Transmission Expansion Advisory Committee

April 12, 2012
Issues Tracking
• Open Issues
  – None

• New Issues
April 2012 RPM Planning Parameters for 2015/16
BRA Auction - Assumptions
Key Planning Assumptions

• Transmission
  – The list of key transmission assumptions is in the RPM BRA Delivery Year 2015/16 Planning Period Parameters posting

• Generation
  – RMR assumption:
    • Ashtabula
    • Eastlake 1
    • Eastlake 2
    • Eastlake 3
    • Lake Shore 18
  – Synchronous Condenser conversion assumption:
    • Eastlake 4
    • Eastlake 5
Chesapeake & Yorktown Retirement Notifications - Solution Alternatives Evaluation
Chesapeake and Yorktown Deactivation Notifications

- **Deactivation Notification:**
  - Chesapeake Units 1-2 & Yorktown 1
    - 381 MW
    - Requested Retirement Date: December 31, 2014
  - Chesapeake 3&4
    - 354 MW
    - Requested Retirement Date: December 31, 2015
Chesapeake and Yorktown Deactivation Notifications
Study With No Solution Alternatives

- No Solution Alternatives
  - Studies performed to identify criteria violations

- Studies Previously Performed
  - 2015 & 2016 study years
    - N-1 Thermal and Voltage
      - No issues identified
    - N-1-1 Thermal and Voltage
      - Overloads identified
    - Dominion criteria – critical system conditions
      - Overloads identified
    - Generator Deliverability
      - Overloads identified
    - Load Deliverability
      - Overloads identified
Solution Alternatives
- Dominion
- LS Power (Northeast Transmission Development)

Solution Alternatives Studies Performed
- 2015 & 2016 study years
- N-1 Thermal and Voltage
- N-1-1 Thermal and Voltage

Solution Alternatives Studies In-progress
- Dominion criteria – critical system conditions
- Generator Deliverability
- Load Deliverability
Dominion Proposed Solution

- Construct a 38 mile long 500 kV line from Chickahominy Substation (or alternatively, Surry)
- Install two 500/230 kV transformers and a 230/115 transformer at Skiffes Creek Switching Station.
- Install a Skiffes Creek – Whealton 230 kV circuit
- Install three 500 kV breakers at Chickahominy Substation
- Install six 230 kV Breakers at Skiffes Creek
- Install four 115 kV Breakers at Skiffes Creek Switching Station.
- Estimated Cost: TBD
Dominion Proposed Solution Performance

- Dominion proposal addresses all criteria violations that result from the Chesapeake and Yorktown Deactivation notifications.

- PJM currently validating several new potential issues that result from the proposal.

- **2016 N-1 Thermal**
  - Several new potential 115 kV overloads
  - Verifying limits
LS Power / Northeast Transmission Development
Proposed Solution

- Build a new Great Bridge 500 kV substation (3 breaker ring bus) along existing Fentress-Septa 500 kV circuit.

- Build a new Great Bridge 115 kV substation at the intersection of the Fentress-Septa 500 kV circuit and the Hickory-Great Bridge 115 kV circuit.

- Install a new Great Bridge 500/115 kV transformer.

- Reconductor Great Bridge-Chesapeake 115 kV with high temperature conductor.

- Install a second Yorktown 230/115 kV transformer.

- New Surry-Skiffes Creek single circuit 230 kV line in series with a PAR at Surry.

- Estimated Cost: TBD
• Northeast Transmission Development proposed solution does not address previously identified 2016 N-1-1 thermal issue

• PJM currently validating several new potential issues that result from the proposal

• 2015 N-1 Thermal
  – New potential 115 kV overload

• 2016 N-1 Thermal
  – New potential 115 kV overload
  – New potential 345 kV overload

• 2016 N-1-1 Thermal
  – Previously identified overload of Huntsman - Thresher 230kV line for the loss of the Suffolk – Yadkin 500 kV and Fentress – Septa 500 kV circuits remains
• Validate and evaluate new issues

• Remaining Studies
Generation Deactivation Notification (Retirements) Update
All Pending Generator Deactivations

