MAAC and EMAAC Reactive Analysis Details</td>
<td>Request for more detail for MAAC and EMAAC reactive issues. Suggestion to order the list of issues by severity.</td>
<td>Open</td>
<td>TEAC</td>
<td>5/12/2010</td>
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</table>

Open Issues:

New Issues:
MAAC Analysis Update
• 2015 RTEP case had an incorrect impedance for the Meadow Brook – Loudoun section of TrAIL. The incorrect impedance was similar to the original as-planned impedance of TrAIL

• Retool in progress
Comparison of 15 year thermal analysis

Complete retool in progress
  - Thermal
  - Voltage
  - PV

Evaluation of base system & alternatives

<table>
<thead>
<tr>
<th>From Bus</th>
<th>To Bus</th>
<th>100% Year Incorrect TrAIL Impedance</th>
<th>100% Year Corrected TrAIL Impedance</th>
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</thead>
<tbody>
<tr>
<td>Lexington</td>
<td>Dooms</td>
<td>2017</td>
<td>2017</td>
</tr>
<tr>
<td>Mt. Storm</td>
<td>T157 Tap</td>
<td>2017</td>
<td>2015</td>
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<tr>
<td>T157 Tap</td>
<td>Doubs</td>
<td>2017</td>
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<tr>
<td>Pruntytown</td>
<td>Mt. Storm</td>
<td>2019</td>
<td>2020</td>
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<tr>
<td>Jacks Mountain</td>
<td>Juniata #1</td>
<td>2019</td>
<td>2018</td>
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<tr>
<td>Jacks Mountain</td>
<td>Juniata #2</td>
<td>2020</td>
<td>2020</td>
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<tr>
<td>Greenland Gap</td>
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<td>2021</td>
<td>2025</td>
</tr>
<tr>
<td>Mt. Storm</td>
<td>Greenland Gap</td>
<td>2022</td>
<td>&gt;2025</td>
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<td>Bath County</td>
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<tr>
<td>Keystone</td>
<td>Jacks Mountain</td>
<td>2023</td>
<td>2022</td>
</tr>
<tr>
<td>Harrison</td>
<td>Pruntytown</td>
<td>2024</td>
<td>&gt;2025</td>
</tr>
<tr>
<td>Keystone</td>
<td>Conemaugh</td>
<td>&gt;2025</td>
<td>2025</td>
</tr>
</tbody>
</table>
Revised Liberty / LS Power
- 502J – Hunterstown 500 kV (includes 50% series compensation)
- Hunterstown – TMI 500 kV
- Hunterstown – Kemptown 500 kV
- Lexington – Dooms 500 kV

PATH
- Amos – Welton Spring – Kemptown
- Includes baseline reactive upgrades of 1000 MVAR shunt and 500 MVAR SVC at Welton Spring and a 250 MVAR shunt at Kemptown 500kV
Dominion Alternative #1
- Rebuild Mt. Storm – Doubs
- 50% series compensation on Meadow Brook end of Trail
- Rebuild Mt. Storm – Pruntytown

Dominion Alternative #2
- Rebuild Mt. Storm – Doubs
- 50% series compensation on Meadow Brook end of Trail
- Build a portion of PATH stopping at Mt. Storm (requires a new 765/500 kV transformer)

Dominion Alternative #3
- Rebuild Mt. Storm – Doubs
- 50% series compensation on Meadow Brook end of Trail
- Build a portion of PATH stopping at Welton Spring (requires new 765/500 kV transformer)

Dominion Alternative #4
- Rebuild Mt. Storm – Doubs
- Build PATH proposal

* All Dominion alternatives include 900 MVAR SVC’s at Loudoun 230 kV and T157 Tap 500 kV and 900 MVAR of static capacitors at other locations
Harrison – Dickerson Alternative
- Harrison – Dickerson New 500kV AC Line
- New Dickerson 500/230 kV Station
- Series Comp on Meadow Brook – Loudoun
- Lexington – Dooms 500 kV
## 15 Year MAAC Thermal Alternative Analysis

