Issues Tracking
• Open Issues
  – None

• New Issues
EIPC Update
• Upcoming postings to EIPC webpage
  – EIPC Work Plan Schedule - Sept 11
  – Principles and Guidelines Document – Sept 11
  – Proposed Scenarios – Sept 25
  – EIPC Webinar – tentatively scheduled Nov 12

EIPC will use EIPC distribution list and PJM will also send notification via TEAC list when information is available

Stakeholders are encouraged to provide input on any of the above documents and/or scenarios when information is available.
2013 RTEP Scenario Analysis Update
2013 RTEP – Renewable Portfolio Standards Scenarios
Renewable Portfolio Standards (RPS)

- Status
  - RPS Targets (MWh) Update
  - Study Assumptions and Goals
  - Scenario Descriptions
ANALYSIS - 2013 Wind Penetration Scenarios

• Refresh 2012 RPS analysis
  – 2028 modeling year with 2013 RTEP assumptions
  – Meet RPS State requirements
  – Scenario 1: 7 GW off shore wind
  – Scenario 2: On shore wind, only queued off shore
  – Scenario 3: Import non ISA/FSA wind from external sources (4 DC interconnections)

• Sensitivities
  – Scenario 1a: 2 GW north (1 GW each at two NJ points)
  – Scenario 1b: 3 GW north (add 3rd NJ interconnection)
  – Reduced coal cycling in Scenario 2

• Support state requests
  – NJ off shore scenario – phased development – nearer study year
STATUS - 2013 Wind Penetration Scenario

• Initial scenarios 1, 1a, 1b
  – Peak and off peak reliability analysis complete
  – Market Efficiency complete with and without off shore DC backbone – very high congestion due to non-reliability compliant system
  – Interconnection and reliability upgrades to be developed
  – Rerun market efficiency to determine dc benefits
• Scenarios 2 and 3 and sensitivities in progress
• Specific state analyses under discussion
<table>
<thead>
<tr>
<th><strong>2028 RPS Study Generation (MW)</strong></th>
<th>Solar</th>
<th>Wind</th>
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<td>Pending Deactivations</td>
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* Capacity factors based on historical data
** Assumes ~12,000 MW of DR
*** Assumes 38% for solar and 15% for wind
• **Assumptions**
  – Assume RPS supply from PJM resources
  – 7 GW Offshore
  – Study year: 2028

• **Analysis**
  – Reliability Analysis (50/50 load level)
    • Generator Deliverability
    • Common Mode Outage test (DCTLs)
    • Security Constrained Optimal Power Flow (Light Load – 50% of Peak Load) (SCOPF)
  – Market Efficiency Analysis
    • Production cost simulation using PROMOD

• **Market Efficiency Result**
  – Thermally overloaded facilities
  – Future Congestion $’s, load payments and generator revenues for year 2028
  – Generation curtailments
  – LMP prices on and off peak
  – Develop transmission overlay
<table>
<thead>
<tr>
<th>Renewable Resources</th>
<th>Wind</th>
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<td><strong>Solar</strong></td>
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<td><strong>Total</strong></td>
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<td><strong>Total</strong></td>
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<td><strong>Total</strong></td>
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<tr>
<th>Other Resources To Meet IRM</th>
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<tr>
<td>Natural Gas</td>
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<tr>
<td>Nuclear</td>
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<tr>
<td>Other (Coal, Diesel, Oil, etc.)</td>
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</table>

* Generator Interconnection projects that are not yet in service and are modelled in the 2013 RTEP 2018 base case

** Based on amount of wind & solar projected in each PJM state in GE PRIS Task 2 Scenario Development - Final Report
Reliability Analysis Overloads - Scenario 1

Legend
- Subs ≥ 500 kV
- Trans Lines = 500 kV
- Subs = 345 kV
- Trans Lines = 345 kV
- Generator Deliverability Constraints Scenario 1
- SCOPF Constraints Scenario 1

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<thead>
<tr>
<th>Voltage Level</th>
<th>Light Load</th>
<th>Peak</th>
<th>Grand Total</th>
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<tr>
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<td>68</td>
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RPS – Scenario Sensitivities 1A & 1B

• Scenario Sensitivity RPS1A:
  – Hudson 1000MW offshore injection
  – Cardiff 1000MW offshore injection
  – DC line between Hudson and Cardiff

• Scenario Sensitivity RPS1B:
  – Hudson 1000MW offshore injection
  – Cardiff 1000MW offshore injection
  – Cedar 1000MW offshore injection
  – DC line between Hudson and Cedar and Cardiff
Reliability Analysis Overloads - Scenario 1A

<table>
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<tr>
<td>500</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td><strong>9</strong></td>
<td><strong>56</strong></td>
<td><strong>65</strong></td>
</tr>
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</table>

Legend:
- Slips <= 590 kV
- Trans Lines <= 500 kV
- Slips = 345 kV
- Trans Lines = 345 kV
- SCOPF Constraints Scenario 1A
- Generator Delievability Constraints Scenario 1A
Reliability Analysis Overloads - Scenario 1B

Legend
- S3L = 500 kV
- Trans Lines <= 500 kV
- S345 kV
- Trans Lines = 345 kV
- SCOPF Constraints Scenario 1B
- Generator Deliverability Constraints Scenario 1B

<table>
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<tr>
<th>Voltage Level</th>
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<th>Peak</th>
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</tr>
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<tr>
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RPS Market Efficiency Overview
• Overall Assumptions
  – Model the latest Renewable Portfolio Standards (RPS) state targets
    • Assume production from renewable wind
    • Update target PJM installed renewable MW requirements
    • Update installed reserve calculation
    • Update ISA/FSA
  – 2013 PJM Load Forecast Report
    • 15 Year Load Forecast
    • Include Demand Response (DR) and Energy Efficiency (EE) to reflect the May 2013 RPM Auction.
• RPS 1A Phase I - New Jersey Offshore Wind:
  – Hudson 1000MW offshore injection
  – Cardiff 1000MW offshore injection
  – DC line between Hudson and Cardiff

• RPS 1B Phase I - New Jersey Offshore Wind:
  – Hudson 1000MW offshore injection
  – Cardiff 1000MW offshore injection
  – Cedar 1000MW offshore injection
  – DC line between Hudson and Cedar and Cardiff
Preliminary Findings
- Unrealistic high on-peak LMP and load payments due to interconnection related overloads around offshore wind injection points.
- Significant wind curtailment in Dominion off shore injections.
- Uncontrollable transmission constraints at injections.

Next Steps:
- Develop transmission overlays to address reliability and market efficiency issues.
• Assumptions
  – **Low GW Offshore**
  – Otherwise, same as RPS – Scenario #1 but with a low GW offshore assumption
  – The remainder of the state target RPS will be sourced from inland PJM resources
## Renewable Resources

### Solar

<table>
<thead>
<tr>
<th>Company</th>
<th>Existing</th>
<th>Queue*</th>
<th>Additional**</th>
<th>TOTAL</th>
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<tbody>
<tr>
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<td>2,090</td>
<td>3,276</td>
<td>5,615</td>
</tr>
<tr>
<td>AEP</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>APS</td>
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<td>1,041</td>
<td>574</td>
<td>589</td>
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<td>37,978</td>
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### Wind

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<tr>
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## Other Resources To Meet IRM

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<tr>
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* Generator Interconnection projects that are not yet in service and are modelled in the 2013 RTEP 2018 base case

** Based on amount of wind & solar projected in each PJM state in GE PRIS Task 2 Scenario Development - Final Report
RPS – Scenario #3

• Assumptions
  – **RPS Source from Neighboring Entities**
  – Otherwise, same as RPS – Scenario #2 (low MW offshore)
  – The remainder of the state target RPS will be sourced from inland PJM resources

• Neighboring Entities
  – Assume 40% of the PJM RPS supplied from renewable wind in the Midwest ISO (MISO)
    • Assume DC injection points from MISO to PJM
    • Injection points to PJM to be determined
## Renewable Resources

### Solar

<table>
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<th>Generator</th>
<th>Existing</th>
<th>Queue*</th>
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### Wind

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<tr>
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<td>OFFSHORE</td>
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<td>MISO</td>
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### Total

- **Existing**: 6,851 MW
- **Queue**: 18,094 MW
- **Additional**: 16,213 MW
- **TOTAL**: 41,159 MW

### Other Resources To Meet

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<tr>
<th>IRM</th>
<th>Natural Gas</th>
<th>Nuclear</th>
<th>Other (Coal, Diesel, Oil, etc.)</th>
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<td>22,799</td>
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<td>1,173</td>
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* Generator Interconnection projects that are not yet in service and are modeled in the 2013 RTEP 2018 base case
** Based on amount of wind & solar projected in each PJM state in GE PRIS Task 2 Scenario Development - Final Report
2013 RTEP Baseline Update
• Evaluation of 2018 Summer
  ✓ Base case analysis – complete
  ✓ Generator deliverability analysis – complete
  ✓ Load deliverability analysis – developing solutions
  ✓ N-1-1 Thermal and Voltage Analysis
    • Problem identification complete
    • Developing final solutions
**Basecase Analysis Violation**

- Voltage drop violations at Dale, Shingletown, Moshannon, Millersburg, Elko and Quehanna 230 kV buses for several category C contingencies.
- Install a 250 MVAR SVC at Squab Hollow 230 kV. (B2362)
- This project will also replace baseline B2180: Build a 2nd Glade - Warren 230 kV line
- Estimated Project Cost: $33.5M
- Expected IS Date: 6/1/2015
- Projected IS Date: 6/1/2016
• **Basecase Analysis Violation**

• Low voltage and voltage drop violations at Moshannon, Elko, Milesburg, Dale Summit, Carbon Center, and Quehanna 230 kV buses for several line fault with stuck breaker contingencies at Shingletown 230 kV substation.

• Convert the Shingletown 230 kV bus into a 6 breaker ring bus (B2363)

• Estimated Project Cost: $5.5M

• Expected IS Date: 6/1/2018
• **Basecase Analysis Violation**

- Low voltage and voltage drop violations at Carbon Center 230 kV bus and Ridgeway, Elko, Carbon Center, Paper City and Willamette 138 kV buses for the Elko 230 kV #4 breaker failure.

- Install a new 230/138 kV transformer at Squab Hollow 230 kV substation. Loop the Forest - Elko 230 kV line into Squab Hollow. Loop the Brookville - Elko 138 kV line into Squab Hollow. (B2364)

- Estimated Project Cost: $16.8M

- Expected IS Date: 6/1/2015
- Projected IS Date: 6/1/2016
Project Scope Change

- B2120

- Original Scope: Reconductor both Lake Lynn - Lardin 138 kV circuits
- Original cost: $22.9M

- New Scope: Six-Wire Lake Lynn - Lardin 138 kV circuits
- Cost Estimate: $0.1 M

- Required IS Date: 6/1/2015
• **Project Scope Update**

• B1972

• Original Scope: Replace disconnect switch on the South Canton 765/345 kV transformer.

• New Scope: Replace disconnect switch on South Canton 765/345kV transformer with a new 345kV CB string and associated protection

• Estimated Project Cost: $2.0M

• Projected IS Date: 12/01/2014
PSE&G Transmission Zone - Northern NJ
Short Circuit
• PSEG Short Circuit Issue
  – 2012 RTEP identified several busses in PSEG zone where the fault currents exceed 80 kA
  – A number of alternatives evaluated including rebuilding stations to 90 kA standard, installing current limiting reactors, splitting the system, installing FCL (fault current limiters) technology
• Simulations indicate overdutied breakers over 80 kA at:
  – Hudson
  – Essex
  – Kearny
PJM is evaluating alternative solutions

- **Double circuit 345 kV Solution**
  - Isolate Hudson 230 kV from the 138 kV at Marion and 345 kV at Farragut
  - Convert the 138 kV buses and transmission facilities on the path from Linden to Bergen to double circuit 345 kV
- **Back to Back HVDC at Hudson**
- **Other solutions considered**
  - **Double circuit 230 kV Solution**
    - Isolate Hudson 230 kV from the 138 kV at Marion and 345 kV at Farragut
    - Convert the 138 kV buses and transmission facilities on the path from Linden to Bergen to double circuit 230 kV
  - **Other configurations**
    - Transformer based fault current limiters
- **Hudson #2 generation location assumption**
  - Existing Hudson 230 kV or converted Marion 230 kV or 345 kV station?
FCL – Fault Current Limiter Technology

• Technology
  – Small impedance and nominal load, large impedance during a fault

• Discussion with product vendor

• Status
  – Limited global deployment on distribution system
- Recent stakeholder proposal to build parallel 700 MW HVDC converter stations
- Associated Stakeholder PJM queue request for 400 MW withdrawal from Hudson to New York
PSEG Transmission Zone Short Circuit
Double circuit 230 kV Solution Alternative

Legend
- 138 kV
- 230 kV
- 345 kV
- 1150
- new
- 2159
- 1008
- 2217
- s0316
- aboveground
- underground

Existing

Proposed
• Double circuit 345 kV Solution
• Existing baseline projects included in the scope
Existing RTEP Project Mitigated by Double Circuit 345 kV Alternative

- B2159
  - Reviewed October 2012
  - N-1-1 Violations

- Generation Deliverability/N-1-1 Thermal:
  - The Linden – North Ave. 138 kV circuit is overloaded for a line fault stuck breaker contingency loss of the Bayway – Doremus 138 kV, Bayway 138/26 kV bank #2 and Bayway 138 kV bus 1-3. Several 138 kV circuits in the Linden vicinity overloaded for N-1-1 contingencies.

- Proposed Solution:
  - Reconfigure the Linden, Bayway, North Ave., and Passaic Valley S.C. 138 kV substations. Construct and loop new 138 kV circuit to new airport station (B2159).

- Estimated Project Cost:
  - $250 M

- Expected IS Date:
  - 6/1/2017
• B1082
  – Reviewed October 2009
  – N-1-1 Violations

- N-1-1 Thermal Violation
- Normal overload on the East Rutherford – Athenia 138 kV circuit for the loss of the Bergen GT unit + basecase
- Proposed Solution: Install a 230/138 kV transformer at Bergen substation (B1082)
- Estimated Cost: $22.6 M
- Required IS Date: 6/1/2014
Existing RTEP Project Mitigated by Double Circuit 345 kV Alternative

- B2217
- Reviewed March 2013

- The Bergen – North Bergen 138 kV line is overloaded for loss of the Bergen 138 kV bus section #3.
- Proposed Solution: Rebuild 2.19 miles of overhead line E-1305-5 (Bergen - North Bergen). (b2217).
- Cost Estimate: $38 M
- Required IS Date: 6/1/2015.
- **S0316**
  - Reviewed August 2011

**PSE&G Transmission Zone**

- **PSE&G Reliability:**
  - Marion 138kV operated as a split bus limiting operator flexibility.
- **Unreliable straight-bus design**
- **Equipment age –** station is 1920s vintage
- **Proposed Solution:**
  - Reconfigure Marion for Breaker and Half. Build for 230kV, operate at 138kV with 80kA breakers (S0316)
- **Estimated Project Cost:**
  - $150 M
- **Expected IS Date:**
  - 6/1/2016
2018 RTEP Violations Mitigated by Double Circuit 345 kV Alternative

- Several reliability criteria violations in Northern PSE&G
- Reviewed June 2013

- Summary of Potential Generation Deliverability Violations
- Several 230 kV circuits are overloaded in the Northern PSEG Aldene vicinity.
- The overloads include existing and future facilities
## Solution Alternatives

### Baseline Performance*

<table>
<thead>
<tr>
<th>Location</th>
<th>Breaker Capacity</th>
<th>No Solution</th>
<th>HVDC Solution</th>
<th>HVDC w/Hudson #2 moved to NY side</th>
<th>Double Circuit 230 kV Alternative</th>
<th>Double Circuit 345 kV Alternative</th>
<th>Double Circuit 345 kV (w/ Hudson #2 at Marion 345 kV) Alternative</th>
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</thead>
<tbody>
<tr>
<td>Essex 230kV</td>
<td>80</td>
<td>80.4</td>
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<td>Hudson 1-6 230kV</td>
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*Includes all existing and ISA generation
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<th>Location</th>
<th>Breaker Capacity</th>
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<td>74.7</td>
<td>58.7</td>
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**Includes all existing and ISA generation as well as X2-050 (660 MW at Essex 230 kV) & Y2-105 (50 MW at Eagle Point 230 kV)**
## 345 kV Alternative – Cost Estimate* & Breakdown