Over 16,000 MW of Pending Deactivations (~13,500 MW since 11/2011)
### Deactivations received since 3/15/2012 update

<table>
<thead>
<tr>
<th>Units</th>
<th>Trans Zone</th>
<th>Requested Deactivation Date</th>
<th>Status</th>
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<tr>
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<td>Crawford 7</td>
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<td>Crawford 8</td>
<td>ComEd</td>
<td>12/31/2014 (no later than)</td>
<td>No Impacts</td>
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<tr>
<td>Conesville 3</td>
<td>AEP</td>
<td>12/31/2012</td>
<td>Reliability Analysis Underway</td>
</tr>
<tr>
<td>Big Sandy 1</td>
<td>AEP</td>
<td>6/1/2015</td>
<td>Reliability Analysis Underway</td>
</tr>
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<td>Clinch River 3</td>
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<td>Muskingum River 4</td>
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<td>Sporn 1</td>
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<td>Sporn 2</td>
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<tr>
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<td>Avon Lake 9</td>
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<td>4/16/2015</td>
<td>Reliability Analysis Underway</td>
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</table>
| Sewaren 1 | PSEG       | 6/1/2015                    | Reliability Analysis Underway  
PSEG also contemplating re-use of Capacity Rights for a new generation project |
| Sewaren 2 | PSEG       | 6/1/2015                    | Reliability Analysis Underway  
PSEG also contemplating re-use of Capacity Rights for a new generation project |
| Sewaren 3 | PSEG       | 6/1/2015                    | Reliability Analysis Underway  
PSEG also contemplating re-use of Capacity Rights for a new generation project |
| Sewaren 4 | PSEG       | 6/1/2015                    | Reliability Analysis Underway  
PSEG also contemplating re-use of Capacity Rights for a new generation project |
ATSI/AP (FES) Deactivations – Status and Next Steps

Armstrong 1, & 2; Ashtabula 5; Bay Shore 2, 3, & 4; Eastlake 1, 2, 3, 4, & 5; Lake Shore 18; R Paul Smith 3 & 4

Requested deactivation date: 9/1/2012
Current status of 2013 assumptions

- Assumed RMR for 2013 **TENTATIVE – SUBJECT TO REVIEW**
  - Ashtabula 5, Eastlake 1, Eastlake 2, Eastlake 3, Lake Shore
- System Topology Assumption
  - ATSI:
    - Install a 50 MVAR capacitor bank at the Maclean 138 kV station. Projected in-service date is 6/1/2013.
    - Install a 345/138 kV transformer at the Inland Q-11 station. Projected in-service date is 6/1/2013.
    - Install a 138 kV circuit breaker at the Inland Q-11 station. Projected in-service date is 6/1/2013.
    - Upgrade terminal equipment on the Avon – Crestwood 138 kV line. Projected in-service date is 6/1/2013.
  - AP:
    - Replace breaker risers at Marlowe 138 kV and wave traps at Marlowe 138 kV and Bedington 138 kV to increase the rating on the Marlowe – Bedington 138 kV line #1 (PJM proposed baseline upgrade b1837)(new ratings will be 267/352 MVA SN/SE). The expected in-service date is 6/1/2013.

- Remaining violations identified may be mitigated by generation re-dispatch in real time with Operations monitoring all the identified contingencies, including the NERC Category ‘C’ contingencies.
ATSI/AP (FES) Deactivations – Assumptions

- ATSI Load Deliverability Voltage Sample Case would not converge and did not permit solving initial load flow to begin study without the following assumptions:
  - Eastlake units 2-5 converted to synchronous condensers
  - Eastlake unit 5 projected to be converted to a synchronous condenser by 6/1/2013.
  - Eastlake units 2, 3, and 4 projected to be converted to synchronous condensers by 6/1/2015.
ATSI Transmission Zone Violations

- Criteria violations
  - N-1 Common Mode Voltage Study
  - N-1-1 Voltage
  - N-1-1 Thermal
  - Generation Deliverability
  - Load Deliverability