### Analysis In-Progress

<table>
<thead>
<tr>
<th>From Bus</th>
<th>To Bus</th>
<th>2015 Baseline Case – no alternatives</th>
<th>PATH</th>
<th>Revised Liberty</th>
<th>Dominion Alternative #1</th>
<th>Dominion Alternative #2</th>
<th>Dominion Alternative #3</th>
<th>Dominion Alternative #4</th>
<th>Harrison – Dickerson</th>
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<tbody>
<tr>
<td>Lexington</td>
<td>Dooms</td>
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</tbody>
</table>

- All results include updated TrAIL impedance
<table>
<thead>
<tr>
<th>Mileage Description</th>
<th>Existing ROW</th>
<th>New ROW</th>
<th>Total</th>
<th>Number of States</th>
<th>Cost ($B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATH</td>
<td>121.2 (adjacent to existing ROW)</td>
<td>156.1</td>
<td>277.3*</td>
<td>MD, VA, WV</td>
<td>$2.10</td>
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<tr>
<td>Revised Liberty</td>
<td>Estimated 270 - 300 (40 - 50% estimated to be parallel to existing transmission ROW)</td>
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<td>PA, MD, VA</td>
<td>$1.34</td>
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<tr>
<td>Dominion Alt #1</td>
<td>99 - Rebuild of existing transmission</td>
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<td>99</td>
<td>MD, VA, WV</td>
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<td>Dominion Alt #2</td>
<td>99 - Rebuild of existing transmission</td>
<td>0</td>
<td>99</td>
<td>MD, VA, WV</td>
<td>$1.32 (includes $0.9 for portion of PATH)</td>
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<tr>
<td>Dominion Alt #3</td>
<td>99 - Rebuild of existing transmission</td>
<td>0</td>
<td>99</td>
<td>MD, VA, WV</td>
<td>$1.32 (includes $0.9 for portion of PATH)</td>
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<tr>
<td>Dominion Alt #4</td>
<td>99 - Rebuild of existing transmission</td>
<td>0</td>
<td>99</td>
<td>MD, VA, WV</td>
<td>$2.52 (includes $2.1 for entire PATH)</td>
</tr>
</tbody>
</table>

* Data based on filed Line Route Evaluations (LRE)
• Updated alternative analysis
  – Thermal & Reactive

• More detailed side by side comparison

• Potential for additional siting analysis by consultant
EMAAC Alternative Analysis Update
• Minimal impact to EMAAC result from TrAIL impedance correction
Northern Route (Kemptown) Alternative
- A new 500 kV line from Kemptown to Peach Bottom to Keeney South to Salem with 500/230 kV substation at Emory Grove (near Northwest)

MAPP Alternative
- MAPP (A new 500 kV line from Possum Point to Chalk Pt to Calvert Cliffs; HVDC circuits from Calvert Cliffs to Vienna to Indian River)
• Conceptual study of Northern Alternative performed by an independent consultant

  – Identification of possible route
  – Overall estimated project cost
  – Potential risks to completion
  – Estimated project duration
  – Assessment of the feasibility of successful completion of the project
• Identification of possible route
  – Possible route follows mostly existing right-of-way from Kemptown – Peach Bottom
  – New “Keeney South” substation
  – ROW congestion, especially in Keeney area
• Overall estimated project cost
  – $1.15 B - $1.46 B

• Estimated Project Duration
  – 111 month estimate, based on a very conservative approach
  – More aggressive estimate requested from the consultant
Potential Risks to Completion

- Water Crossings
  - C&D Canal
  - Delaware River

- Environmental Permits
  - Delaware, NJ, MD, PA
# EMAAC Alternative Side by Side Comparison

<table>
<thead>
<tr>
<th></th>
<th>Mileage</th>
<th>States</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Existing ROW</td>
<td>New ROW</td>
<td></td>
</tr>
<tr>
<td>MAPP</td>
<td>105</td>
<td>55*</td>
<td>MD, DE, VA (less than 1/2 mile)</td>
</tr>
<tr>
<td>Northern Route (Kemptown)</td>
<td>30.5</td>
<td>94.7</td>
<td>MD, PA, DE, NJ</td>
</tr>
</tbody>
</table>

* agreements in place for entire 55 miles, 39 miles is underwater
* All EMAAC alternatives assume additional reactive support
* All EMAAC alternatives assume additional reactive support
* All EMAAC alternatives assume additional reactive support
• Both alternatives solve the EMAAC voltage issues through 2019