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<th>Project Status</th>
<th>PJM Project ID</th>
<th>Estimated Cost (S M)</th>
<th>Subtotal Cost Estimate</th>
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<tr>
<td><strong>PJM Board Approved RTEP Projects</strong></td>
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<td>Reinforce Linden - PVSC Corridor - Reconfigure the Linden, Bayway, North Ave, and Passaic Valley S.C. 138 kV substations. Construct and loop new 138 kV circuit to new airport station (b2159)</td>
<td>Baseline - Approved</td>
<td>b2159</td>
<td>$250</td>
<td>($325.50)</td>
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<tr>
<td>Install 230/138 kV transformer at Bergen substation</td>
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<td>Rebuild 2.19 miles of overhead line E-1306-5 (Bergen - North Bergen)</td>
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<td>$37.5</td>
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<td>Reconfigure Marion for Brecker and Half. Build for 230 kV, operate at 138 kV with 80 kA breakers</td>
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<td>Reconductor of PVSC - Bayonne Circuit</td>
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<td>Build a parallel Stanley Terrace - McCarter</td>
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<td>Build a parallel McCarter - West Orange</td>
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<td>Upgrade U-2273 (VFT - Warinanco)</td>
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<td>Upgrade N-2240 (Warinanco - Aldene)</td>
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<td>Upgrade S-2271 (Tosco - VFT)</td>
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<td>Upgrade B-2264 (Tosco - Linden)</td>
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<td><strong>Total</strong></td>
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<td>Net Cost $ 62.20</td>
</tr>
</tbody>
</table>

* Planning level cost estimates provided by PSE&G
Double Circuit 345 kV Alternative - Performance

• Short Circuit performance

• Load Flow
  – Also obviates the need for existing (board approved) and future RTEP upgrades (valid 2018 violations that require a solution)
  – Limited additional studies
HVDC Solution Alternatives - Cost Estimate

- HVDC Cost Estimates (as provided by the Z1-033 project sponsor)
  - Methodology & assumptions
    - 20% Risk & Contingency
  - 2 X 500 MW HVDC at Hudson 230 kV
    - $550 M
  - 2 X 700 MW HVDC at Hudson 230 kV
    - $640 M
    - Includes $25 M for 345 kV cable system cooling
HVDC Solution Alternatives - Considerations

• 2 X 500 MW HVDC at Hudson 230 kV
  – PJM Analysis complete
  – Continue coordination with NYISO

• 2 X 700 MW HVDC at Hudson 230 kV
  – Z1-033 Merchant Transmission Project (400 MW)
  – Merchant Transmission Study - Impact of 400 MW withdrawal
  – PJM/NYISO Wheel Considerations
  – Continue coordination with NYISO

• Hudson #2 Generation Location
• Short Circuit Performance

• Load Flow
  – Does not obviate the need for any RTEP upgrades
  – Extensive additional studies
• **Consultant selected**
  – **Scope**
    • HVDC and 345 kV Double Circuit Alternatives
    • Cost & constructability
  – **Progress**
  – **Timeline**
  – **Deliverables**
• September 12th TEAC
  – Review analytical results
• October 10th TEAC
  – Update feasibility study progress
• November 7th TEAC
  – Recommend solution to TEAC
• December PJM Board
  – Recommend solution to PJM Board
• **Next Steps**
  – Feasibility analysis
    • Cost & Constructability
  – Additional load flow analysis
  – Coordination with NYISO
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<tr>
<th>Unit(s)</th>
<th>Transmission Zone</th>
<th>Requested Deactivation Date</th>
<th>PJM Reliability Status</th>
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</thead>
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<td>AE</td>
<td>Change deactivation date from 5/31/2015 to 5/31/2014</td>
<td>Reliability analysis underway</td>
</tr>
<tr>
<td>(158 MWs)</td>
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<td>Beckjord units 2 &amp; 3</td>
<td>DEOK</td>
<td>Change deactivation date from 4/1/2015 to 11/21/2013 (or earlier if possible)</td>
<td>Reliability analysis underway</td>
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<td>(222 MWs)</td>
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<td>Gilbert unit 8</td>
<td>JCPL</td>
<td>Deactivation request withdrawn</td>
<td>N/A</td>
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<td>(90MWs)</td>
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</table>
Hatsfield’s Ferry, Units 1-3
- 1590 MWs
- Requested Deactivation Date: October 9, 2013

Mitchell, Units 2-3
- 359 MWs
- Requested Deactivation Date: October 9, 2013
Baseline NERC Category B violation:
Clinch River - Clinchfield 138kV line is overloaded for the single contingency loss of Clinch River - Fremont 138kV line

Proposed Solution (Existing Upgrade b1444):
Perform electrical clearance studies on Clinch River - Clinchfield 138 kV line (a.k.a. sag studies) and upgrade the risers at Clinch River 138 kV substation with 1590 ACSR

Required in-service date: 06/01/2014
Expected in-service date: 06/01/2015
Cost: $0.1M

Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
Baseline NERC Category C violation:
Cross Street - Hogan 138kV line is overloaded for the breaker contingency Desoto substation, loss of Desoto to Fall Creek 138 kV line and Desoto 345/138 kV transformer

Proposed Solution (Existing Upgrade b1434):
Perform a sag study on the line from Desoto to Madison. Replace bus and risers at Daleville station and replace bus and risers at Madison station

Required in-service date: 06/01/2014
Expected in-service date: 12/31/2014
Cost: $0.5M

Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
Common Mode Outage
Muskingum River - East New Concord 138kV line is overloaded for the breaker contingency: loss of kammer - S.Canton 765kV, Kammer - 502 Junction 500kV lines and Kammer 765/500kV, S.Canton 765/345kV, S.Canton 345/138kV transformers

N-1-1 Violation:
Muskingum River - East New Concord 138/138kV line is overloaded for the N-1-1 contingency loss of Hatfield to Ronco 500 kV line followed by the loss of Kammer to South Canton 765 kV line, South Canton 765/345 kV transformer #3, South Canton 345/138 kV transformer #4

Proposed Solution (Existing Upgrade b1473):
Perform a sag study on the East New Concord – Muskingum River section of the Muskingum River – West Cambridge 138 kV circuit

Required in-service date: 06/01/2014
Expected in-service date: 12/31/2013
Cost: $0.15M
- Common Mode Outage and N-1-1 Violation:
  - Muskingum River 345/138kV transformer is overloaded for the tower contingency: loss of Beverly - Tidd and Kammer – Muskingum River 345kV lines
- Proposed Solution (Existing Upgrade b2021): Add 345/138 transformer at Sporn, Kanawah River & Muskingum River stations
- Required in-service date: 06/01/2014
- Expected in-service date: 12/30/2016
- Cost: $30M
- Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
• Common Mode Outage Violation:
• Muskingum River - Wolf Creek 138kV line is overloaded for the breaker contingency: loss of Mountaineer - Belmont - Kammer 765kV, 502 Junction - Kammer 500 kV lines and Belmont 765/500 and Kammer 765/500 kV transformers
• N-1-1 Violation:
• Muskingum River - Wolf Creek 138/138kV line is overloaded for the loss of Grafton to Pruntytown 138 kV line followed by the loss of Belmont to Kammer 765 kV line, Belmont to Mountaineer & Belmont 765/500 kV transformer
• Proposed Solution (Existing Upgrade b2286):
  Rebuild 4.7 miles of Muskingum River to Wolf Creek 138 kV line and remove the 138/138 kV transformer at Wolf Creek Station
  • Required in-service date: 06/01/2014
  • Expected in-service date: 12/01/2016
  • Cost: $10 M
• Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield's Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
Common Mode Outage and Baseline NERC Category C violation:

- Atkins - Rural Retreat 138kV line is overloaded for the breaker contingency '1594_C2_05J.FERR 765-B1': loss of Cloverdale - Jackson Ferry 765 kV line and Jacksons Ferry 765/138kV transformer
- Proposed Solution (Existing upgrade b1663, b1663.1, b1663.2): Install double circuit 138kV circuit from Jackson’s Ferry to Wythe
  - Required in-service date: 06/01/2014
  - Expected in-service date: 06/01/2015
  - Cost: $45M
  - Interim solution: Place Broadford 138kV reactor in service at all times
• Common Mode Outage and Baseline NERC Category C violation:
  • Broadford – Broadford 138kV line is overloaded for the breaker contingency '1594_C2_05J.FERR 765-B1': loss of Cloverdale - Jackson Ferry 765kV line and Jacksons Ferry 765/138kV transformer
  • Proposed Solution (Existing upgrade b1663, 1663.1, b1663.2): Install double circuit 138kV circuit from Jackson’s Ferry to Wythe
  • Required in-service date: 06/01/2014
  • Expected in-service date: 06/01/2015
  • Cost: $45M
  • Interim solution: Place Broadford 138kV reactor in service at all times
AEP

1. Common Mode Outage and Baseline NERC Category C violation:
   - Broadford – Smyth 138kV line is overloaded for the breaker contingency '1594_C2_05J.FERR 765-B1': loss of Cloverdale - Jackson Ferry 765kV line and Jacksons Ferry 765/138kV transformer
   - Proposed Solution (Existing upgrade b1663, 1663.1, b1663.2): Install double circuit 138kV circuit from Jackson’s Ferry to Wythe
   - Required in-service date: 06/01/2014
   - Expected in-service date: 06/01/2015
   - Cost: $45M
   - Interim solution: Place Broadford 138kV reactor in service at all times
Common Mode Outage and Baseline NERC Category C violation:

Smyth – Atkins 138kV line is overloaded for the breaker contingency '1594_C2_05J.FERR 765-B1': loss of Cloverdale - Jackson Ferry 765kV line and Jacksons Ferry 765/138kV transformer

Proposed Solution (Existing upgrade b1663, b1663.1, b1663.2): Install double circuit 138kV circuit from Jackson’s Ferry to Wythe

Required in-service date: 06/01/2014
Expected in-service date: 06/01/2015
Cost: $45M
Interim solution: Place Broadford 138kV reactor in service at all times
• **Generation Deliverability and Baseline NERC Category B violation:**
  - Conesville East - Prep Plant Tap 138kV line is overloaded for the single contingency 'B_LINE_TIE_010': loss of Ohio Central - Muskingum River 345kV line

• **Proposed Solution (Existing Upgrade b1502):** Perform a sag study of the Prep Plant Tap - Conesville East 138 kV
  - Required in-service date: 06/01/2014
  - Expected in-service date: 06/01/2014
  - Cost: $0.01M
Generation Deliverability and Baseline NERC Category B violation:

- Prep Plant Tap - Ohio Central 138kV line is overloaded for the single contingency 'B_LINE_TIE_010': loss of Ohio Central – Muskingum River 345kV line

- Proposed Solution (Existing Upgrade b1474): Perform a sag study on the Ohio Central – Prep Plant tap 138 kV circuit

  - Required in-service date: 06/01/2014
  - Expected in-service date: 06/01/2014
  - Cost: $0.04M
• Common Mode Outage and Baseline NERC Category C violation:
  • Circleville - Harrison 138kV line is overloaded for the breaker contingency ‘6773_C2_05BIXBY 345-301W’: loss of Bixby - Nfork 345kV line and both Bixby 345/138kV transformers
• Proposed Solution (Existing Upgrade b2256): Rebuild approximately 20 miles of Ross - Harrison 138 kV line in Ohio
• Required in-service date: 06/01/2014
• Expected in-service date: 06/01/2017
• Cost: $40.5M
• Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
• Common Mode Outage and Baseline NERC Category C violation:
  • Dexter - Elliot Tap 138kV line is overloaded for the breaker contingency '2893_C2_05MUSKNG 345-SE': loss of Muskingum River - Waterfront 345kV line and unit #2 at Muskingum River station
  • Proposed Solution (Existing Upgrade b1447): Dexter – Elliot tap 138 kV sag check
  • Required in-service date: 06/01/2014
  • Expected in-service date: 12/31/2013
  • Cost: $0.06M
Common Mode Outage:

- Elliot Tap - Poston 138kV line is overloaded for the breaker contingency '2893_C2_05MUSKNG 345-SE': loss of Muskingum River - Waterfront 345kV line and unit #2 at Muskingum River station

Proposed Solution (Existing Upgrade b2032):
- Rebuild 138 kV Elliot tap - Poston line
- Required in-service date: 06/01/2014
- Expected in-service date: 06/01/2014
- Cost: $8.7M
• Common Mode Outage and Baseline NERC Category C violation:
• Clinch River – Lebanon 138kV line is overloaded for the tower contingency '408': loss of Beaver - Dorton - Beef Hide - Fleming, Beaver - Fremont2-Fremont1, Dorton - Clinch River 138kV lines and underlying distribution system
• Proposed Solution (Existing Upgrade b1483): Sag Study 1 mile of the Clinch River – Saltville 138kV line and replace the risers and bus at Clinch River, Lebanon, and Elk Garden Stations
• Required in-service date: 06/01/2014
• Expected in-service date: 12/31/2013
• Cost: $0.22M
• Common Mode Outage:
  Lebanon - Elk Garden Tap 138kV line is overloaded for the tower contingency '408': loss of Beaver - Dorton - Beef Hide - Fleming, Beaver - Fremont2-Fremont1, Dorton - Clinch River 138kV lines and underlying distribution system
• Proposed Solution (Existing Upgrade b1483): Sag Study 1 mile of the Clinch River – Saltville 138kV line and replace the risers and bus at Clinch River, Lebanon, and Elk Garden Stations
• Required in-service date: 06/01/2014
• Expected in-service date: 12/31/2013
• Cost: $0.22M
- Common Mode Outage and Baseline NERC Category C violation:
- Elk Garden Tap – Saltville 138kV line is overloaded for the tower contingency '408': loss of Beaver - Dorton - Beef Hide - Fleming, Beaver - Fremont2-Fremont1, Dorton - Clinch River 138kV lines and underlying distribution system
- Proposed Solution: Sag Study 1 mile of the Clinch River – Saltville 138kV line and replace the risers and bus at Clinch River, Lebanon, and Elk Garden Stations
- Required in-service date: 06/01/2014
- Expected in-service date: 12/31/2013
- Cost: $0.22M
AEP

• Common Mode Outage and Baseline NERC Category C violation:
• Kammer - West Bellaire 345kV line is overloaded for the breaker contingency '4831_C2_05KAMMER 765-NN': loss of Kammer - S.Canton 765kV, Kammer - 502 Junction 500kV lines and Kammer 765/500kV, S.Canton 765/345kV, S.Canton 345/138kV transformers
• Proposed Solution (Existing Upgrade b2019): Establish Burger 345/138 kV station
• Required in-service date: 06/01/2014
• Expected in-service date: 06/01/2015
• Cost: $35M
• Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
AEP

Common Mode Outage and Baseline NERC Category C violation:

Kanawha – Carbondale 138kV line is overloaded for the breaker contingency ‘5031_C2_05KAMMER 765-PP2’: loss of Mountaineer - Belmont - Kammer 765kV, 502 Junction - Kammer 500 kV lines and Belmont 765/500 and Kammer 765/500kV transformers

Proposed Solution (Existing Upgrade b1865):
Perform a sag study on the Kanawha - Carbondale 138 kV line

Required in-service date: 06/01/2014
Expected in-service date: 06/01/2015
Cost: $0.07M

Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
• Common Mode Outage and Baseline NERC Category C violation:

• Layman - Corner 138kV line is overloaded for the breaker contingency '5031_C2_05KAMMER 765-PP2': loss of Mountaineer - Belmont - Kammer 765kV, 502 Junction - Kammer 500 kV lines and Belmont 765/500 and Kammer 765/500kV transformers

• Proposed Solution (Existing Upgrade b1480): Perform upgrades and a sag study on the Corner – Layman 138 kV section of the Corner – Muskingum River 138 kV circuit

• Required in-service date: 06/01/2014

• Expected in-service date: 12/31/2013

• Cost: $0.2M
Common Mode Outage and Baseline NERC Category C violation:

Meigs Sw – Dexter 138kV line is overloaded for the breaker contingency '2893_C2_05MUSKNG 345-SE': loss of Muskingum River - Waterfront 345kV line and unit #2 at Muskingum River station

Proposed Solution (Existing Upgrade b1448): Perform a sag study on the Meigs-Dexter 138 kV line

Required in-service date: 06/01/2014

Expected in-service date: 12/31/2013

Cost: $0.02M
• Common Mode Outage and Baseline NERC Category C violation:
• Rutland - Meigs Sw 138kV line is overloaded for the breaker contingency ’2893_C2_05MUSKNG 345-SE': loss of Muskingum River - Waterfront 345kV line and unit #2 at Muskingum River station
• Proposed Solution (Existing Upgrade b1449): Meigs tap – Rutland 138 kV sag check
• Required in-service date: 06/01/2014
• Expected in-service date: 12/31/2013
• Cost: $0.01M
Generation Deliverability and Baseline NERC Category B violation:

- Spencer Ridge – Crooksville 138kV line is overloaded for the single contingency '734_B2_TOR8011': loss of Muskingum River - Waterfront 345kV line

- Proposed Solution (Existing Upgrade b1860):
  - Perform a sag study on the Crooksville - Spencer Ridge section (14.3 miles) of the Crooksville-Poston-Strouds Run 138 kV circuit
  - Required in-service date: 06/01/2014
  - Expected in-service date: 06/01/2016
  - Cost: $0.06M

- Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
• Common Mode Outage:
• Sporn – Rutland 138kV line is overloaded for the breaker contingency ‘2893_C2_05MUSKNG 345-SE’: loss of Muskingrum River - Waterfront 345kV line and unit #2 at Muskingum River station
• Proposed Solution (Existing Upgrade b2054): Perform a sag study of Sporn - Rutland 138 kV line
• Required in-service date: 06/01/2014
• Expected in-service date: 12/31/2014
• Cost: $0.05M
• Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
Common Mode Outage:
Tiltonsville – Windsor 138kV line is overloaded for the tower contingency 'AP_C5_25': loss of Tidd - Wylie Ridge and Tidd - Collier 345kV lines

Proposed Solution (Existing Upgrade b2031):
Sag study on Tilton - W. Bellaire section 1 (795 ACSR), about 12 miles

Required in-service date: 06/01/2014
Expected in-service date: 06/01/2015
Cost: $0.05M

Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
Common Mode Outage and Baseline NERC Category C violation:

West Bellaire – Tiltonsville 138kV line is overloaded for the tower contingency 'AP_C5_25': loss of Tidd - Wylie Ridge and Tidd - Collier 345kV lines

Proposed Solution (Existing Upgrade b2031):
Sag study on Tilton - W. Bellaire section 1 (795 ACSR), about 12 miles

Required in-service date: 06/01/2014
Expected in-service date: 06/01/2015
Cost: $0.05M
Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
Generation Deliverability Violation:

- Waterford - Muskingum River 345kV line is overloaded for the single contingency '37_B2_TOR12_WOMOP': loss of Mountaineer - Belmont - Kammer 765kV line and Belmont 765/500kV transformer.