- Multiple 138kV bus voltage magnitude and voltage drop violations
- Multiple 138kV thermal violations
- Ashtabula 345/138kV transformer thermal violation
- Star 345/138kV transformer #1 thermal violation
- Hanna 345/138kV transformer thermal violation
- Highland – G689 345 kV line thermal violation
- South Canton - Star 345 kV line thermal violation (AEP-ATSI)
• Convert Eastlake units 2, 3, 4 to a synchronous condenser.
• Projected in-service date is 6/1/2015.
ATSI Reinforcement

- Convert Lakeshore unit to a synchronous condenser.
- Projected in-service date is 6/1/2015.
- N-1-1 Voltage Magnitude: (most severe) Lemoyne-Midway 345kV + Lemoyne-Maclean 138kV (91%)
- Install a 50 MVAR capacitor bank at the Maclean 138 kV station.
- Cost estimate: TBD
- Projected in-service date is 6/1/2013.
ATSI Reinforcement

- Gen Deliv: Eastlake 345kV BKR failure results in Ashtabula 345-138kV Transformer overload at 105%
- Install a 345/138 kV transformer at the Inland Q-11 station.
- Cost estimate: TBD
- Projected in-service date is 6/1/2013.
ATSI Reinforcement

- Gen Deliv: Inland-Ivy Q-11 138kV + Inland-Ivy Q-14 Common Tower Outage results in 116% overload on Clinton-Ridge Q-12 138kV
- Install a 138 kV circuit breaker at the Inland Q-11 station.
- Cost estimate: TBD
- Projected in-service date is 6/1/2013.
• Gen Deliv: Avon-Fowles Q-2 138kV + Avon-Fowles Q-3 138kV Common Tower Outage results in 107% overload on Avon-Crestwood Q-1 138kV line section

• Upgrade terminal equipment on the Avon – Crestwood 138 kV line.

• Cost estimate: TBD

• Projected in-service date is 6/1/2013.
- Gen Deliv: Hanna 345kV B106 BKR Failure results in 105% overload on Hanna 345-138kV TR #1
- Loop the Chamberlin - Mansfield 345 kV line into the Hanna 345 kV substation (existing base line upgrade b1283)
- Cost estimate: $9.075M
- Projected in-service date is 6/1/2014 (Advance from 6/1/2015)
ATSI Reinforcement

- Gen Deliv: Loss of Beaver-Davis Besse 345kV results in 128% thermal overloads on Lakeview-Ottawa 138kV + Greefield-Lakeview 138kV lines
- Build new Hayes 345/138 kV substation with new 138 kV lines to: Greenfield #1, Greenfield #2, and Avery (existing baseline upgrade b1281)
- Cost estimate: $34.4M
- Projected in-service date is 6/1/2014 (Advance from 6/1/2015)
ATSI Reinforcement

- Gen Deliv: Loss of Beaver-Davis Besse 345kV results in 128% thermal overloads on Lakeview-Ottawa 138kV + Greefield-Lakeview 138kV lines
- Build Beaver - Hayes - Davis Besse #2 345 kV line (existing base line upgrade b1282)
- Cost estimate: $34.65
- Projected in-service date is 6/1/2014 (Advance from 6/1/2015)
ATSI Reinforcement

- Gen Deliv: Galion 138kV Bkr 54 Failure results in 111% overload on Galion-Leaside 138kV
- Re-conductor the Galion – Leaside 138 kV line with 336 ACSS.
- Cost estimate: TBD
- Projected in-service date is 6/1/2014.
ATSI Reinforcement

- Gen Deliv: Brookside-Howard 138kV + Brookside-Leaside 138kV Common Tower Outage results in 107% overload on Galion-GM-Ontario-Cairns 138kV line sections
- Re-conductor the Galion – GM Mansfield – Ontario - Cairns 138 kV line with 477 ACSS.
- Cost estimate: TBD
- Projected in-service date is 6/1/2014.
• N-1-1 Thermal: Loss of Allen Junction 345-138kV TR + Bayshore 345-138kV TR results in 110% OL on Eber-Liquid Air 138kV line section
• Install a 2nd 345/138 kV transformer at the Allen Junction station.
• Cost estimate: TBD
• Projected in-service date is 6/1/2014.
ATSI Reinforcement