• The Northern Option is less robust than MAPP without a strong source into Kemptown

• Finalize Northern Alternative conceptual study

• More detailed side by side comparison

• Remaining analysis
Baseline Reliability Update
BRH Alternatives
• Branchburg – Roseland – Hudson

• 2008 RTEP identified several overloads in northern PS starting in 2013

• Updated analysis completed as part of this year’s RTEP shows fewer violations

• PJM currently evaluating below 500 kV alternative solutions
• Generator Deliverability, Load Deliverability (PS and PSNorth), N-1-1
• Branchburg – Roseland – Hudson not modeled in 2015 case
• Reliability Violations (Thermal)
  – Roseland – Cedar Grove “F” circuit
  – Cedar Grove – Clifton “K”
  – Roseland – Cedar Grove “B” circuit
  – Cedar Grove – Clifton “B”
  – Clifton – Athenia “K”
  – Roseland – W. Caldwell
  – Athenia – Bergen 230 kV
• Potential Alternative
  – Convert the existing two 138 kV circuits between Roseland – Kearny – Hudson to 230 kV operation
  – Expand existing Bergen 230 kV substation and build new underground cable from Bergen to Athenia

• Analysis underway
Preliminary 2015 Solutions
• Potential N-1-1 Thermal Violation
• Keystone – Sorenson 345 kV is overloaded for the loss of Greentown - Jefferson 765 kV and the loss of Desoto - Sorenson 345 kV
• Potential Solution: A sag study will be required to potentially increase the emergency rating and determine if additional action is required in order to increase the rating
• Preliminary Estimated Project Cost: $0.1012 M
• Estimated IS Date: 6/1/2015
• Potential Generator Deliverability Violation
• N42 Tap - Sporn 345 kV is overload for the loss of Muskingum River – Waterford 345 kV
• Potential Solution: Replace the riser at the Sporn station to increase the thermal rating
• Preliminary Estimated Project Cost: $0.3 M
• Estimated IS Date: 6/1/2015
• Potential Common Mode Outage Violation
• West Bellaire – Tidd 345KV is overloaded for a Kammer – South Canton 765 kV line fault with a stuck breaker at Kammer
• Potential Solution: Tidd - West Bellaire 345 kV would need an electrical clearance study to determine if a higher emergency rating can be utilized
• Preliminary Estimated Project Cost : $0.078 M
• Estimated IS Date: 6/1/2015
• Potential Generator Deliverability Violation
• Waterford – Muskingum River 345kV is overloaded in the base case and for the loss of Kammer - Belmont – Mountaineer 765 kV
• Potential Solution: Reconductor Waterford – Muskingum 345 kV (5 miles) with ACSR and upgrade Muskingum risers
• Preliminary Estimated Project Cost: $14 M
• Estimated IS Date: 6/1/2015
• **PSE&G Violations:**
  The following 230 kV circuits in PSE&G area are overloaded for several contingencies.
  - Gloucester – Cuthbert
  - Cuthbert – Camden
  - Eagle Point – Gloucester
  - Thorofare – Deptford
  - Mickleton – Thorofare

• **Potential Solution:**
  Build two new underground 230 kV circuits from Gloucester to Camden and install shunt reactor at Gloucester.
2015 Analysis Update
• Common Mode Outage Procedure
• The Bagley – Raphael 230 kV circuit is overloaded for the loss of the Conastone – Northwest 230 kV double circuit tower contingency
• Recommended Solution: Rebuild the existing Bagley – Raphael Road 230 kV line to a double circuit 230 kV line (B2051) and reconfigure Raphael Road to terminate the new circuit (B2051.1)
• Estimated Project Cost: $30 M
• Expected IS Date: 6/1/2015
• Baseline Voltage Violation
  – The loss of the Conastone – Northwest 230 kV double circuit tower contingency causes a voltage collapse

• N-1-1 Thermal Violation
  – The Northwest – Conastone 230 kV circuit ‘2322’ has a violation of the normal rating for the loss of the Northwest – Conastone 230 kV circuit ‘2310’