Proposed Solution (Existing Upgrade b2017):
- Reconductor or rebuild Sporn - Waterford - Muskingum River 345 kV line
- Required in-service date: 06/01/2014
- Expected in-service date: 6/1/2015
- Cost: $200M

Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
• Common Mode Outage and Baseline NERC Category C violation:
• Wolf Creek – Layman 138kV line is overloaded for the breaker contingency '5031_C2_05KAMMER 765-PP2': loss of Mountaineer - Belmont - Kammer 765kV, 502 Junction - Kammer 500 kV lines and Belmont 765/500 and Kammer 765/500kV transformers
• Proposed Solution (Existing Upgrade b1962): four 765 kV breakers at Kammer
• Required in-service date: 06/01/2014
• Expected in-service date: 06/01/2015
• Cost: $30M
• Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
• Common Mode Outage and Baseline NERC Category C violation:
  • Wolf Creek - Wolf Creek 138/138kV line is overloaded for the breaker contingency ‘5031_C2_05KAMMER 765-PP2’: loss of Mountaineer - Belmont - Kammer 765kV, 502 Junction - Kammer 500 kV lines and Belmont 765/500 and Kammer 765/500kV transformers
  • Proposed Solution (Existing Upgrade b1962): four 765 kV breakers at Kammer
  • Required in-service date: 06/01/2014
  • Expected in-service date: 06/01/2015
  • Cost: $30M
  • Interim solution: Re-dispatch generation to control post contingency flow. Hatsfield’s Ferry & Mitchell have a limited impact on the constraint. Output of other available units will be re-dispatched to control the flow on the facility.
N-1-1 voltage violations:
- Voltage drop violation at West Union 138 kV bus and Middlebourne 138 kV bus for the loss of Belmont to Harrison 500 kV line followed by the loss of Belmont to Kammer 765 kV line
- Loss of several single contingencies cause voltage collapse condition
- Proposed Solution (New Upgrade b2298): Install a 31.7 MVAR, 138 kV capacitor bank at West Union Substation
  - Cost estimate $0.94M
  - Required in-service date: 06/01/2014
  - Expected in service date: 06/01/2014
Common Mode Outage and Baseline NERC Category C violation:
- Collins Ferry - West Run 138kV line is overloaded for the breaker contingency 'AP_SB_467': loss of Hatfield – Ronco 500kV line and generator #3 at Hatfield
- Proposed Solution (Existing Upgrade b1989): Cancel
  - New Upgrade b2299: reconductor from Collins Ferry to West Run with 556 ACSS
- Required in-service date: 06/01/2014
- Expected in-service date: 06/01/2014
- Cost: $0.7M
• Common Mode Outage and Baseline NERC Category C violation:
• Osage - Collins Ferry 138kV line is overloaded for the breaker contingency 'AP_SB_467': loss of Hatfield – Ronco 500kV line and generator #3 at Hatfield
• Proposed Solution (Existing Upgrade b1987): Reconductor from Collins Ferry to Osage with 795 ACSS
• Required in-service date: 06/01/2014
• Expected in-service date: 04/15/2014
• Cost: $1.8M
- Common Mode Outage and Baseline NERC Category C violation:
- Beaver - Black River 138kV line is overloaded for the tower contingency 'C5-TWL-CR012A': loss of Beaver - Johnson and Beaver - Henrieta 138kV lines
- Proposed Solution (New Upgrade b2301): Recondenser 0.7 miles of 605 ACSR conductor on the Beaver-Black River 138kV line
- Required in-service date: 06/01/2014
- Expected in-service date: 12/31/2014
- Cost: $2.5M
Common Mode Outage and Baseline NERC Category C violation:

Lakeview – Greenfield 138kV line is overloaded for the tower contingency '520-X2': loss of Davies Bease - Hayes and Beaver - Davies Bease 345kV lines

Proposed Solution (Existing Upgrade b1959): Build a new 138kV line from West Fremont-Hayes substation (~30 miles)

- Required in-service date: 06/01/2014
- Expected in-service date: 06/01/2018
- Cost: $45M
- Interim: Operating procedure to open the Greenfield-Lakeview 138kV line
• Common Mode Outage and Baseline NERC Category C violation:
  • Ottawa TE – Lakeview 138kV line is overloaded for the tower contingency '520-X2': loss of Davies Bease - Hayes and Beaver - Davies Bease 345kV lines
  • Proposed Solution (Existing Upgrade b1959): Build a new 138kV line from West Fremont-Hayes substation (~30 miles)
  • Required in-service date: 06/01/2014
  • In-service date: 06/01/2018
  • Cost: $45M
  • Interim: Operating procedure to open the Greenfield-Lakeview 138kV line
• Common Mode Outage:

• Blairsville East 115/138kV transformer is overloaded for the breaker contingency 'AP_SB_352': loss of all generation at Springdale station

• Proposed Solution (Existing Upgrade b1967): replace 138/115 kV Blairsville transformer

• In-service date: 06/01/2014

• Cost: $4.2M
Common Mode Outage:
West Run - Lake Lynn 138/138kV line is overloaded for the breaker contingency 'AP_SB_467': loss of Hatfield – Ronco 500kV and generator #3 at Hatfield

N-1 Thermal Violation:
West Run - Lake Lynn 138/138kV line is overloaded for the single contingency: loss of Hatfield – Ronco 500kV

Proposed Solution (Existing Upgrade b1988):
- Cancel
- New Upgrade b2300: reconductor from Lake Lynn to West Run with 556 ACSS

In-service date: 12/01/2014
Cost: $4.3M

Interim solution: Operate with 502 junction – Osage 138kV line #1 & 2 open
Artificial Island RTEP Proposal Window
Artificial Island Proposal Window Timeline

**Announcement**
- Announce window and potential timeline
- Request CEII/NDA submittals from anticipated participants
- Request Designated Entity Pre-Qualification

**PSS/E v32 Case Development**
- Initial PSS/E v32 case created
  - Benchmarking in Progress
  - Develop and benchmark critical system condition cases

**Window Opened**
- (4/29/2013 - 60 Day Duration)
  - Open the “Artificial Island” RTEP Proposal Window
  - Complete problem statement available
  - Analytical files available

**Coordinate with Window Participants and Receive Solution Proposals**
- Coordination VIA www.pjm.com
- Data, Information
- Questions & Answers

**Proposal Window Closed on 6/28/2013**

**PJM Evaluates Solution Proposals**
Artificial Island Proposal Window Status

- Window opened on 4/29/2013
- Closed on 6/28/2013
- 26 individual proposals
- 7 entities
- Project Naming Convention
- Project Identification Taxonomy: 2013_1-1A
All information at this point is provided by the project sponsors
- Sponsoring Entity
- Cost Estimate
- Mileage
- Routing
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<th>Project ID</th>
<th>TO</th>
<th>Cost ($M)</th>
<th>Major Components</th>
<th>Supporting info</th>
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<tr>
<td>P201_11A</td>
<td>Virginia Electric and Power Corp</td>
<td>$133</td>
<td>500 kV ACSR SVC near New Freedom</td>
<td>Two 23 kV Thyristor Controlled Series Compensation (TCSR) Devices near New Freedom</td>
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<tr>
<td>P201_11B</td>
<td>Virginia Electric and Power Corp</td>
<td>$123</td>
<td>New 500 kV from Salem - new station in Delaware</td>
<td>New 600 kV station in Delaware that taps existing Cedar Creek - Red Lion 230 kV and Carmanas - Red Lion 230 kV line</td>
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<tr>
<td>P201_11C</td>
<td>Virginia Electric and Power Corp</td>
<td>$202</td>
<td>New 500 kV from Hope Creek - a new station in Delaware</td>
<td>Install a new 600kV line from Hope Creek - Red Lion/ New Salem - Hope Creek 600 kV line</td>
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<tr>
<td>P201_12A</td>
<td>Transource</td>
<td>$210 - $269</td>
<td>Salem - Cedar Creek 236 kV</td>
<td>Two 23 kV TCSR Transformers near Salem, Loop in Red Lion - Carmanas 230 to Cedar Creek</td>
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<tr>
<td>P201_12B</td>
<td>Transource</td>
<td>$185 - $269</td>
<td>Salem - North Cedar Creek (new) 236 kV</td>
<td>Two 23 kV TCSR Transformers near Salem and Loop in Red Lion - Carmanas 230 and Red Lion / Cedar Creek 239 kV</td>
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<tr>
<td>P201_12C</td>
<td>Transource</td>
<td>$123 - $186</td>
<td>Salem - Red Lion 600 kV</td>
<td>New Salem - Hope Creek 600 kV line and new 600/230 station east of Lumberton</td>
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<tr>
<td>P201_12D</td>
<td>Transource</td>
<td>$208 - $394</td>
<td>New Freedom - Lumberton - North Smithburg (new) 500 kV line</td>
<td>New Salem - Hope Creek 600 kV line and new 600/230 station east of Lumberton</td>
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<td>P201_13A</td>
<td>FirstEnergy</td>
<td>$420.7 (Only FirstEnergy portion)</td>
<td>New Freedom - Smithburg 500 kV line with a loop into Lumberton</td>
<td>Hooper Creek - Red Lion 500 kV line</td>
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<tr>
<td>P201_14A</td>
<td>PHI Eelton</td>
<td>$475</td>
<td>Pearl Bottom - Kennebuc Red Line - Salem 500 kV</td>
<td>Remove Kennebuc - Red Line 230 kV, Repower 230 around Hwy 506/Transconductor/Harmony Chapel St 138 kV</td>
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<tr>
<td>P201_16A</td>
<td>LG Power</td>
<td>$160.3K - $195.3M</td>
<td>Salem - Silver Run (new) 200 kV, Salem 650/230 kV Transformer</td>
<td>New 200 kV station that taps existing Cedar Creek - Red Lion 230 kV and Carmanas - Red Lion 230 kV</td>
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<tr>
<td>P201_16D</td>
<td>LG Power</td>
<td>$159</td>
<td>Salem - Red Lion 500 kV</td>
<td>New 500 kV line</td>
</tr>
<tr>
<td>P201_16A</td>
<td>Atlantic Wind</td>
<td>$152</td>
<td>320 kV HVAC Salem-Hope Creek - Cardiff</td>
<td>SVC at Salem/Hope Creek, New HVAC Stations at Cardiff and Salem</td>
</tr>
<tr>
<td>P201_17A</td>
<td>PE33G</td>
<td></td>
<td>Salem-Hope Creek to Pearl Bottom 500 kV</td>
<td>Existing PCN</td>
</tr>
<tr>
<td>P201_17B</td>
<td>PE33G</td>
<td></td>
<td>Salem-Hope Creek to Pearl Bottom 500 kV</td>
<td>Same as 1A with Loop into Kennebuc</td>
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<tr>
<td>P201_17C</td>
<td>PE33G</td>
<td></td>
<td>Salem-Hope Creek to Pearl Bottom 500 kV</td>
<td>Same as 1A with Loop into Kennebuc</td>
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<tr>
<td>P201_17D</td>
<td>PE33G</td>
<td></td>
<td>Salem-Hope Creek to Pearl Bottom 500 kV</td>
<td>Same as 1A with Loop into Kennebuc</td>
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<tr>
<td>P201_17E</td>
<td>PE33G</td>
<td></td>
<td>New Freedom - Drainage 500 kV Salem - Hope Creek 600 kV lines</td>
<td>Same as 1A with New PCN</td>
</tr>
<tr>
<td>P201_17F</td>
<td>PE33G</td>
<td></td>
<td>New Freedom - Drainage 500 kV Salem - Hope Creek 600 kV lines</td>
<td>Same as 1A with New PCN</td>
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<tr>
<td>P201_17G</td>
<td>PE33G</td>
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<td>New Freedom - Drainage 500 kV Salem - Hope Creek 600 kV lines</td>
<td>Same as 1A with New PCN</td>
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<tr>
<td>P201_17H</td>
<td>PE33G</td>
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<td>New Freedom - Drainage 500 kV Salem - Hope Creek 600 kV lines</td>
<td>Same as 1A with New PCN</td>
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<tr>
<td>P201_17I</td>
<td>PE33G</td>
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<td>New Freedom - Drainage 500 kV Salem - Hope Creek 600 kV lines</td>
<td>Same as 1A with New PCN</td>
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<tr>
<td>P201_17J</td>
<td>PE33G</td>
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<td>New Freedom - Drainage 500 kV Salem - Hope Creek 600 kV lines</td>
<td>Same as 1A with New PCN</td>
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<tr>
<td>P201_17K</td>
<td>PE33G</td>
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<td>P201_17L</td>
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<td>New Freedom - Drainage 500 kV Salem - Hope Creek 600 kV lines</td>
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<td>P201_17M</td>
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<tr>
<td>P201_17N</td>
<td>PE33G</td>
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<td>New Freedom - Drainage 500 kV Salem - Hope Creek 600 kV lines</td>
<td>Same as 1A with New PCN</td>
</tr>
</tbody>
</table>
• Performance with respect to AI Window scope of work
  – Stability & Voltage

• Evaluation Methodology
• PJM Evaluation In-Progress
  – Physical Characteristics
  – Commonalities of design
  – Areas of concern
    • Line crossings, river crossings, ability to expand/reconfigure existing stations, required outages
  – Cost Review
• Independent Review
Objectives

1. Generate maximum power (3818 MW total) from all AI Units (Salem1: 1253MW, Salem-2: 1245MW, Hope Creek: 1320MW) without a minimum MVAr requirement from the AI. Full maximum power must be maintained under both the baseline and all N-1 outage conditions of 500kV transmission lines in the AI area. For both the baseline and N-1 outage conditions, AI voltage must be maintained within operating limits and stable for all NERC Category B and C contingencies. NERC Category C3 contingencies “N-1-1 contingencies” do not need to be run on top of the N-1 outage condition.

2. Maximum MW output from AI should not be affected by the simultaneous outage of Power System Stabilizers (PSS) of Artificial Island units Hope Creek and Salem-2. The Salem-1 PSS is assumed to be on for all scenarios.