• N-1-1 Voltage Magnitude: Bayshore 345-138kV Transformer + Lemoyne-Maclean 138kV results in low voltage (90%) at Maclean
• Install a 2nd 345/138 kV transformer at the Bayshore station.
• Cost estimate: TBD
• Projected in-service date is 6/1/2014.
ATSI Reinforcement

- Load Deliverability: 2015 RTEP case will not solve without additional feed into Cleveland Area + multiple retired units converted to Synchronous Condensers
- Create a new Northfield Area 345 kV switching station by looping in the Eastlake – Juniper 345 kV line and the Perry - Inland 345 kV line.
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
• Load Deliv: 2015 RTEP case will not solve without additional feed into Cleveland Area + multiple retired units converted to Synchronous Condensers
• Build a new Mansfield - Northfield Area 345 kV line.
• Cost estimate: TBD
• Projected in-service date is 6/1/2015.
ATSI Reinforcement

- Gen Deliv: Star 345kV B-12 Bkr Failure, Star B-8 138kV Bkr Failure, Barberton-Star 138kV + Cloverdale-Star 138kV TWL, results in thermal overloads on Star 345-138kV TR #1 101%, Star-Barberton #1 106%, and Star-Barberton #2 103%
- Create a new Harmon 345/138/69 kV substation by looping in the Star – South Canton 345 kV line.
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
• Gen Deliv: Galion 138kV Bkr Failure, Brookside-Howard 138kV + Brookside-Leaside 138kV Common Tower Outage results in thermal overloads on Galion-Leaside 112%, and Galion-GM 101%

• Build a new Harmon – Brookside + Harmon - Longview 138 kV line

• Cost estimate: TBD

• Projected in-service date is 6/1/2015.
ATSI Reinforcement

- N-1-1 Voltage Magnitude: Loss of Bayshore 345-138kV TR + Lemoyne-Maclean 138kV results in Low Voltage at Maclean 138kV 90%
  - Create a new Five Points Area 345/138 kV substation by looping in the Lemoyne – Midway 345 kV line.
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
ATSI Reinforcement

- Addition to scope of Hayes 345-138kV Sub project due to N-1-1 LV 90% for loss of Hayes 345-138kV TR + Ottawa-Lakeview 138kV
- Install a 50 MVAR capacitor at Hayes 138 kV.
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
• Needed in conjunction with Hayes 345-138kV Sub project due to Common Mode outage (Greenfield 138kV Bus) 135% OL on Avery 138-69kV
• Install a 138/69 kV transformer at the Avery station.
• Cost estimate: TBD
• Projected in-service date is 6/1/2015.
• Needed in conjunction with Hayes 345-138kV Sub project due to Common Mode outage (Greenfield 138kV Bus) 105% overload on Avery-Hayes 138kV
• Increase design temperature limitation on the Avery – Hayes 138 kV line by raising the existing structures. New ratings will be 224/282 MVA (SN/SE)
• Cost estimate: TBD
• Projected in-service date is 6/1/2015
ATSI Reinforcement

- N-1-1 Thermal for loss of one of the Cloverdale-Harmon 138kV lines + Harmon-Star 345kV line results in 115% OL on the remaining Cloverdale-Harmon 138kV line
- Reconductor Cloverdale - Harmon #2 and #3 138kV lines with 795 ACSS or greater conductor 6 miles total + Terminal upgrades. New Ratings 295 SN / 375 SE
- Cost estimate: TBD
- Projected in-service date is 6/1/2015
ATSI Reinforcement

- N-1-1 Voltage Magnitude: (most severe) Lemoyne-Midway 345kV + Lemoyne-Maclean 138kV (91%)
- Change the transformer tap settings on the Maclean 138/69 kV transformers
- Cost estimate: TBD
- Projected in-service date is 6/1/2015
• Gen Deliv: Loss of Richland N bus to Richland J bus section results in 108% overload on Richland-Naomi 138kV line
• Replace 336.4 ACSR SCCIR at Richland to upgrade the Richland – Naomi 138 kV line. New Ratings 161 SN / 191 SE
• Cost estimate: TBD
• Projected in-service date is 6/1/2015
ATSI Reinforcement