• Generation Deliverability
  – The Conastone – Northwest 230 kV circuit is overloaded for the loss of the Brighton – Doubs and Brighton – Conastone 500 kV double tower contingency
• **Recommended Solution:** Construct 500/230 kV Emory Grove station with a 500 kV double breaker configuration by tapping the Conastone–Brighton 500 kV, Conastone – Northwest 230 kV and rebuild Emory Grove to the Northwest circuits to separate pole-lines with bundled conductor (B2054)

• **Estimated Project Cost:** $71 M

• **Expected IS Date:** 6/1/2015
• Baseline NERC Category C Thermal Violation
• The High Ridge – Howard 230 kV circuit is overloaded for the loss of the Conastone – Northwest 230 kV double circuit tower contingency
• Recommended Solution: Replace terminal equipment at Pumphrey tap 230 kV (B2052)
• Estimated Project Cost: $0.1 M
• Expected IS Date: 6/1/2015
• Common Mode Outage Violation
• Electric Junction 345/138 kV Transformer and related 345 kV and 138 kV terminal lines at Electric Junction overloaded for loss of Electric Junction 345 kV bus 3 or bus tie 3-4
• Recommended Solution: Move line 16703 termination from bus 4 to bus 3 at Electric Junction
• Estimated Project Cost: $3.0 M
• Expected IS Date: 6/1/2015
• Generator Deliverability violation
• Plano – Electric Junction 345 kV (line 16703) is overloaded for the loss of Plano – Electric Junction 345 kV (line 16704)
• Recommended Solution: Replace 345 kV bus ties 1-2 and 1-9 at Plano to increase rating on line 16703
• Estimated Project Cost: $2.0 M
• Expected IS Date: 6/1/2015
- PSEG Load Deliverability Violation
- Branchburg – Readington 230 kV circuit is overloaded for the loss of the Whippany – Roseland 230 kV circuit.
- Recommended Solution: Upgrade terminal equipment at Readington (substation conductor) (B0423.1).
- Estimated Project Cost: $0.10M
- Expected IS Date: 6/01/2011
- Generation Deliverability
- Burlington – Croydon 230 kV is overloaded for several contingencies
- Recommended Solution: Reconductor the PSEG portion of the Burlington – Croydon circuit with 1590 ACSS (B1197.1)
- Estimated Project Cost: $3.0 M
- Expected IS Date: 6/1/2015
2014 Baseline Retool Update
• Baseline Voltage Violation
• Voltage collapse for several stuck breaker contingencies at Elko and Carbon Center

• Recommended Solution:
  – Convert Carbon Center from 138 kV to a 230 kV ring bus (B2021.1)
    – Estimated Project Cost - $2.0M
  – Construct Bear Run 230 kV Substation with 230/138 kV transformer (B2021.2)
    – Estimated Project Cost - $6.0M
  – Loop Carbon Center Junction – Willamette line into Bear Run (B2021.3)
    – Estimated Project Cost - $3.2M
  – Carbon Center - Carbon Center Junction & Carbon Center Junction - Bear Run Conversion from 138 kV to 230 kV (B2021.4)
    – Estimated Project Cost - $4.3M

• Total Estimated Project Cost: $15.5M
• Expected IS Date: 6/1/2014
2013 Baseline Retool Update
• B0661: Install a Plano 345/138 kV Transformer

• 2013 retool analysis indicates that the in-service date can be deferred from 6/1/2013 to 6/1/2014
- **B0663**: Reconductor East Frankfort - Goodings Grove 345 kV "Red"

- 2013 retool analysis indicates that the in-service date can be deferred from 6/1/2013 to 6/1/2014
2012 Baseline Retool Update
2012/2013 RPM First Incremental Auction Planning Parameters
   - To be posted later this week

• Additional RTEP study work
Offshore Wind Study
• **Background**
  – Requested by the Organization of PJM States Inc. (OPSI)

• **Scope**
  – Evaluate the reliability and market efficiency of 10,000 MW of offshore wind
    • Reliability - Generator deliverability analysis
    • Market Efficiency - Promod production cost simulation

• **Timeline**
  – Initial results in early October 2010
• Develop study assumptions

• Develop and evaluate off-shore system configurations

• Evaluate and identify on-shore injection points (i.e. location and amount)

• Identify reinforcements that would be required to the existing system due to the injections

• Evaluate performance with respect to RPS requirements
Next Steps
Review Issues Tracking