3. Reduce operational complexity.

4. Improve Artificial Island stability.

5. Maintain PJM System Operating Limits (SOLs)
• Power factor assumptions from M14B
• Defaulted AI units to 265 MVAR each (795 total)
  – Where 265 MVAR is the minimum MVAR in the current AIOG for no outages
• AI Voltages around 1.05 p.u.
1. Evaluation of cases at 795 MVAR (1.05 p.u.)
   - This is what most sponsors evaluated against and declared success
2. PJM Baseline Criteria (Projects exactly as proposed)
   - Unity Power Factor = 1.0 p.u. on the high side of the GSU
   - Voltages < 1.05
   - See criteria on next slide
3. PJM Baseline Criteria (Projects modified by PJM)
   - Obvious enhancements
     - Not expected to significantly impact cost, scope, schedule, etc.
1. Evaluation of Cases at 795 MVAR

• Result:
  – Screened performance for critical conditions
  – Compared results with the results provided by the sponsoring entities
  – Observed generally good performance for most proposals
2. PJM Baseline Criteria (Projects exactly as proposed)

• Criteria:
  – Consistent with PJM baseline criteria where no operating guide exists

• Result:
  – Identified issues with most of the proposals
3. PJM Baseline Criteria (Projects modified by PJM)

• Criteria: Same as #2 but PJM made simple modifications
• Result:
  – Analysis is in-progress
  – Several have been completed with improved performance
Artificial Island Next Steps

• Additional analytical studies
  – Thermal studies
  – Voltage studies
  – Short Circuit studies

• Independent feasibility analysis
Conceptual Artificial Island Schedule

- September 12th TEAC
  - Update analytical progress
- October 10th TEAC
  - Update analytical progress
  - Update feasibility study progress
- November 7th TEAC
  - Update feasibility study progress
- December 11th TEAC
  - Update feasibility study progress
- January – February 2014
  - Recommend solution to TEAC
- January – February 2014
  - Recommend solution to PJM Board
Supplemental Projects
• Supplemental:
• To improve reliability due to age and condition of the Keeney 500/230 kV transformers.
• Proposed Solution:
  – Replace two 500/230 kV autotransformers at Keeney EHV substation
• Estimated Project Cost: $ 20.83 M
• Expected IS Date: 12/31/2014
Recommendations to PJM Board in October
Recommendations to PJM Board in October 2013

• This is the first request for PJM Board approval of the RTEP in 2013
  – Includes SRRTEP reliability projects reviewed at March and August 2013 SRRTEP meetings
  – Includes TEAC reliability projects reviewed during 12/2012 through 9/2013 (today)

• The PJM Board will be requested to approve projects in this section of the presentation for inclusion in the RTEP
**Basecase Analysis Violation**

- Voltage drop violations at Dale, Shingletown, Moshannon, Millersburg, Elko and Quehanna 230 kV buses for several category C contingencies.
- Install a 250 MVAR SVC at Squab Hollow 230 kV. (B2362)
- This project will also replace baseline B2180: Build a 2nd Glade - Warren 230 kV line
- Estimated Project Cost: $33.5M
- Expected IS Date: 6/1/2015
- Projected IS Date: 6/1/2016
• **Basecase Analysis Violation**

  • Low voltage and voltage drop violations at Moshannon, Elko, Milesburg, Dale Summit, Carbon Center, and Quehanna 230 kV buses for several line fault with stuck breaker contingencies at Shingletown 230 kV substation.

  • Convert the Shingletown 230 kV bus into a 6 breaker ring bus (B2363)

  • Estimated Project Cost: $5.5M

  • Expected IS Date: 6/1/2018
• **Basecase Analysis Violation**

• Low voltage and voltage drop violations at Carbon Center 230 kV bus and Ridgeway, Elko, Carbon Center, Paper City and Willamette 138 kV buses for the Elko 230 kV #4 breaker failure.

• Install a new 230/138 kV transformer at Squab Hollow 230 kV substation. Loop the Forest - Elko 230 kV line into Squab Hollow. Loop the Brookeville - Elko 138 kV line into Squab Hollow. (B2364)

• Estimated Project Cost: $16.8M

• Expected IS Date: 6/1/2015

• Projected IS Date: 6/1/2016
Project Scope Update

B1972

Original Scope: Replace disconnect switch on the South Canton 765/345 kV transformer.

New Scope: Replace disconnect switch on South Canton 765/345kV transformer with a new 345kV CB string and associated protection.

Estimated Project Cost: $2.0M

Projected IS Date: 12/01/2014
• The Bluebell 138 kV breaker ‘301-B-94' is overstressed
• Proposed Solution: Revise the reclosing for the Bluebell 138 kV breaker ‘301-B-94' (b2188)
• Estimated Project Cost: $25 K
• Expected IS Date: 6/1/2017
• The Lowellville 138 kV breaker ‘110-B-4’ is overstressed
• Proposed Solution: Replace the Lowellville 138 kV breaker ‘110-B-4’ (b2193)
• Estimated Project Cost: $175 K
• Expected IS Date: 6/1/2017
• The Roberts 138 kV breaker ‘601-B-60’ is overstressed
• Proposed Solution: Replace the Roberts 138 kV breaker ‘601-B-60’ (b2195)
• Estimated Project Cost: $175 K
• Expected IS Date: 6/1/2017
• The Sammis 138 kV breaker ‘780-B-76’ is overstressed
• Proposed Solution: Replace the Sammis 138 kV breaker ‘780-B-76’ (b2196)
• Estimated Project Cost: $175 K
• Expected IS Date: 6/1/2017
• Generator Deliverability Violation/Light Load Violation

• The Cloverdale - Lexington 500 kV line is overloaded for a Loss of Mt. Storm - Valley 500 kV or Bath - Valley 500kV or North Anna unit #1 or North Anna unit #2

• Reconductor the AEP portion of the Cloverdale – Lexington 500kV line with 2-1780 kcmil ACSS. (B1797.1)

• Estimate Cost: $40M

• Expected IS Date: 6/1/2015
**Project Scope Change**

- B1816.1
- Old Scope: Replace relaying at the Mt. Airy substation on the Carroll - Mt. Airy 230 kV line
- New Scope: Replace 50FD Fault Detector relay at Carroll substation on the Carroll-Mt Airy 230 kV Line and change the CT ratio at Mt. Airy

- Estimated Project Cost: $0.1M
- Projected IS Date: 6/1/2013
- **Project Scope Expansion (B1660)**

- Previous B1660 - Install a 765/500 kV transformer at Cloverdale - $65 M

- Expanded B1660 Scope
  - Install 6-765 kV circuit breakers
  - Establish a 500 kV Cloverdale east station and 765 kV to Cloverdale 500 kV East Tie Line
  - Incremental 765 kV station work to add 2 additional 765 kV Circuit Breakers
  - Reconfiguration of miscellaneous facilities including relocation (B1660.1)
  - Incremental Cost Estimate: $85 M

- Updated Total Estimated Project Cost: $150 M

- Projected IS Date: 12/31/2016
The Brunot Island 138 kV breakers ‘Z-40 COLLIER’ and ‘Z-41 COLLIER’ are overstressed

Proposed Solution: Revise the reclosing of the Brunot Island 138 kV breakers ‘Z-40 COLLIER’ and ‘Z-41 COLLIER’ (b2198-b2199)

Estimated Project Cost: $0

Expected IS Date: 6/1/2013
- The Crescent 138 kV breakers ‘Z-29 Beaver,’ ‘Z-82 VALLEY,’ and ‘Z-21 NORTH’ are overstressed

- Proposed Solution: Revise the reclosing of Crescent 138 kV breakers ‘Z-29 Beaver,’ ‘Z-82 VALLEY,’ and ‘Z-21 NORTH’ (b2200-2202)

- Estimated Project Cost: $0

- Expected IS Date: 6/1/2013
• The Elrama 138 kV breakers ‘Z18-USX CLAI,’ ‘Z13-WEST MIF,’ and ‘Z15-DRAVOSBU’ are overstressed
• Proposed Solution: Revise the reclosing of The Elrama 138 kV breakers ‘Z18-USX CLAI,’ ‘Z13-WEST MIF,’ and ‘Z15-DRAVOSBU’ (b2203-b2205)
• Estimated Project Cost: $0
• Expected IS Date: 6/1/2013
- The Woodville 138 kV breakers ‘Z-106 PINEY’ and ‘Z-64 COLLIER’ are overstressed
- Proposed Solution: Revise the reclosing of Woodville 138 kV breakers ‘Z-106 PINEY’ and ‘Z-64 COLLIER’ (b2206-b2207)
- Estimated Project Cost: $0
- Expected IS Date: 6/1/2013
• The Beaver Valley 138 kV breaker ‘Z-28 CRESCEN’ is overstressed
• Proposed Solution: Revise the reclosing of Beaver Valley 138 kV breaker ‘Z-28 CRESCEN’ (b2208)
• Estimated Project Cost: $0
• Expected IS Date: 6/1/2013
• The Cheswick 138 kV breaker ‘Z-51 WILMERD’ is overstressed
• Proposed Solution: Revise the reclosing of Cheswick 138 kV breaker ‘Z-51 WILMERD’ (b2209)
• Estimated Project Cost: $0
• Expected IS Date: 6/1/2013
• The Edison – Meadow Road Q138 kV line is overloaded for various contingencies.
• The Meadow Road Q – Metuchen 138 kV line is overloaded for various contingencies.
• Proposed Solution: Rebuild 4 miles of overhead line from Edison - Meadow Rd - Metuchen (Q-1317) (b2218).
• Cost Estimate: $46 M
• Required IS Date: 6/1/2015.
• Revised Required In-Service Date for previously approved baseline upgrade b1900:
  • The Linwood – Chichester 230 kV line #1 is overloaded for the single contingency loss of the Linwood – Chichester 230 kV line #2 and loss of Philips Island generating units CT2, CT3, and ST1.
  • The Linwood – Chichester 230 kV line #2 is overloaded for the single contingency (‘220-43’) loss of the Linwood – Chichester 230 kV line #1 and loss of Philips Island generating units CT2, CT3, and ST1.
  • Proposed Solution: Add a 3rd 230 kV transmission line between Chichester and Linwood substations and remove the Linwood SPS (b1900).
• Original Required IS Date: 6/1/2018.
• Revised Required IS Date: 6/1/2015.
• Change in scope of upgrade addressing the Howard – Brookside 138 kV overload:
• The Howard – Brookside 138 kV tie line (AEP/ATSI) is overloaded for the tower contingency loss of the Galion - Leaside 138 kV line and the Galion - GM Mansfield 138 kV line.
• Original Proposed Solution to be cancelled: Build a new ATSI/AEP 138 kV Substation (Brubaker) near the territory border and a new 138 kV line from the new substation to Longview (B1935).
• Estimated Project Cost (B1935): $18M
• Required IS Date (B1935): 6/1/2015
• Recommend the cancellation of B1935
• New Proposed Solution: see next 2 slides.
ATSI Transmission Zone

Continued from previous slide...

Change in scope of upgrade addressing the Howard – Brookside 138 kV overload:

- The Howard – Brookside 138 kV tie line (AEP/ATSI) is overloaded for the tower contingency loss of the Galion - Leaside 138 kV line and the Galion - GM Mansfield 138 kV line.

- New Proposed Solution: Reconductor the ATSI portion of the Howard - Brookside 138 kV line (b2122.1).
  - Cost Estimate: $7.75 M

- New Proposed Solution: Upgrade terminal equipment at Brookside on the Howard - Brookside 138 kV line (b2122.2).
  - Cost Estimate: $63 K
  - Required IS Date: 6/1/2015.
• Continued from previous slide…
• Change in scope of upgrade addressing the Howard – Brookside overload:
• The Howard – Brookside 138 kV tie line (AEP/ATSI) is overloaded for the tower contingency loss of the Galion -Leaside 138 kV line and the Galion - GM Mansfield 138 kV line.
• New Proposed Solution: Upgrade terminal equipment at Howard on the Howard - Brookside 138 kV line (b2122.3).
• Cost Estimate: $600 K
• New Proposed Solution: Perform a sag study on the Howard - Brookside 138 kV line(b2122.4).
• Cost Estimate: $32 K
• Required IS Date: 6/1/2015.
• Need to relocate substation control equipment due to the generation deactivations at Shawville.

• Proposed Solution: Shawville Substation: Relocate 230 kV and 115 kV controls from the generating station building to a new control building (b2212).

• Cost Estimate: $6.7 M

• Required IS Date: 12/1/2014.
Need to relocate substation control equipment due to the generation deactivations at Armstrong.

Proposed Solution: Armstrong Substation: Relocate 138 kV controls from the generating station building to a new control building (b2213).

Cost Estimate: $2.7 M

Required IS Date: 12/1/2013.
• Need to relocate substation control equipment due to generation deactivations at Albright.

• Proposed Solution: Albright Substation: Install a new control building in the switchyard and relocate controls and SCADA equipment from the generating station building to the new building (b2214).

• Cost Estimate: $3.4 M

• Required IS Date: 6/30/2014.
• Need to relocate substation control equipment due to generation deactivations at Rivesville.

• Proposed Solution: Rivesville Switching Station: Relocate controls and SCADA equipment from the generating station building to a new control building (b2215).

• Cost Estimate: $800 K

• Required IS Date: 12/31/2013.
Need to relocate substation control equipment due to generation deactivation at Willow Island.

**Proposed Solution:** Willow Island: Install a new 138 kV cross bus at Belmont Substation and reconnect and reconfigure the 138 kV lines to facilitate removal of the equipment at Willow Island switching station (b2216).

- Cost Estimate: $2.0 M
- Required IS Date: 12/31/2014.
The Brues 138 kV bus section 1-2 is overloaded for the N-1-1 loss of the Kammer – South Canton 765 kV line and South Canton 765/345 kV transformer and South Canton 345/138 kV transformer #4 followed by the loss of the Tidd – West Bellaire 345 kV line.

Proposed Solution: Upgrade relay at the Brues station (b2055).

Cost Estimate: $100 K

Required IS Date: 6/1/2015.
The Parkersburg – Belpre 138 kV line is overloaded for the N-1-1 loss of the Waverly – Williamstown 138 kV line followed by the loss of the Muskingham River 345/138 kV transformer banks A & B.

Proposed Solution: Reconductor 0.33 miles of the Parkersburg - Belpre line and upgrade Parkersburg terminal equipment (b2117).

Cost Estimate: $250 K

Required IS Date: 6/1/2015.
• Low voltage magnitude at the Paden City and New Martinsville 138 kV buses for the N-1-1 loss of the Kammer – Natrium 138 kV line followed by the loss of the Kammer – Ormet 138 kV line.
• Proposed Solution: Add a 44 MVAR Capacitor at New Martinsville (b2118).
• Cost Estimate: $1.10 M
• Required IS Date: 6/1/2015.
• The Carlls Corner - Laurel 69 kV line is overloaded for the tower contingency loss of the BL England – Scull – Mill 138 kV lines #1 and #2.
• Proposed Solution: Upgrade the 69 kV bus at Laurel (b2123).
• Cost Estimate: $175 K
• Required IS Date: 6/1/2015.
• The Lake Lynn - Lardin 138 kV line #1 is overloaded for the loss of the Lake Lynn - Lardin 138 kV line #2.

• The Lake Lynn - Lardin 138 kV line #2 is overloaded for the loss of the Lake Lynn - Lardin 138 kV line #1.

• Proposed Solution: Six-Wire Lake Lynn - Lardin 138 kV circuits (b2120).

• Cost Estimate: $0.1 M

• Required IS Date: 6/1/2015.
• N-1-1 Thermal Violation

• The Marlowe – Halfway 138 kV line is overloaded for the loss of the Nipetown - Bedington 138 kV line and Bedington - Doubs 500kV line

• Proposed Solution: Replace 1000 Cu Substation Conductor and 1200 Amp Wave Trap at Marlowe (b2267)

• Estimate Project Cost: $0.05M

• Required IS Date: 6/1/2017
• N-1-1 Thermal Violation

• Overload of the Double Toll Gate – Riverton 138 kV circuit due to various N-1-1 contingency combinations

• Proposed Solution: Reconductor 6.8 Miles of 138 kV 336ACSR with 336ACSS from Double Toll Gate to Riverton. (b2268)

• Estimate Project Cost: $3.5M

• Required In-Service Date: 6/1/2017
• **N-1-1 Thermal Violation:**
  • The Susquehanna-Jenkins 230 kV circuit is overloaded for multiple N-1-1 contingencies.
  • **Proposed Solution:**
    - Rebuild approximately 23.7 miles of the Susquehanna-Jenkins 230 kV circuit. This upgrade replaces a temporary SPS scheme that is already planned to mitigate the violation until this longer term solution is implemented (B2269).

• **Estimated Project Cost:**
  - $109.5 M

• **Expected IS Date:**
  - 11/30/2019
The Croydon – Burlington 230 kV line is overloaded for various contingencies. Additional reinforcement of the line is needed as loading on the line has increased due to the various generator deactivations.

**Original Solution:** Reconductor the PECO portion of the Burlington - Croydon circuit and replace aerial wire at Croydon (b1197).