- N-1-1 Thermal (most severe) loss of Highland-Mahoningside 138kV + Evergreen-Highland #2 138kV results in 117% OL on Evergreen-Highland #1 138kV
- Build a new 345-138kV Substation at Niles. Requires 1.2 mile 345kV loop into substation of the Highland – Shenango 345 kV line. Requires new 345-138kV transformer. Project also increased short circuit levels to benefit power quality due to multiple EAF loads in the area.
- Cost estimate: TBD
- Projected in-service date is 6/1/2015
ATSI Reinforcement

- Gen Deliv: Galion-Leaside 138kV + Galion-GM 138kV Common Tower Outage results in 115% overload on Brookside-Howard 138kV line
- ATSI-AEP 138kV Substation on near territory border + 138kV from new substation to Longview approx. 8 miles.
- Cost estimate: TBD
- Proposed in-service date: TBD
ATSI Reinforcement

- N-1-1 Thermal: Loss of Allen Junction-Lulu 345kV + Lemoyne-FivePoints 345kV results in 102% overload on Lemoyne-BG Tap 138kV
- Build new Allen Jct - Midway - Lemoyne 345kV line (48 miles of open tower position)
- Cost estimate: TBD
- Proposed in-service date: 6/1/2016
AP Transmission Zone Violations

• Criteria violations
  – N-1-1 Thermal
  – Generation Deliverability

• Multiple 138kV thermal violations
• Replace breaker risers and wave traps at Marlowe 138 kV. Replace wave traps at Bedington 138 kV (existing base line upgrade b1837)
• Cost Estimate $0.1M
• Expected in-service date is 6/1/2013.
• Reconductor the Bartonville – Stephenson 138 kV; Stonewall - Stephenson 138 kV line with 954 ACSR (existing base line upgrade b1142)

• Cost estimate: $2.3M

• Projected in-service date is 12/1/2013.
• Loop the Homer City-Handsome Lake 345 kV line into the Armstrong substation and install a 345/138 kV transformer at Armstrong.

• **Cost estimate:** TBD

• Projected in-service date 6/1/2014
PN Transmission Zone Violations

- Criteria violations
  - N-1-1 Thermal
- Erie South 230/115kV transformer #1
- Erie South 230/115kV transformer #6
• Construct Four Mile Junction 230/115 kV substation (existing base line upgrade b1609)
• Cost estimate: $11.1M
• Projected in-service date: 6/1/2014
AEP Transmission Zone Violations

- Criteria violations
  - N-1-1 Thermal
  - Generation Deliverability
  - Load Deliverability

- Multiple 138kV thermal violations

- Kammer-West Bellaire 345kV line thermal violation

- South Canton - Star 345 kV line thermal violation (AEP-ATSI)
• Reconductor AEP portion of South Canton – Star 345 kV line and upgrade terminal equipment at South Canton (existing base line upgrade b1812)
• Cost estimate: $0.8M
• Projected in-service date: 12/31/2013
FES (APS) Deactivations

- Albright 1, 2, & 3; Rivesville 5 & 6; Willow Island 1 & 2
- Requested deactivation date: 9/1/2012
FES (APS) Deactivations

- Replace line trap at Stonewall on the Stephenson 138 kV line terminal (existing base line upgrade b1902)
- Cost estimate: $0.05M
- Projected in-service date is 6/1/2013
GenOn Deactivations

- Niles 1 & 2; Elrama 1, 2, 3 & 4
- Requested deactivation date: 6/1/2012
GenOn Deactivations