- Cost Estimate: $1.0 M
- Required IS Date: 6/1/2014.

**Revised Solution:** Reconductor the PECO portion of the Burlington - Croydon circuit, replace some towers, and replace aerial wire at Croydon (b1197).

- Cost Estimate: $4.4 M
- Required IS Date: 6/1/2014.
• PSE&G Reliability Criteria:
  • Improves reliability at Sewaren station due to condition of equipment. In addition, the Sewaren station was damaged as a result of Superstorm Sandy. The upgrade will also address short circuit violations at Sewaren and prevent future storm damage.

• Proposed Solution:
  – Eliminate the Sewaren 138 kV bus by installing a new 230 kV bay at Sewaren 230 kV (B2276).
  – Convert the two 138 kV circuits from Sewaren – Metuchen to 230 kV circuits including the Lafayette and Woodbridge substations. (B2276.1).
  – Reconfigure the Metuchen 230 kV station to accommodate the two converted circuits (B2276.2).

• Estimated Project Cost:
  – $ 101 M

• Expected IS Date:
  – 6/1/2015
### Proposed Final Solutions - MAAC

Solutions to address operational performance due to high voltage in PJM Operations

<table>
<thead>
<tr>
<th>Upgrade ID</th>
<th>Description</th>
<th>TO</th>
<th>In Service Date</th>
<th>Cost Estimate ($M)</th>
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<tr>
<td>b2175.1</td>
<td>200 MVAR shunt reactor at Brunot Island 345 kV</td>
<td>DL</td>
<td>6/1/2016</td>
<td>8.65</td>
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<tr>
<td>b2175.2</td>
<td>200 MVAR shunt reactor on future Brunot Island – Carson 345 kV circuit</td>
<td>DL</td>
<td>6/1/2016</td>
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<td>b2229</td>
<td>Install a 300 MVAR reactor at Dequine 345 kV</td>
<td>AEP</td>
<td>12/1/2016</td>
<td>8</td>
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<tr>
<td>b2230</td>
<td>Replace existing 150 MVAR reactor at Amos 765 kV substation on Amos – N. Proctorville - Hanging Rock with 300 MVAR reactor</td>
<td>AEP</td>
<td>6/1/2016</td>
<td>5</td>
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<td>b2231</td>
<td>Install 765 kV reactor breaker at Dumont 765 kV substation on the Dumont - Wilton Center line</td>
<td>AEP</td>
<td>12/1/2015</td>
<td>2</td>
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<tr>
<td>b2232</td>
<td>Install 765 kV reactor breaker at Marysville 765 kV substation on the Marysville - Maliszewski line</td>
<td>AEP</td>
<td>6/1/2015</td>
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<td>b2233</td>
<td>Change transformer tap settings for the Baker 765/345 kV transformer</td>
<td>AEP</td>
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<td>b2235</td>
<td>130 MVAR reactor at Monocacy 230 kV</td>
<td>APS</td>
<td>6/1/2015</td>
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### Proposed Final Solutions - MAAC

Solutions to address operational performance due to high voltage in PJM Operations

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<th>In Service Date</th>
<th>Cost Estimate ($M)</th>
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<td>b2239</td>
<td>50 MVAR reactor at Saddlebrook 230 kV</td>
<td>PSEG</td>
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<td>9.2</td>
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<td>b2240</td>
<td>50 MVAR reactor at Athenia 230 kV</td>
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<td>b2241</td>
<td>50 MVAR reactor at Bergen 230 kV</td>
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<td>b2242</td>
<td>50 MVAR reactor at Hudson 230 kV</td>
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<td>b2243</td>
<td>Two 50 MVAR reactors at Stanley Tce 230 kV</td>
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<td>b2244</td>
<td>50 MVAR reactor at West Orange 230 kV</td>
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<td>b2245</td>
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<td>PSEG</td>
<td>6/1/2015</td>
<td>6.9</td>
</tr>
<tr>
<td>b2246</td>
<td>150 MVAR reactor at Camden 230 kV</td>
<td>PSEG</td>
<td>6/1/2015</td>
<td>8.3</td>
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<tr>
<td>b2247</td>
<td>150 MVAR reactor at Gloucester 230 kV</td>
<td>PSEG</td>
<td>6/1/2015</td>
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<tr>
<td>b2248</td>
<td>50 MVAR reactor at Clarksville 230 kV</td>
<td>PSEG</td>
<td>6/1/2015</td>
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<td>b2249</td>
<td>50 MVAR reactor at Hinchmans 230 kV</td>
<td>PSEG</td>
<td>6/1/2015</td>
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<td>b2250</td>
<td>50 MVAR reactor at Beaverbrook 230 kV</td>
<td>PSEG</td>
<td>6/1/2015</td>
<td>7</td>
</tr>
<tr>
<td>b2251</td>
<td>50 MVAR reactor at Cox's Corner 230 kV</td>
<td>PSEG</td>
<td>6/1/2015</td>
<td>7</td>
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</table>
Solutions to address operational performance due to high voltage in PJM Operations

<table>
<thead>
<tr>
<th>Upgrade ID</th>
<th>Description</th>
<th>TO</th>
<th>In Service Date</th>
<th>Cost Estimate ($M)</th>
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<tbody>
<tr>
<td>b2227</td>
<td>50 MVAR shunt reactor at Mickleton 230 kV and relocate Mickleton #1 230 69 kV transformer</td>
<td>AEC</td>
<td>6/1/2016</td>
<td>7.6</td>
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<td>b2228</td>
<td>+150/-100 MVAR SVC at Cedar 230 kV</td>
<td>AEC</td>
<td>6/1/2016</td>
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<td>b2234</td>
<td>2x130 MVAR reactor at West Wharton 230 kV</td>
<td>JCPL</td>
<td>4/1/2015</td>
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<tr>
<td>b2236</td>
<td>50 MVAR reactor at Buckingham 230 kV</td>
<td>PECO</td>
<td>12/31/2017</td>
<td>3.9</td>
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<tr>
<td>b2237</td>
<td>150 MVAR shunt reactor at Alburtis 500 kV</td>
<td>PPL</td>
<td>6/1/2016</td>
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<tr>
<td>b2238</td>
<td>100 MVAR shunt reactor at Elimsport 230 kV</td>
<td>PPL</td>
<td>6/1/2016</td>
<td>6.5</td>
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<tr>
<td>b2279</td>
<td>Add two 100 MVAR reactors at Dickerson Station H and two 100 MVAR reactors at Brighton 230 kV substation</td>
<td>PEPCO</td>
<td>6/1/2016</td>
<td>16</td>
</tr>
</tbody>
</table>

* PJM estimate
Additional & Temporary Bath County SPS

- Install temporary Bath County SPS (B2281)
  - To support RTEP project B1908 – Rebuild Dooms – Lexington 500 kV

- Required in-service date: 9/1/2014

- Estimated project cost: $1.5 M
• **Common Mode Outage Violation:**
  - The Upper Pittsgrove – Landis 138 kV circuit is overloaded for line fault with stuck breaker at Churchtown contingency, resulting in the loss of the Churchtown – Chambers and Churchtown – Orchard 230 kV circuits.

• **Proposed Solution:**
  - Rebuild 9.7 miles of circuit 1406 (Upper Pittsgrove – Landis 138 kV) and an upgrade of the Landis terminal equipment (B2283).

• **Estimated Project Cost:**
  - $11.2 M

• **Expected IS Date:**
  - 6/1/2018
• Common Mode Outage Violation:
  • The Frackville – Siegfried 230 kV circuit is overloaded for the Montour – Susquehanna 230 kV tower line contingency.

• Proposed Solution:
  – Rebuild the Siegfried-Frackville 230 kV line (B2282).

• Estimated Project Cost:
  – $84.5 M

• Expected IS Date:
  – 6/1/2018
• The Charles 138 kV breaker ‘919’ is overstressed
• Proposed Solution: Revising the reclosing of Charles 138 kV breaker ‘919’ to 15 sec (b2303)
• Estimated Project Cost: $0
• Expected IS Date: 6/1/2014
• The USAP 138 kV breaker ‘XFMR’ is overstressed

• Proposed Solution: Replace the USAP 138 kV breaker ‘XFMR’ (b2280)

• Estimated Project Cost: $0.33M

• Expected IS Date: 6/1/2014


Estimated Project Cost: $60K per breaker

Expected IS Date: 6/1/2014
• Common Mode Outage Violation:
  • The Atlantic – W4-021 – Freneau 230 kV circuit is overloaded for multiple tower line contingencies.
• Proposed Solution:
  – Freneau Substation - upgrade 2.5 inch pipe to bundled 1590 ACSR conductor at the K1025 230 kV Line Terminal (B2289).
• Estimated Project Cost:
  – $0.0791M
• Expected IS Date:
  – 6/1/2018
• Generation Deliverability and Common Mode Outage Violation:
  • The Raritan River – Kilmer – Lake Nelson – Middlesex Switch Rock 230 kV circuit I-1023 is overloaded for several single, tower, and faulted breaker contingencies.
  
  • Proposed Solution:
    – Replace disconnect switches at Kilmer, Lake Nilson and Greenbrook 230 kV substations on the Raritan River - Middlesex (I-1023) circuit (B2290).
  
  • Estimated Project Cost:
    – $4.5 M
  
  • Expected IS Date:
    – 6/1/2018
Generation Deliverability and Common Mode Outage Violation:

The Kilmer – Lake Nelson 230 kV circuit W-1037 is overloaded for several single, tower, and faulted breaker contingencies.

Proposed Solution:
- Replace circuit switcher at Lake Nelson 230 kV substation on the Raritan River - Middlesex (W-1037) circuit (B2291).

Estimated Project Cost:
- $0.25 M

Expected IS Date:
- 6/1/2018
- **Generation Deliverability Violation:**
  - The Susquehanna – Jenkins 230 kV circuit is overloaded for several contingencies.

- **Proposed Solution:**
  - Advance the in-service date of the B2269 (Rebuild approximately 23.7 miles of the Susquehanna - Jenkins 230 kV circuit) from 11/30/2019 to 6/1/2018.

- **Estimated Project Cost:**
  - $0 M

- **Expected IS Date:**
  - 6/1/2018
- The Whippany 230 kV breaker ‘B1 (CAP)’ is overstressed
- Proposed Solution: Replace the Whippany 230 kV breaker ‘B1 (CAP)’ with a 63kA breaker (b2292)
- Estimated Project Cost: $326 K
- Expected IS Date: 6/1/2014
• The Erie South 230 kV breaker ‘Buffalo Rd’ is overstressed
• Proposed Solution: Replace the Erie South 230 kV breaker ‘Buffalo Rd’ with 40kA breaker (b2293)
• Estimated Project Cost: $142.3 K
• Expected IS Date: 6/1/2014
• The Johnstown 115 kV breaker ‘BON AIR’ is overstressed
• Proposed Solution: Replace Johnstown 115 kV breaker ‘BON AIR’ with 40kA breaker ‘(b2294)
• Estimated Project Cost: $181.3 K
• Expected IS Date: 6/1/2014
• The Salem 500kV breaker ‘10X’ is overstressed
• Proposed Solution: Replace the Salem 500kV breaker ‘10X’ with a 63kA breaker (b2295)
• Estimated Project Cost: $3.2 M
• Expected IS Date: 6/1/2014
- The Mickleton 230 kV breakers ‘PCB V’ and ‘PCB U’ are overstressed
- Proposed Solution: Replace the Mickleton 230 kV breakers ‘PCB V’ and ‘PCB U’ with 63kA breakers (b2296-b2297)
- Estimated Project Cost: $400 K (per breaker)
- Expected IS Date: 6/1/2014
• Low Voltage and Voltage Drop Violations - AEP Criteria

• Low voltage and voltage drop issues at Marcellus 34.5kV buses for base case and the loss of Corey transformer

• Establish a new 138/12 kV station, transfer and consolidate load from its Nicholsville and Marcellus 34.5kV stations at this new station. (B2344.1)
• Tap the Hydramatic – Valley 138 kV circuit (~ structure 415), build a new 138 kV line (~3.75 miles) to this new station. (B2344.2)
• From this station, construct a new 138 kV line (~1.95 miles) to REA’s Marcellus station. (B2344.3)
• From REA’s Marcellus station construct new 138 kV line (~2.35 miles) to a tap point on Valley – Hydramactic 138 kV ckt (~structure 434). (B2344.4)
• Retire sections of the 138 kV line in between structure 415 and 434 (~2.65 miles). (B2344.5)
• Retire AEP’s Marcellus 34.5/12 kV and Nicholsville 34.5/12 kV stations and also the Marcellus – Valley 34.5 kV line. (B2344.6)

• Estimated Project Cost: $15M
• Expected IS Date: 6/1/2018
• Low Voltage and Voltage Drop Violations - AEP Criteria

• Low voltage and voltage drop issues at Keeler and Sister Lake 34.5kV buses for base case and the loss of Corey transformer

• Construct a new 69 kV line from Hartford to Keeler (~8 miles)  (B2345.1)
• Rebuild the 34.5 kV lines between Keeler - Sister Lakes and Glenwood tap switch to 69 kV (~12 miles)  (B2345.2)
• Implement in - out at Keeler and Sister Lakes 34.5kV stations (B2345.3)
• Retire Glenwood tap switch and construct a new Rothadew station. These new lines will continue to operate at 34.5 kV. (B2345.4)

• Estimated Project Cost: $30M
• Expected IS Date: 6/1/2018
• **Generator Deliverability Violation/ Basecase Analysis Violation**

  • The North Bellville – Millwood 138 kV line is overloaded for the loss of the Galion – Ohio Central 345kV line.

  • Perform a sag study for Howard - North Bellville – Millwood 138 kV line including terminal equipment upgrades. (B2346)

  • Estimated Project Cost: $0.273M

  • Expected IS Date: 6/1/2018
- **Common Mode Outage Procedure Violation**

- The S073 – North Delphos 138 kV line is overloaded for multiple category C contingencies.

- Replace the North Delphos 600A switch. Rebuild approximately 18.7 miles of 138 kV line North Delphos - S073. Reconductor the line and replace the existing tower structures. (B2347) – Converted from N3231 (Cancel N3231)

- Estimated Project Cost: $22.44M

- Expected IS Date: 6/1/2017
- **AEP Criteria Violation**
  - The Garden Creek - Whetstone Branch - Knox Creek - Coal Creek 69kV lines are overloaded for the loss of the Claypool Hill - Broadford 138 kV line.
  - Reinforce existing 69kV network by constructing a new 138 kV line from Richlands Station to intersect with the Hales Branch – Grassy Creek 138 kV circuit. (B2348)
  - Estimated Project Cost: $28M
  - Expected IS Date: 6/1/2017
• **Project Update – B2256**

  • Original description: Rebuild approximately 20 miles of Ross - Harrison 138 kV line in Ohio.

  • New description: Upgrade approximately 36 miles of 138 kV through path facilities between Harrison 138 kV station and Ross 138 kV station in Ohio.

  • OLD Estimated Project Cost: $40.5M

  • New Estimated Project Cost: $45M

  • Expected IS Date: 6/1/2017
• **Basecase Analysis Violation – NERC Category C**

  • Low voltage at Vandergrift, Kiski Valley, Brackenridge and Allegheny #4 Ludlum 138 kV buses for multiple category C contingencies.

  • Install 39.6 MVAR Capacitor at Shaffers Corner 138 kV Substation. (B2341)

  • Estimated Project Cost: $1.4 M

  • Expected IS Date: 6/1/2018
• **NERC Category C - N - 1 - 1 Voltage Violation**

  - Low Voltage at East Run Tap 138 kV, Flat Run, Mobley, Middlebourne, Metz, Jacksonburg, Fairview, Dents Run 138 kV buses for the loss of the Fairview – Grant Town 138 kV line and the loss of the Whiteley – Blacksville – Miracle Run 138 kV line with Mark West load addition at Mobley metering point.

  - Construct a new 138 kV switching station (Shuman Hill substation), which is next the Mobley 138 kV substation and install a 31.7 Mvar capacitor. (B2342)

  - Estimated Project Cost: $1.73M

  - Expected IS Date: 12/31/2013
• **FE Criteria Violation**

  • Low voltage and voltage drop violation at multiple 138 kV buses such as Mobley, Sherwood, Flat Run138 kV buses and ect. for various "Open Ended" outages for MarkWest load addition at Sherwood metering point; the risk of voltage violations (i.e. Loss of Load) will be greater than 100 hours.

  • Install a 31.7 Mvar capacitor at West Union 138 kV substation. (B2343)

  • Estimated Project Cost: $0.95M

  • Expected IS Date: 12/31/2013
• **Additional Scope for B2174**

  • **Original Scope:**
    • See baseline project B2174 – reconfiguration of the 69 kV and 138 kV network in the Duquesne zone

  • **Added Scope:**
    • Replace relays at Mitchell 138 kV substation (B2174.8)
    • Estimated Project Cost: $0.15M
    • Replace primary relay at Piney Fork 138 kV substation (B2174.9)
    • Estimated Project Cost: $0.035M
    • Perform relay setting changes at Bethel Park 138 kV substation (B2174.10)
    • Estimated Project Cost: $0.005M

  • Expected IS Date: 6/1/2015
**Project Cancellation**

- **Driver:** Cancellation of S0027 – New Load serving substation at South Chambersburg 138 kV

- **Cancel B1824:** Reconductor Grand Point - Guilford 138 kV line approximately 8 miles of 556 ACSR with 795 ACSR

- **Estimated Project Cost:** $3.75M

- **Expected IS Date:** 6/1/2016
• **Project Scope Change**

  • B1840
  
  • Original Scope: Construct a 138 kV line between Buckhannon and Weston 138 kV substations
  • Estimated Project Cost: $17.5M

  • New Scope: Loop the Buckhannon - Glen Falls 138 kV line into West Milford Substation
  • Estimated Project Cost: $12.2M

  • Expected IS Date: 6/1/2015
• **Project Cancellation**

• B1299: Add SCADA control and motor operators to switches 13153 and 13154 near Silica

• Estimated Project Cost: $0.55M

• Expected IS Date: 6/1/2015

• Reason: This project is no longer needed given the generation retirements and associated transmission projects in the ATSI zone
• **Project Cancellation**

  - B1691: Install a new Bluebell - S. Akron 138 kV circuit
  - B1691.1: Un - six wire sections of E. Akron - Knox 138 kV
  - B1691.2: Un - six wire sections of Bluebell - C. Central 138 kV
  - B1691.3: Reconductor approximately 5.5 miles of ACSR with ACSS conductor from Bluebell to start of 6 - wire sections
  - B1691.4: Create Bluebell - South Akron 138 kV line with new connections
  - B1691.5: Replace 250 Cu and 336.4 ACSR with 954 ACSR SSCIR at Bluebell
  - B1691.6: Replace Relays at Bluebell and add line breaker at tap to Alliance Castings

  - Estimated Project Cost: $3.3M
  - Expected IS Date: 6/1/2016

  - **Reason:** This project is no longer needed due to B1977: Build new Toronto 345/138 kV substation by looping in the Sammis – Wylie Ridge 345 kV line and tie in four 138 kV lines
- **NERC Category C3 - N - 1 - 1 thermal Violation**

  - The Greensburg – Green County 69kV line can not be dispatched below normal rating for the loss of the Green County – Marion County 161kV line.

  - Upgrade the bus and jumpers with 750 MCM copper conductor at Green County 69KV substation.(B2309)

  - Estimated Project Cost: $0.1M

  - Expected IS Date: 6/1/2018
EKPC Criteria Violation

- Overload of the North Springfield - South Springfield 69 kV line during an outage of the Hodgenville - Sulphur Creek 69 kV line with LGE/KU's Brown Unit #3 off.

- Increase the maximum operating temperature of the North Springfield - South Springfield 69 kV line to 167 degrees Fahrenheit. (B2310)

- Estimated Project Cost: $0.16M

- Expected IS Date: 6/1/2015
• **EKPC Criteria Violation**

  • Overload of the Loretto - Sulphur Creek 69 kV line during an outage of the East Bardstown - Owens Illinois 69 kV line with LGE/KU's Brown Unit #3 off.

  • Increase the maximum operating temperature of the Loretto - Sulphur Creek 69 kV line to 167 degrees Fahrenheit. (B2311)

  • Estimated Project Cost: $0.16M

  • Expected IS Date: 6/1/2015
• **EKPC Criteria Violation**

  • Overload of the Loretto - South Springfield 69 kV line during an outage of the East Bardstown - Owens Illinois 69 kV line with LGE/KU's Brown Unit #3 off.

  • Increase the maximum operating temperature of the South Springfield - Loretto 69 kV line to 167 degrees Fahrenheit. (B2312)

  • Estimated Project Cost: $0.07M

  • Expected IS Date: 6/1/2015
• **EKPC Criteria Violation**

  - Low voltage at the Parkway 69 kV bus for an outage of the Patton Road Junction - Fox Hollow 69 kV line and at the Goodnight 69 kV bus for an outage of the Summershade - Barren County 161 kV line with Cooper Unit #2 off.

  - Construct 8.8 miles of 69 kV line between the Cave City and Bon Ayr distribution substations. Operate this line normally open. (B2313)

  - Estimated Project Cost: $3.63M

  - Expected IS Date: 12/1/2013
EKPC Criteria violation

Low voltage at the Mercer County Industrial 69 kV bus during normal conditions; non-convergent solution during an outage of the North Springfield - Mackville 69 kV line section with Dale Unit #3 off.

- Construct 8.6 miles of 69 kV line between the Mercer County Industrial and Van Arsdell distribution substations.
- Construct a new 69 kV switching station ("South Anderson") adjacent to the LGE/KU Bonds Mill substation.
- Loop the North Springfield - Van Arsdell 69 kV line through South Anderson.
- Terminate the existing 69 kV interconnection to the LGE/KU Bonds Mill substation at South Anderson and establish a second 69 kV interconnection from South Anderson to the LGE/KU Bonds Mill substation.
- Construct 0.12 miles of 69 kV line from South Anderson to the Powell Taylor distribution substation and serve this substation radially from South Anderson.

- Estimated Project Cost: $6.64M
- Expected IS Date: 12/1/2013
• **EKPC Criteria Violation**

Low voltage at the Mercer County Industrial 69 kV bus during normal conditions; non-convergent solution during an outage of the North Springfield - Mackville 69 kV line section with Dale Unit #3 off.

• Increase the size of the existing HT Adams 69 kV, 7.2 MVAR capacitor bank to 14.28 MVAR. (B2315)

• Estimated Project Cost: $0.05M

• Expected IS Date: 12/1/2013
• **EKPC Criteria Violation**

• Low voltage at the Mercer County Industrial 69 kV bus during normal conditions; non-convergent solution during an outage of the North Springfield - Mackville 69 kV line section with Dale Unit #3 off.

• Increase the size of the existing Hunt Farm Junction 69 kV, 8.2 MVAR capacitor bank to 16.33 MVAR. (B2316)

• Estimated Project Cost: $0.05M

• Expected IS Date: 12/1/2013
EKPC Transmission Zone

• **EKPC Criteria Violation**

  - Low voltage at the Keith and Penn 69 kV buses during an outage of the Adams - Penn 69 kV line or during an outage of LGE/KU's Adams 138/69 kV transformer.

  - Construct 10.9 miles of 69 kV line between the Owen County substation and the Keith distribution substation. Operate the existing Penn - Keith 69 kV line normally - open. (B2317)

• Estimated Project Cost: $3.94M

• Expected IS Date: 6/1/2014
EKPC Criteria Violation

- Low voltage at the Parkway 69 kV bus for an outage of the Fox Hollow - Parkway 69 kV line.
- Construct 2.7 miles of 69 kV line between the Fox Hollow substation and the Parkway distribution substations. Serve the Parkway #1 and #2 distribution substations radially from Fox Hollow. Operate the Cave City - Bon Ayr 69 kV line normally - closed. (B2318)

- Estimated Project Cost: $3.09M
- Expected IS Date: 6/1/2014
• **EKPC Criteria Violation**

  - Overload of the Helechawa - Sublett 69 kV line during an outage of the Skaggs - Maggard 69 kV line with LGE/KU's Trimble County Unit #2 off.

  - Increase the maximum operating temperature of the Helechawa - Sublett 69 kV line to 167 degrees Fahrenheit. (B2319)

• Estimated Project Cost: $0.1M

• Expected IS Date: 6/1/2014
EKPC Transmission Zone

- **EKPC Criteria Violation**

  - Low voltage at the Van Arsdell 69 kV bus during an outage of the Clay Lick Junction - Van Arsdell 69 kV line with LGE/KU's Brown Unit #3 off.

  - Install a 69 kV, 15.31 MVAR capacitor bank at the Perryville substation. (B2320)

  - Estimated Project Cost: $0.28M

  - Expected IS Date: 6/1/2014
• **EKPC Criteria Violation**

• Low voltage at the Veechdale 69 kV bus during an outage of the Shelby County 161/69 kV transformer.

• Install a 69 kV, 25.51 MVAR capacitor bank at the Veechdale substation. (B2321)

• Estimated Project Cost: $0.41M

• Expected IS Date: 6/1/2014
• **EKPC Criteria Violation**

• Overload of the Dale - Three Forks 138 kV line during an outage of the JK Smith - Union City 138 kV line with Cooper Unit #2 off.

• Change the CT tap on circuit breaker N35 - 804 at Dale Station to at least 800 amps to increase the relay loadability on the Dale - Three Forks 138 kV line to at least 282 MVA. (B2322)

• Estimated Project Cost: $0M

• Expected IS Date: 6/1/2014
EKPC Criteria Violation

- Low voltage at the Millersburg and Reid Village 69 kV buses during an outage of the Hunt - Miller Hunt 69 kV line with LGE/KU's Brown Unit #3 off; low voltage at the Millersburg and Headquarters 69 kV buses during an outage of LGE/KU's Kenton 138/69 kV transformer with LGE/KU's Brown Unit #3 off.

- Rebuild the existing Cynthiana - Headquarters 69 kV line using 556.5 MCM ACSR conductor and operate this line normally closed. (B2323)

- Estimated Project Cost: $1.73M

- Expected IS Date: 12/1/2015
EKPC Criteria Violation

Overload of the JK Smith - Dale 138 kV line during an outage of the North Clark - Avon 345 kV line with LGE/KU's Brown Unit #3 off.

Remove the existing 1200 - amp line traps at JK Smith and Dale associated with the JK Smith - Dale 138 kV line.(B2324)

Estimated Project Cost: $0M

Expected IS Date: 12/1/2015
• **EKPC Criteria Violation**

• Overload of the Glendale - Hodgenville 69 kV line during an outage of LGE/KU's Elizabethtown - Elizabethtown #4 69 kV line with LGE/KU's Brown Unit #3 off.

• Increase the maximum operating temperature of the Glendale - Hodgenville 69 kV line to 212 degrees Fahrenheit. (B2325)

• Estimated Project Cost: $0.14M

• Expected IS Date: 6/1/2015
EKPC Transmission Zone

- **EKPC Criteria Violation**

- Overload of the Fayette - Davis 69 kV line during an outage of LGE/KU's Brown - Baker Lane - Higby Mill 138 kV line with Cooper Unit #2 off.

- Increase the maximum operating temperature of the Fayette - Davis 69 kV line to 248 degrees Fahrenheit. (B2326)

- Estimated Project Cost: $0.08M

- Expected IS Date: 6/1/2017
EKPC Criteria Violation

Overload of the Boone - Boone Distribution 69 kV line during an outage of the Hebron DEOK - Hebron EKPC 138 kV line with LGE/KU's Trimble County Unit #2 off.

Increase the maximum operating temperature of the Boone - Boone Distribution 69 kV line to 302 degrees Fahrenheit. (B2327)

Estimated Project Cost: $0.01M

Expected IS Date: 6/1/2015
EKPC Criteria Violation

Overload of the West Bardstown Junction - West Bardstown 69 kV line during an outage of the Bullitt County 161/69 kV transformer with LGE/KU's Mill Creek Unit #4 off.

Increase the maximum operating temperature of the West Bardstown Junction - West Bardstown 69 kV line to 284 degrees Fahrenheit. (B2328)

Estimated Project Cost: $0.14M

Expected IS Date: 6/1/2015
EKPC Transmission Zone

- **EKPC Criteria Violation**
  - Overload of the Magnolia - Summersville 69 kV line during an outage of the Green County 161/69 kV transformer with Cooper Units #1 & #2 off.
  - Increase the maximum operating temperature of the Magnolia - Summersville 69 kV line to 167 degrees Fahrenheit (B2329)
  - Estimated Project Cost: $0.24M
  - Expected IS Date: 6/1/2015
• **EKPC Criteria Violation**

• Overload of the Liberty Church - Bacon Creek 69 kV line during an outage of LGE/KU's Farley - US Steel 69 kV line with Cooper Units #1 & #2 off.

• Increase the maximum operating temperature of the Bacon Creek - Liberty Church 69 kV line to 212 degrees Fahrenheit. (B2330)

• Estimated Project Cost: $0.03M

• Expected IS Date: 6/1/2015
EKPC Criteria Violation

Overload of the Headquarters - Millersburg Junction 69 kV line during an outage of the Hunt - Miller Hunt 69 kV line.

Increase the maximum operating temperature of the Headquarters - Millersburg Junction 69 kV line to 167 degrees Fahrenheit. (B2331)

Estimated Project Cost: $0.08M

Expected IS Date: 6/1/2015
EKPC Transmission Zone

• **EKPC Criteria Violation**

  • Overload of the JK Smith - Dale 138 kV line during an outage of the North Clark - Avon 345 kV line with LGE/KU's Brown Unit #3 off.

  • Increase the maximum operating temperature of the JK Smith - Dale 138 kV line to 275 degrees Fahrenheit.(B2332)

  • Estimated Project Cost: $0.19M

  • Expected IS Date: 6/1/2015
• **EKPC Criteria Violation**

• Overload of the Elizabethtown - Tunnel Hill 69 kV line during an outage of LGE/KU's Elizabethtown - Nelson County - Bardstown 138 kV line with Brown Unit #3 off.

• Increase the maximum operating temperature of the Elizabethtown - Tunnel Hill 69 kV line to 284 degrees Fahrenheit. (B2333)

• Estimated Project Cost: $0.11M

• Expected IS Date: 6/1/2015
• **EKPC Criteria Violation**

• Low voltage at the Keith 69 kV bus during an outage of LGE/KU's Ghent - Owen County - Scott County 138 kV line with LGE/KU's Ghent Unit #1 off and low voltage at the Clay Village 69 kV bus during an outage of the Clay Village Tap - Clay Village 69 kV line with LGE/KU's Brown Unit #3 off.

• Install a 69 kV, 28.06 MVAr capacitor bank at the Owen County substation. (B2334)

• Estimated Project Cost: $0.36M

• Expected IS Date: 6/1/2017
- **EKPC Criteria Violation**

- Low voltage at the Jenny Wiley 69 kV bus during an outage of the Thelma - Jenny Wiley 69 kV line with an outage of LGE/KU's Mill Creek #4 off.

- Install a 69 kV, 14.29 MVAR capacitor bank at the Magoffin County substation. (B2335)

- Estimated Project Cost: $0.3M

- Expected IS Date: 12/1/2017
• **EKPC Criteria Violation**

  Overload of the Bacon Creek - South Corbin 69 kV line during an outage of LGE/KU's Farley - US Steel 69 kV line with Cooper Units #1 & #2 off.

  Increase the maximum operating temperature of the South Corbin - Bacon Creek 69 kV line to 212 degrees Fahrenheit. (B2336)

• Estimated Project Cost: $0.03M

• Expected IS Date: 6/1/2018
EKPC Criteria Violation

- Low voltage at the Pleasant Grove 69 kV bus during an outage of the Bullitt County 161/69 kV transformer with LGE/KU's Mill Creek Unit #4 off.

- Increase the size of the existing Cedar Grove 69 kV, 10.8 MVAR capacitor bank to 20.41 MVAR. (B2337)

- Estimated Project Cost: $0.06M

- Expected IS Date: 6/1/2018
• **EKPC Criteria Violation**

• Overload of the Nelson County - West Bardstown Junction 69 kV line during an outage of LGE/KU's Bardstown 138/69 kV transformer with Cooper Units #1 & #2 off.

• Upgrade the 4/0 copper bus and jumpers at the Nelson County substation associated with the Nelson County - West Bardstown Junction 69 kV line using 500 MCM copper or equivalent equipment. (B2339)

• Estimated Project Cost: $0.1M

• Expected IS Date: 6/1/2018
EKPC Transmission Zone

- **EKPC Criteria Violation**

  - Overload of the Barren County - Horse Cave Tap 69 kV line during an outage of the Bonnieville - Bonnieville Distribution 69 kV line with LGE/KU's Brown Unit #3 off.