- Criteria violations
  - N-1 Voltage
  - N-1 Thermal
  - N-1-1 Voltage Magnitude and Drop
  - N-1-1 Thermal
  - Generation Deliverability
- Multiple 138kV thermal violations
- Meadow Brook & Doubs 500kV low voltage
- Multiple 138kV bus voltage magnitude violations
- Waterford-Muskinghum River 345kV thermal
- West Bellaire-Tidd 345kV thermal
- Raystown-Lewistown 230kV thermal
- Shawville-Shingleton 230kV thermal
• Loop in E. Akron-Sammis 138kV line and Expand Knox substation to 6 breaker ring bus (existing b1692)
• Cost estimate : $3.7M
• Projected in-service date is 6/1/2013
• The Barberton - Star 138kV line loads to 104.3% of its rating of 206 for the single contingency 'B_LINE1_CR_013' followed by the 'B_LINE1_CR_016'
• Replace Barberton - Star 138 kV #1 wavetrap, CFZ relay, and line exit conductor at Barberton (existing upgrade b1285)
• Cost estimate: $.08M
• Projected in-service date is 6/1/2012
ATSI Reinforcement

- Replace the Star 345/138 kV #3 transformer with a larger transformer (existing base line upgrade b1693)
- Cost estimate: $5M
- Projected in-service date is 6/1/2013
ATSI Reinforcement

- Reconductor Evergreen-Highland #1 138kV with 477 ACSS (2.5 miles)
- **Cost estimate: TBD**
- Projected in-service date is 6/1/2013
• Reconductor Evergreen-Highland #2 138kV with 477 ACSS (2.5 miles)

• Cost estimate: TBD

• Projected in-service date is 6/1/2013
• Reconductor Highland-Salt Springs 138kV with 795 ACSS (6.7 miles)
• Cost estimate: TBD
• Projected in-service date is 6/1/2013
• Create a new Harmon 345/138/69 kV substation by looping in the Star – South Canton 345 kV line
• Cost estimate: TBD
• Projected in-service date is 6/1/2015
• The Galion - Gen. Motors Corp Cpc Group ckt 1 138/138kV line loads to 105.88% of its rating of 225 MVA for the tower contingency 'C5-TWL-SR043'
• Galion - Gen. Motors Corp Cpc Group - Ontario line: Bypass Gen. Motors Corp Cpc Group substation (existing base line upgrade b1585)
• Cost estimate: $0.05M
• Projected in-service date is 6/1/2012 (Advance from 6/1/2016)
- Reconductor W. Fremont-Groton-Hayes 138kV line
- Cost estimate: TBD
- Projected in-service date: 6/1/2018
- Short term: Existing Operating Procedure to open Lakeview-Greenfield from 6/1/2012 through 6/1/2018
AEP Reinforcement

- The Canton Central - Southeast Canton 138kV line loads to 173.5% of its rating of 296 for the single contingency '1277_B3' followed by the '6148_B2_TOR747_MO P'
- Sag Study on 7.2 miles SE Canton-Canton Central 138kV ckt.
- **Cost estimate:** $0.3M
- **Projected in-service date:** 12/1/2012
The Southeast Canton - Sunnyside 138kV line loads to 113.4% of its rating of 296 for the single contingency '5133_B2_TOR689' followed by the '5180_B2_TOR747_W OMOP'.

Sag study on the Southeast Canton – Sunnyside 138kV line.

Cost estimate: $0.25M

Projected in-service date: 12/1/2012
The Tiltonsville - Windsor ckt 1 138/138kV line loads to 137.3% of its rating of 205 MVA for the breaker contingency '4831_C2_05KAMMER 765-NN'.

Sag study on the Tiltonsville - Windsor 138 kV circuit (existing base line upgrade b1457).

Cost estimate: $.02M

Projected in-service date: 12/1/2012
AEP Reinforcement

- The Canton Central - Wagenhals 138kV line loads to 148.1% of its rating of 296 for the single contingency '6148_B2_TOR747_MO P' followed by the '5229_B2_TOR2181'
- Sag study on the Sunny - Canton Central - Wagenhals 138kV line (existing base line upgrade b1455)
- Cost estimate: $.032M
- Projected in-service date: 12/1/2012
• The Northeast Canton - Wagenhals 138kV line loads to 110.9% of its rating of 205 for the single contingency '750_B3' followed by the '5197_B2_TOR761A_M_OAB'.

• Sag study on the North East Canton - Wagenhals 138kV circuit (existing base line upgrade b1500).

• Cost estimate: $.02M

• Projected in-service date: 12/1/2012
The Belmont #1 765/500kV transformer overloads for the stuck breaker contingency '4831_C2_05KAMMER 765-NN'

Add four 765 kV breakers at Kammer remove stuck breaker contingency which causes several violations.

Cost Estimate: $30M

Projected in-service date is 6/1/2015
• The North Zanesville - Zanesville ckt 1 138/138kV line loads to 108.11% of its rating of 205 MVA for the bus contingency '6404_C1_05OHIOCT 138-2'
• Sag study on the North Zanesville – Zanesville 138 kV circuit (existing base line upgrade b1452)
• Cost estimate: $.01M
• Projected in-service date: 12/1/2012
AEP Reinforcement

- The Ohio Central - Powelson ckt 1 138/138kV line loads to 118.61% of its rating of 205 MVA for the bus contingency '6404_C1_05OHIOCT 138-2'
- The Powelson - North Zanesville ckt 1 138/138kV line loads to 116.64% of its rating of 205 MVA for the bus contingency '6404_C1_05OHIOCT 138-2'
- Sag study on the North Zanesville – Powelson and Ohio Central – Powelson 138 kV circuit (existing base line upgrade b1453)
- Cost estimate: $.1304M
- Projected in-service date: 12/1/2012
AEP Reinforcement

- The Waterford - Muskingum River ckt 1 345/345kV line loads to 123.76% of its rating of 1409 MVA for the single contingency '6361_B3_05BELMON 765-1_WOMOAB_WOMOP'
- Sag study on the Waterford – Muskingum 345kV circuit (existing base line upgrades b1811.1, 1811.2)
- Build approximately 1 mile of circuit comprising of 2-954 ACSR to get the rating higher.
- Cost estimate: $3.5M
- Projected in-service date: 12/1/2013
- The West Bellaire - Tidd ckt 1 345/345kV line loads to 111.47% of its rating of 971 MVA for the breaker contingency '4831_C2_05KAMMER 765-NN'
- Sag study on the Tidd-West Bellaire 345kV circuit (existing base line upgrade b1456)
- **Cost estimate: $0.07M**
- Projected in-service date: 12/1/2012
The West Bellaire - Tiltonsville ckt 1 138/138kV line loads to 110.8% of its rating of 251 MVA for the breaker contingency '4743_C2'.

- Perform a Sag Study on section 1 (~12 miles) of the West Bellaire – Tiltonsville 138 kV line (existing base line upgrade b1457).

- Cost estimate: $0.02M

- Projected in-service date: 12/1/2012
• The Hanson - Meadowview ckt 1 138/138kV line loads to 102.91% of its rating of 167 MVA for the single contingency '6174_B2_TOR98A_MOAB'
• Perform a Sag Study on the Hansonville – Meadowview 138kV line (Improve the emergency rating to 245 MVA). (B1879 )
• Estimated Project Cost: $0.1M
• Expected IS date: 06/01/2016
• Convert Moshannon substation to a 4 breaker 230 kV ring bus
• Cost estimate: TBD
• Projected in-service date: 6/1/2014
PN Reinforcement

- Install a 44 MVAR 138 kV capacitor at Luxor substation
- Cost estimate: TBD
- Projected in-service date: 6/1/2014
• Replace the 1200 Amp Line trap at Lewistown on the Raystown-Lewistown 230 kV line and replace substation conductor at Lewistown
• Cost estimate: TBD
• Projected in-service date: 12/1/2013
- Replace the Blairsville 138/115 kV transformer
- Cost estimate: TBD
- Projected in-service date: 6/1/2014
• Install 600MVAR SVC at Meadow Brook substation (existing base line upgrade b1804)
• Cost estimate: $60M
• Projected in-service date: 6/1/2014
• Establish operating procedure such that breaker 89, connecting Cheswick-Logans Ferry Z-53 to the No. 3 138 kV bus at Cheswick Substation is normally open.