  - Increase the Zone 3 distance relay setting at Barren County associated with the Barren County - Horse Cave Tap 69 kV line to at least 85 MVA. (B2340)

- Estimated Project Cost: $0M

- Expected IS Date: 6/1/2018
• Short Circuit Violation

• The Dravosburg 138 kV breaker 'Z73 West Mifflin' is overstressed

• Proposed Solution: Revise the reclosing of the Dravosburg 138 kV breaker 'Z73 West Mifflin' to 15 sec (b2278)

• Estimated Project Cost: $0

• Expected IS Date: 6/1/2014
- **N-1-1 Voltage Violation**
  
  Voltage drop violation at Muskingum 138 kV bus for the loss of Muskingum 345/138 kV transformer C and Muskingum 345/138 kV transformers A and B
  
  Loop the North Muskingum - Crooksville 138 kV line into AEP's Philo 138 kV station which lies approximately 0.4 miles from the line. (B2252)
  
  - Estimated Project Cost: $3.5M
  - Required IS Date: 6/1/2017
• **N-1-1 Voltage Violation**

• Low Voltage at Goodrich, Riverview, Mill Creek, Gorsuch, Harmar Hill 138 kV buses for various contingency pairs

• Install an 86.4 MVAr capacitor bank at Gorsuch 138 kV station in Ohio. (B2253)

• Estimated Project Cost: $0.35M

• Required IS Date: 6/1/2017
• **N-1-1 Thermal Violation**

• The Corner – Degussa 138 kV line is overloaded for the loss of the Oak Grove – Waverly 138 kV line and the Willow - Cytec 138 kV line

• Rebuild approximately 4.9 miles of Corner - Degussa 138 kV line in Ohio (B2254)

• Estimated Project Cost: $7.5M

• Required IS Date: 6/1/2017
• **N-1-1 Thermal Violation**

• The Maliszewski - Polaris 138 kV line is overloaded for the loss of the Genoa – Maliszewski 138 kV line and the Corridor – Genoa 138 kV line

• Rebuild approximately 2.8 miles of Maliszewski - Polaris 138 kV line in Ohio. (B2255)

• Estimated Project Cost: $4.2M

• Required IS Date: 6/1/2017
• **N-1-1 Thermal Violation**

  The Delano–Scippo 138 kV line is overload for the loss of the Biers Run–Bixby 345 kV line and the Biers Run–Circleville 138 kV line

  • Rebuild approximately 20 miles of Ross - Harrison 138 kV line in Ohio. (B2256)

  • Estimated Project Cost: $40.5M

  • Required IS Date: 6/1/2017
• **N-1-1 Voltage Violation**

• Low voltage and voltage drop at The BUSHZ, Corey, GMPLAN, Moore Park 138 kV buses for the loss of 138 kV bus for the loss of the Mottville – Corey – East Elkhart 138 kV line and the Bushz - Flowerfield – Valley 138 kV line

• Rebuild the Pokagon - Corey 69 kV line as a double circuit 138 kV line with one side at 69 kV to serve the existing stations and the other side as an express circuit between Pokagon and Corey 69kV stations. (B2257)

• Estimated Project Cost: $65M

• Required IS Date: 6/1/2017
• **Project Cancellation**

  • Cancel B1872: Add a 57.6 MVAr capacitor bank at East Elkhart 138 kv station in Indiana - $0.6M

  • Cancel B1876: Install a 14.4 MVAr capacitor bank at Capital Avenue (AKA Currant Road) 34.5 kV bus - $0.2M

  • Original Required IS Date: 6/1/2016
• **AEP Criteria Violation**

  • The Tams Mountain - Bolt 46 kV circuit is overloaded for the loss of the Mullens – Wyoming 138 kV line

  • Rebuild 1.41 miles of #2 CU 46kV line between Tams Mountain – Slab Fork to 138 kV standards. The line will be strung with 1033 ACSR (B2258)

  • Estimated Project Cost: $2.4M

  • Required IS Date: 6/1/2017
- **AEP Criteria Violation**
  - The Kammer - Ireland Mine 69kV section is overloaded for the outage of the existing George Washington 138/69kV transformer.
  - Install a new 138/69kV Transformer at George Washington 138/69kV substation to provide support to the 69 kV system in the area (B2259)

- Estimated Project Cost: $7M

- Required IS Date: 03/31/2013
N-1-1 Voltage Violation

Low Voltage magnitude at Stonewall, Carrol, and Taneytown 138 kV buses for various N-1-1 contingency combinations

Proposed Solution: Install 32.4MVAR capacitor at Bartonville (b2260)

- Estimated Project Costs: $0.9M
- Required IS Date: 6/1/2015

Proposed Solution: Install 33MVAR capacitor at Bartonville and Damascus (b2261)

- Estimated Project Costs: $1.1M
- Required IS Date: 6/1/2017
• **Project Cost Change**
  
  • B2171: Replace/Raise structures on the Parsons - William 138 kV line section to eliminate clearance de-rate
  
  • Old Estimated Project Cost: $0.8M
  • New Estimated Project Cost: $0.15M
  
  • Required IS Date: 6/1/2017
• **Project Cost Change**

• B2172: Replace/Raise structures on the Parsons-Loughs Lane 138 kV line section to eliminate clearance de-rate

• Old Estimated Project Cost: $1M
• New Estimated Project Cost: $0.55M

• Required IS Date: 6/1/2017
Deactivation Requirement

- Need to relocate substation control equipment due to the generation deactivations at New Castle.
- Proposed Solution: New Castle Generating Station - Relocate 138 kV, 69kV, and 23kV controls from the generating station building to new control building (B2262)
- New Estimated Project Cost: $1.15M
- Required IS Date: 6/1/2015
Deactivation Requirement

- Need to relocate substation control equipment due to the generation deactivations at Niles.

- Niles Generation Station - Relocate 138 kV and 23kV controls from the generating station building to new control building (B2263)

- New Estimated Project Cost: $2.86M
- Required IS Date: 6/1/2015
Deactivation Requirement

- Need to relocate substation control equipment due to the generation deactivations at Avon Lake.

- Avon Lake Generating Station - Relocate 345kV and 138 kV controls from the generating station building to new control building (B2264)

- New Estimated Project Cost: $1.15M

- Required IS Date: 6/1/2015
Deactivation Requirement

- Need to relocate substation control equipment due to the generation deactivations at Ashtabula.

- Ashtabula Generating Station - Relocate 138 kV controls from the generating station building to new control building (B2265)

- New Estimated Project Cost: $1.15M

- Required IS Date: 6/1/2015
• **N-1-1 Thermal Violation**

  The Cloverdale – Star 138 kV line is overloaded for the loss of the Sammis – Star 345kV line and the loss of the Harmon – Star 345kV line; The Cloverdale – Star 138 kV line can not be dispatched below normal rating for the loss of the Harmon – Star 345kV line.

• Increase the design operating temperature on the Cloverdale – Star 138 kV line (B2285)

• Estimated Project Cost: $0.6805M

• Projected IS Date: 6/1/2017
- **N-1-1 Thermal Violation**

  - The Cloverdale – Barberton 138 kV line is overloaded for the loss of the Sammis – Star 345kV line and the loss of the Harmon – Star 345kV line

  - Increase the design operating temperature on the Cloverdale – Barberton 138 kV line (B2284)

  - Estimated Project Cost: $0.6805M

  - Projected IS Date: 6/1/2017
• **Project Scope Change**

  • B1840

  • Previous Scope: Construct a 138 kV line between Buckhannon and Weston 138 kV substations
  • Previous Estimated Cost: $17.5M

  • New Scope: Loop the Buckhannon - Glen Falls 138 kV line into the West Milford 138 kV Substation
  • New Estimated Cost: $15.8M

  • Projected IS Date: 6/1/2015
Northern Virginia Operational Performance – Update to Existing Upgrade

- Operational Performance: b2125 Project Update
  - Dominion Virginia Power continues to experience high voltage on the 230 kV transmission system in Northern Virginia during periods of light system load.
  - Light load studies identified the need for four additional shunt reactor banks.

- Current Approved Solution:
  - Project b2125 Install four additional 230 kV 100MVAR variable shunt reactor banks at Clifton, Gallows Road, Garrisonville, and Virginia Hills Substations.

- Total Estimated Project Cost: $24 M
- Project Recommendation Update: Change the Gallows Road reactor plan to the Braddock Substation location
- Updated Expected In-Service Date: 10/1/2014
**Operational Performance – New Upgrade Required**

- **Problem:** Performance of the the 59 Line (Elmont to Greenwood DP 115 kV) during scheduled outages
  - The 59 line contains a line segment that has about 211 feet of 545.4 ACAR conductor. This conductor size significantly limits the load transfer capability of Rappahannock Electric Co-op (REC) to their Greenwood Delivery Point from their St. John’s Delivery Point during scheduled outages for both REC and Dominion equipment maintenance and during unscheduled outage restoration.
  - **Proposed solution:** Reconduct this line segment to achieve a summer emergency rating of 906 amps or greater. This rating will match the conductor rating of 721 ACAR that makes up the majority of the remaining 59 Line to Greenwood Delivery Point.

- **Estimated Project Cost:** $50 K
- **Expected IS Date:** 5/31/2014
• **NERC Category B Single Contingency Violation – Update to Existing Upgrade**

• Project # B1316 Revised Solution

• Problem: For loss of Line #55 at Tarboro 115 kV, opening 55T79 at Tarboro and closing 55T80 at Anaconda results in line #80 Battleboro – Heartsease DP 115 kV exceeding 94%.

• Current Approved Solution: Rebuild 10.7 miles of Line #80 (Battleboro – Heartsease 115 kV DP)

• Estimated Project Cost: $11 M

• Expected IS Date: 6/1/2014

• (Proposed Revision Next Page)
Proposed Revision to Existing Baseline Project:

- Original Cost: $11 M
- Additional Scope due to Revised Solution:
  - Pile drive all structures, add additional matting due to considerable amount of wetlands and farm lands, perform extensive bus work at Battleboro Substation and additional forestry work to cover ROW reclamation and dead tree removal from outside of the ROW
  - Rebuild remaining 4 miles of Line #80 (Heartsease DP to switch 55T80) for a total of 14.7 miles (Battleboro to switch 55T80)
    - Prevents remaining segment from affecting reliability of newly rebuilt line serving 3 Coop delivery points
    - Rebuilds old 1927 construction (85 years old)
    - Installs shield wire (none existing)
  - Revised Estimated Project Cost: $19.4 M
• **Update to Existing Project – Revised IS Date**

  • Line #2124 (Hopewell – Prince George 115 kV) Auto-sectionalizing Scheme (Project b2181) IS Date change
  
  • **Reason for change**: Need for coop to support the outage window. Coop ties will not be available until Spring 2015.
  
  • **Problem**: Lockout of Line #2124 Hopewell – Prince George 115 kV causes an outage of Prince George Electric Cooperative’s Brickhouse DP (15 MW).
  
  • **Proposed Solution**: Install a transmission line sectionalizing scheme at Prince George Substation to automatically open the 230 kV switch at Prince George for Line #2124 lockout and allow Brickhouse DP to be re-energized from the 115kV source. This project adds a motor operator to an existing switch at Prince George and the control scheme.

  • **New Expected IS Date**: May 2015
  
  • **Estimated Project Cost**: $1.11 M
• **Cancel Existing Project**

• RTEP #b1697
• Problem: Overload on Clark - Idylwood 230 kV circuit for the outage of Loudoun - Brambleton 500kV and various other 500kV and 230 kV circuits.
• Proposed Solution: Construct a second Clark-Idylwood 230 kV circuit and install gas-hybrid breakers at Clark Substation.
• Terminal upgrades at Clark and Idylwood along with Idylwood – Liberty Crossing project resolves overloads.
• Estimated Project Cost: $18 M

• **Recommendation:** Cancel this project. The limiting element has increased as a result of breaker replacements at Clark and Idylwood.
• Update to Existing Project - NERC Category C Violation

- Project #B1330 IS Date Change due to permitting issues with Metro Washington Airport Authority (MWAA).

- Problem: For a breaker-failure of 2008T2015 at Dulles, over 300 MVA of load lost.

- Proposed Solution: Install a five breaker ring bus at the expanded Dulles Substation to accommodate the existing Dulles arrangement, and support the Metrorail extension.

- Estimated Project Cost: $6 M

- New Expected IS Date: 12/31/2014
Region with voltage issues

NERC Category C N-1-1 Violation – New Upgrade Required

Problem: The 2015 summer base case indicates the following deficiency
• The 2015 summer basecase indicates that for the loss of the Lanexa Substation end of line #2016 (Lanexa – Correctional 115 kV) and the subsequent loss of the Hayes 230-115kV autotransformer, voltages less than 90% at Hayes and Wan Substations are observed.

Proposed Solution:
• Install a 230 kV, 54 MVAR capacitor bank on the 2016 line at Harmony Village Substation.

Expected IS Date: May 2015

Estimated Project Cost $1.2 M
Approved RTEP Project #B1313 – Proposed changes:
1. Revised solution to resolve original NERC violation and a future NERC violation resulting from a new Dominion Distribution delivery point “Hermitage” TD Nov 2014 to be connected to Lines #88 and #159 between Acca and Carver.
2. Target date change from June 2014 to June 2015 to allow sufficient construction time for proposed solution.

2015 NERC Category B Violations

A. NERC Category B. The N-1 loss of Line #159 Acca to Shockoe, with load on Line #159 restored to Shockoe to Hermitage, loads Line #17 Shockoe to Chesterfield to 131.6% of the STE rating.

B. NERC Category B. The N-1 loss of Line #159 Acca to Shockoe, with load on Line #159 restored Shockoe to Hermitage, results in voltages at Hermitage and Shockoe less than 0.93 p.u.
Long Term Solutions Considered:

- Terminate Line #17 at Northeast Sub
- Build 115kV ring bus and 230 kV breaker and a half scheme at Northeast Sub
- Install a 224 MVA 230/115kV transformer at Northeast
- Uprate Line #17 from Shockoe to Northeast 115 kV (4.75 miles) to a minimum of 257 MVA

- Uprate Line #17 from Shockoe to Chesterfield 115 kV (18.5 miles) to a minimum of 257 MVA
- Install a 115kV ring bus at Hermitage Sub for 159 and 88 Lines – 6 breakers. Design uses GIS due to space constraint.

<table>
<thead>
<tr>
<th>Proposed Solution:</th>
<th>Estimated Project Cost</th>
<th>Does solution solve deficiencies?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A Summer 2015</strong></td>
<td><strong>B Summer 2015</strong></td>
<td></td>
</tr>
<tr>
<td>Terminate Line #17 at Northeast Sub. Build a 115kV ring bus and 230 kV breaker and a half scheme at Northeast Sub. Install a 224 MVA 230/115kV transformer at Northeast Sub. Uprate Line #17 from Shockoe to Northeast (4.75 miles) to a minimum of 257 MVA. This solution significantly improves reliability at Northeast Sub and allows for a future 230 kV line to terminate at Northeast Sub.</td>
<td>$20.0M</td>
<td>Yes</td>
</tr>
<tr>
<td>Uprate Line #17 from Shockoe to Chesterfield 115 kV (18.5 miles) to a minimum of 257 MVA. Install a 115kV ring bus at Hermitage Sub for 159 and 88 Lines – 6 breakers. Design uses GIS due to space constraint. * Construction costs may be higher due to adverse terrain conditions requiring additional matting on segment from Northeast to Chesterfield.</td>
<td>$17.7 M *</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Target Date: May 2015
• **Problem:**  **Generation Deliverability – New Upgrade Required**

• **Problem:**  Thermal overload on Line #201 between Pleasant View and the new 230 kV Switching Station for X4-039 for the contingency loss of the 500kV Line #558 from Pleasant View to Brambleton.

• **Recommended Solution:**  Wreck and rebuild approximately 1.3 miles of the existing 230 kV Line #201 and Line #227 double circuit transmission line between Cochran Mill Substation and the X4-039 230 kV Switching Station. The 201 Line summer emergency rating will need to be increased to 1200 MVA or greater.

• **Estimated Project Cost:** $4 M

• **Expected IS Date:** November 2015
Problem: NERC Category C3 N-1-1 Violations  
– New Upgrade Required

The N-1-1 loss of 500/230 kV Transformers #1 and #3 at Lexington results in consequential load loss of 300MW.

Other Issues

Need to shift load from 115kV system to 230 kV to support future loading at Fishersville, Barterbrook, and along line 117 corridor

N-1-1 Loss of 230/115V Txers #2 & #4 at Lexington Substation results in 90 MVA load loss on 115kV network

(Continued Next Page)
Long Term Solutions Considered:

<table>
<thead>
<tr>
<th>Solutions Considered:</th>
<th>Estimated Project Cost</th>
<th>ROW</th>
<th>Does solution solve Deficiencies?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install a new 39 mile 230 kV transmission line from Dooms to Lexington.</td>
<td>$ 35M</td>
<td>Existing</td>
<td>Yes Yes *No</td>
</tr>
<tr>
<td>Install new 500/230/115kV substation along ROW of existing 230 &amp; 115kV lines into Lexington</td>
<td>$ 42 M</td>
<td>New Substation</td>
<td>Yes No Yes</td>
</tr>
</tbody>
</table>

* Installing a 230/115kV station along shared ROW of lines 194 & 555 addresses this deficiency (future).

Recommended Solution:
- Build a new 39 mile 230 kV transmission line from Dooms to Lexington on existing ROW. This new line would utilize the lower position of the 5-2 transmission line structures on Line #555.

Expected IS Date: Summer 2016
Region with thermal issues

- **NERC Category B & C Violations – Date and Scope Change**
- Project #b1696 IS Date Change
- Problem: The 2016 summer base case indicates the following deficiencies:
  - An outage of Line #2035 (Idylwood – CIA) overloads Idylwood 230 kV Bus by 7.1%
  - An outage of Line #215 (Possum Pt to Hayfield) overloads Idylwood 230 kV Bus by 1.2%
  - An outage of Line #241 (Hayfield – Jefferson St) overloads Idylwood 230 kV Bus by 1.1%
  - Outage of Tower Line 248 & 2023 overload Idylwood Bus by 30.5%
  - Operational performance issues with straight bus
- Potential Solution(s)
  - Install a Breaker and Half Scheme
- New Potential IS Date May 2017
- Cost increase from $35M to $55 due to required use of GIS equipment
NERC Category C3 N-1-1 Violation – New Upgrade Required

Problem:
N-1-1 loss of Line #2010 (Reston-Tysons 230 kV) and Line #2035 (Idylwood-CIA 230 kV) results in the loss of more than 300 MW.

Potential Solutions:

A) Construct a 230 kV OH line along existing Line #2035 corridor, approx. 2.4 miles from Idylwood to Dulles Toll Road (DTR) and 2.1 miles on new right-of-way (ROW) along DTR to new Scott’s Run Substation.

B) Same as A, except 2.1 miles along DTR would be UG due to possible ROW constraints.

C) Construct new 230 kV UG line approx. 4.0 miles along new ROW from Idylwood to new Springhill Substation (approx. 0.7 miles south of Tysons Substation).

D) Construct a 9 mile hybrid (OH & UG) 230 kV line approx. 6 miles UG along new ROW from PEPCO’s Bells Mill Substation to south of the Potomac River and approx 3 miles OH along existing ROW to Scott’s Run Substation.

E) Double-circuit the existing 230 kV loop from Idylwood to CIA to Swinks Mill to Tysons to new Springhill Sub, approx. 13.4 miles

(Continued Next Page)
### Solution Alternative

<table>
<thead>
<tr>
<th></th>
<th>Estimated Project Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A)</strong> 4.5 mile OH line – Idylwood to Scott’s Run</td>
<td>$32M</td>
</tr>
<tr>
<td><strong>B)</strong> 4.5 mile hybrid (OH/UG) line – Idylwood to Scott’s Run</td>
<td>$59M</td>
</tr>
<tr>
<td><strong>C)</strong> 4 mile UG line – Idylwood to Spring Hill</td>
<td>$98-118M</td>
</tr>
<tr>
<td><strong>D)</strong> 9 mile hybrid (OH/UG) line – Bells Mill (PEPCO) to Scott’s Run</td>
<td>$144M</td>
</tr>
<tr>
<td><strong>E)</strong> 13 mile OH line – Double circuit Idylwood to Spring Hill</td>
<td>$76-96M</td>
</tr>
</tbody>
</table>

### Proposed Solution:

A) Construct a 230 kV OH line along existing Line #2035 corridor, approx. 2.4 miles from Idylwood to Dulles Toll Road (DTR) and 2.1 miles on new right-of-way (ROW) along DTR to new Scott’s Run Substation.

### Expected IS Date: Summer 2017

1) Preliminary field visit along proposed route indicates potential ROW constraints that may limit the use of 230 kV OH along DTR. Further analysis by engineering and routing team will be required.

2) Each of the solutions will require new ROW to be acquired.
• Common Mode Outage Procedure:
  • The US Silica to US Silica #1 69 kV circuit is overloaded for tower and line fault stuck breaker contingencies.
• Proposed Solution:
  Rebuild and reconductor 1.2 miles of the US Silica to US Silica #1 69 kV circuit (B2305).
• Estimated Project Cost:
  $ 1.0 M
• Expected IS Date:
  6/1/2018
Common Mode Outage Procedure:

The US Silica #1 to W1-089 Tap 69 kV circuit is overloaded for several tower and line fault stuck breaker contingencies.

Proposed Solution:

Rebuild and reconductor 1.67 miles of the US Silica #1 to W1-089 TAP69 kV circuit (B2306).

Estimated Project Cost:

$1.4 M

Expected IS Date:

6/1/2018
• PHI Planning Criteria
• To prevent overloading the Corson – Sea Isle – Swainton 69 kV line section due to the outage of the Corson - Sea Isle 69kV line, with Middle #3 CT offline.
• Proposed Solution:
  Reconduct the section A of Corson - Sea Isle - Swainton 69kV line (b2351)
• Estimated Project Cost:
  $ 0.95 M
• Expected IS Date:
  6/1/2014
PHI Planning Criteria

- The Middle T3 69kV overcurrent relay will be overloaded in 2014 for the outage of the Middle T4 138/69kV transformer or the Middle Tap-Middle 138 kV line section with Middle #3 CT offline.
- The Middle T4 69kV overcurrent relay will be overloaded in 2014 for the outage of the Middle T3 138/69kV transformer or the Corson-Middle 138 kV line with Middle #3 CT offline.

Proposed Solution:
- Upgrade the overcurrent protective relaying at Middle T3 and T4 138/69kV transformers (b2353)

- Estimated Project Cost:
  - $0.32 M
- Expected IS Date:
  - 6/1/2014
• NERC Category B Violation
• The Churchtown 230/69 kV transformer is overloaded on a contingency basis.
• Proposed Solution: Install second 230/69kV transformer and 230 kV circuit breaker at Churchtown substation (b2354)
• Estimated Project Cost: $ 3.5 M
• Expected IS Date: 6/1/2015
- **Basecase Category C:**
- Loss of more than 300 MW load for tower contingency outage of Raphael Road – Perryman 230 kV circuits 2360 & 2361.
- **Proposed Solution:**
  Install a 230/115kV transformer at Raphael Rd and construct approximately 3 miles of 115kV line from Raphael Rd. to Joppatowne. Construct a 115kV three-breaker ring at Joppatowne to accommodate the new line (B2307).
- **Estimated Project Cost:**
  $35 M
- **Expected IS Date:**
  6/1/2017
• Basecase Category C:
  Loss of more than 300 MW load for tower contingency outage of Waugh Chapel – Cedar Park 115 kV circuits 110543 & 110544.
• Proposed Solution:
  Build approximately 3 miles of 115kV underground line from Bestgate tap to Waugh Chapel. Create a two-breaker bay at Waugh Chapel to accommodate the new underground circuit (B2308).
• Estimated Project Cost:
  $ 27.2 M
• Expected IS Date:
  6/1/2018
• Replace Scope of the existing upgrade B1673

• Old Scope:
  Rocktown - Install a 230/34.5 kV transformer by looping the Pleasant Valley - E Flemington 230 kV Q-2243 line (0.4 miles) through the Rocktown Substation.

• New Scope:
  Rocktown - Install a 230/34.5 kV transformer by looping the Pleasant Valley - Buckingham 230 kV L220 line (0.4 miles) through the Rocktown Substation.

• Estimated Project Cost:
  Previous → $7.83 M
  New → $18 M

• Expected IS Date:
  Previous → 6/1/2013
  New → 6/1/2014
• Generation Deliverability/Basecase Category C:
• The Everts Drive - South Troy 115 kV is overloaded for single and line fault stuck breaker contingencies.
• Proposed Solution:
  Replace the substation conductor and switch at South Troy 115 kV substation (B2304).
• Estimated Project Cost: $ 0.15 M
• Expected IS Date: 6/1/2017
• Update the scope of the existing baseline upgrade B1813.2:
  • Old Scope
    Build a new Pocono 230/69 kV substation.
  • New Scope:
    Build a new Pocono 230/69 kV substation with two 230/69 kV transformers.
• Estimated Project Cost:
  Old $18.29 M
  New $36.5 M
• Expected IS Date:
  11/30/2015
• Update the scope of the existing baseline upgrade B1813.5:
  - Old Scope
    Build new Acahela 230/69 kV substation.
  - New Scope:
    Build new Acahela 230/69 kV substation with two 230/69 kV transformers.
  - Estimated Project Cost:
    Old → $20.02 M
    New → $36.9 M
  - Expected IS Date:
    11/30/2016
• Update the scope of the existing baseline upgrade B1896:
  • Old Scope:
    Install a second 230/138 kV transformer and expand the 138 kV yard at Monroe
  • New Scope:
    Install 69 kV Capacitor at North Stroudsburg 69/12 kV Substation
• Estimated Project Cost:
  Old → $ 8.9 M
  New → $ 3.0 M
• Expected IS Date
  11/30/2014
<table>
<thead>
<tr>
<th>Upgrade ID</th>
<th>Scope</th>
<th>Reason for Cancellation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B0913</td>
<td>Extend Cando Tap to the Harwood-Jenkins #2 69 kV line</td>
<td>Load growth has not developed as expected. Substation is not required for capacity or reliability at this time</td>
</tr>
<tr>
<td>B1890</td>
<td>Add a second 230/69 kV transformer at Pocono (NE/Pocono Reliability Project)</td>
<td>Project scope is being combined with b1813.2 for the installation of the new Pocono Substation for a more reliable design</td>
</tr>
<tr>
<td>B2225</td>
<td>Install 2nd 230/69 kV transformer at Acahela substation</td>
<td>Project scope is being combined with b1813.5 for the installation of the new Acahela Substation for a more reliable design</td>
</tr>
</tbody>
</table>
• Generation Deliverability:
  • The Tuckahoe to Mill 69 kV is overloaded for tower line outage of the BL England – Scull – Mill 138 kV circuits #1 and #2.
• Proposed Solution:
  – Upgrade the Tuckahoe to Mill 69 kV circuit (B2226).
• Estimated Project Cost:
  – $ 9.9 M
• Expected IS Date:
  – 6/1/2017
• Basecase NERC Category C Violation
• Loss of more than 300 MW load for tower contingency outage of Wagner – Pumphrey 115 kV circuits 110534 & 110535.

• Proposed Solution:
  Install a 115 kV tie breaker at Wagner to create a separation from line 110535 and transformer 110-2 (B2219).

• Estimated Project Cost: $ 0.5 M
• Expected IS Date: 6/1/2017
• Basecase NERC Category C:
  • Loss of more than 300 MW load for tower contingency outage of Pumphrey – Granite 115 kV circuits 110527 & 110528.
• Proposed Solution:
  Install a four 115 kV breakers at Chestnut Hill (B2220).
• Estimated Project Cost:
  $ 6.4 M
• Expected IS Date:
  6/1/2017
B1086 upgrade delay:
The in-service date of the B1086 (Build a new 115 kV switching station between Orchard St and Monument St.) has been delayed to 6/1/2017. Install Special Protection Scheme (SPS) to mitigate the violation until the project is completed.

Proposed Solution:
Install an SPS to trip approximately 19 MW load at Green St. and Concord (B2221).

Estimated Project Cost:
$ 0.35 M

Expected IS Date:
6/1/2014
- B1267 and B1267.1 upgrade delay:
  - The in-service date of the B1267.1 (Construct 115 kV double circuit underground line from existing Cold Spring to Erdman substation) and B1267 (Rebuild existing Erdman 115 kV substation to a dual ring-bus configuration to enable termination of new circuits) has been delayed to 6/1/2017.

- Proposed Solution:
  Extend the SPS at Mt. Washington (B1175) until 6/1/2017.
• B0754 Scope Change:
• Old Scope:
  – Rebuild 10 miles of Glasgow to Mt. Pleasant 138 kV line to bring the normal rating to 298 MVA and the emergency rating to 333 MVA.
• New Scope:
  – Rebuild the entire Glasgow to Mt. Pleasant 138 kV line.
• Old Cost Estimate: $ 5.7 M
• Estimated Project Cost: $ 16.34 M
• Expected IS Date: 3/1/2013
• N-1-1:
  • The Eddystone 230/138 kV transformer #8 is overloaded for the Bryn Mawr – Plymouth Meeting 138 kV and the Chichester 230/138 kV transformer 1&2 N-1-1 contingences.
  
• Proposed Solution:
  Install a second Eddystone 230/138 kV transformer (B2222).
  
• Estimated Project Cost:
  $ 7.5 M
  
• Expected IS Date:
  6/1/2017
- PPL EU Reliability Principles and Practices Criteria:
- The Sunbury – Dauphin 69 kV circuit is normally overloaded.
- Proposed Solution:
  - Rebuild and reconductor 2.6 miles of the Sunbury – Dauphin 69 kV circuit (B2223).
- Estimated Project Cost: $3 M
- Expected IS Date: 5/31/2017
PPL EU Reliability Principles and Practices Criteria:

- The Elroy 138/69 kV and Springfield 230/69kV transformers are overloaded for the tower line outage of the Hosensack – Buxmont #3 and Whitpain – Buxmont 230 kV circuits.

Proposed Solution:
- Add a 2nd 150 MVA 230/69 kV transformer at Springfield (B2224).

Estimated Project Cost:
$ 6.79 M

Expected IS Date:
5/31/2018
• PPL EU Reliability Principles and Practices Criteria:
• Exceeds maximum allowable load drop guidelines for loss of Acahela – Jackson #1 & #2 and Acahela – E. Palmerton #1 & #2 69 kV circuits.
• Proposed Solution:
  – Install 2nd 230/69 kV transformer at Acahela substation (B2225).
• Estimated Project Cost: $10.6 M
• Expected IS Date: 11/30/2020
B0707 Scope Change due to re-analysis of the solution:

Old Scope:
  - New 12.5 Mile Bohemia-Twin Lakes 138/69kV S/C Line and Install New 10.8 MVAR, 69kV Capacitor Bank Near Bohemia Substation

New Scope:
  - Rebuild line from Blooming Grove – Hemlock (approximately 10 miles) to double circuit.

Old Cost Estimate:
$ 14.76 M

Estimated Project Cost:
$ 19.03 M

Expected IS Date:
11/30/2013
- B1203 Scope Change due to the existing structures that can't support a second circuit:
  - Old Scope:
    - Add the 2nd Circuit to the East Palmerton-Wagners-Lake Naomi 138/69 kV Tap.
  - New Scope:
    - Rebuild the existing 69 kV single circuit Lake Naomi Tap off of the Blooming Grove – Jackson 69 kV line (approximately 24 miles) to double circuit.
- Old Cost Estimate: $12.82 M
- Estimated Project Cost: $34.8 M
- Expected IS Date: 11/30/2014
• B1203 Scope Change due to space limitation:
  • Old Scope:
    – New 138 kV Taps to Flory Mill 138/69kV Substation.
  • New Scope:
    – Rebuild the existing South Akron – Dillerville #1 & #2 69 kV lines as two vertical 138/69 kV double circuits from Dillerville tap to the Alcoa tap.
• Old Cost Estimate:
  $ 0.69 M
• Estimated Project Cost:
  $ 5.14 M
• Expected IS Date:
  11/30/2013
RTEP Next Steps

• Request PJM Board approval of the RTEP in October 2013
• Continue Artificial Island evaluation
• Continue to resolve 2013 RTEP criteria violations
  – Finalize N-1-1 analysis and solutions
• Follow up sensitivity and scenario analysis to support NYISO border modeling discussion at previous PC meetings
Questions?

Email: RTEP@pjm.com
• 9/9/2013 – Original version distributed to PJM TEAC
• 9/10/2013
  – Added a revision history slide
  – Added several slides to the Deactivation Update section
• 9/11/2013
  – Removed slides for B2189- B2192, B2194, B2197, B2210, B2212 . B2180 and B2116 due to project cancellation
  – Updated B2117 to reconductor 0.33 miles instead of 1.5 miles
  – Added slide for scope change of B2120
  – Cost updated for B2234
  – Scope change (B2270 – B2275)
  – Cost correction for B2174.9 and B2174.10
  – B2260 capacitor size change and in-service date change
  – B2303 number correction
• 10/2/2013
  – Updated Hatfield and Mitchell deactivation slides to include references to the status of the ongoing operating condition evaluations