• Cost estimate: TBD

• Projected in-service date: 6/1/2012
DLCO Reinforcement

- Install a third 345-138 kV autotransformer at Collier Substation. Currently s0321 and will be converted to baseline. 138kV breaker replacements identified as overdutied with the installation of the 3rd transformer.
- Cost estimate: TBD
- Projected in-service date: 6/1/2013
Beckjord 1
- Requested deactivation date: 5/1/2012
- No violations identified
DEOK (Duke Energy) Deactivations

Beckjord 2, 3, 4, 5, & 6

Requested deactivation date: 4/1/2015
DEOK Transmission Zone Violations / Reinforcement

- Criteria violation
  - Generation Deliverability
- Overload of Silver Grove 345/138kV transformer and equipment
- Convert Redbank 345 kV bus to ring
- Projected in-service date: 6/1/2013
AEP Transmission Zone Violations / Reinforcement

- Criteria violations
  - N-1 Common Mode Voltage

- Multiple 138kV voltage violations due to 765kV breaker contingency at Wyoming 765kV

- Install a 765kV breaker at Wyoming 765kV substation (existing baseline upgrade b1661)
- Cost estimate: $5M

- Projected to be in-service by 6-1-2014
PSEG (PSEG Energy) Deactivations

- Bergen 3; Burlington 8; National Park 1; Mercer 3; Seawaren 6

- Requested deactivation date: 6/1/2015
**Solution under review**

- Generation Deliverability
- Eagle Point – Gloucester 230 kV line #1 & Eagle Point – Gloucester 230 kV line #2
- Expedite the 2016 baseline upgrade B1588 from 2016 year to 2015 year
- If B1588 can’t be expedited, establish operating procedures and/or a protection scheme(s) to alleviate the element loading until B1588 goes in service.
- Cost estimate: $25M
- Expected IS date: 6/1/2015
• Generation Deliverability
• Croydon - Burlington 230 kV line
• Replace aerial wire in Croydon substation (existing base line upgrade b1197 incorporates this requirement)
• Cost Estimate $30K
• Expected IS date: 6/1/2015
Genon (New Castle) Deactivations

- New Castle 3, 4, & 5; New Castle Diesels A & B

- Requested deactivation date: 4/16/2015
GenOn (New Castle) Deactivations

- Criteria violations
  - N-1 Thermal
  - N-1-1 Voltage
  - N-1-1 Thermal
  - Generation Deliverability
  - Load Deliverability
- Multiple 138kV and 345 kV bus voltage violations
- Multiple 138kV thermal violations
- Kammer-West Bellaire 345kV thermal violation
- Highland – G689 345 kV thermal violation
- South Canton - Harmon 345 kV line thermal violation (AEP-ATSI)
- Mountain - Belmont 765 kV line thermal violation
- South Canton 765/345 kV transformer thermal violation
AEP Reinforcement

- Reconductor the AEP portion of the South Canton – Harmon 345 kV line and also upgrade risers, wavetrap, and bus work and South Canton. (existing base line upgrade b1812)
- Cost Estimate: $.8M
- Projected in-service date is 6/1/2015.
AEP Reinforcement

- Add four 765 kV breakers at Kammer to remove stuck breaker contingency which causes several violations.
- Cost estimate: $30M
- Projected in-service date is 6/1/2015.
• Reconductor 13 miles of the Kammer – West Bellaire 345kV circuit
• Cost estimate: TBD
• Projected in-service date is 6/1/2014.
• Perform a Sag Study on section 1 (~12 miles) of the West Bellaire – Tiltonsville 138 kV line (existing base line upgrade b1457)
• Cost estimate: $.02M
• Projected in-service date to complete the sag study is 12/1/2012
• Sag study of Newcomerstown - Hillview 138 kV line. Upgrade terminal equipment (existing base line upgrade b1737)
• Cost estimate: $0.2M
• Projected in-service date is 12/01/2014.
• Perform a sag study to improve the emergency rating on the Bridgville – Chandlersville 138 kV line
• Cost estimate: TBD
• Projected in-service date is 12/01/2014.
AEP Reinforcement

• Perform a sag study of the Ohio Central – South Coshocton 138 kV circuit (existing baseline upgrade b1869)
• Cost estimate: $0.07M
• Projected in-service date is 12/01/2014.
• Replace disconnect switch on the South Canton 765/345 kV transformer
• Cost estimate: TBD
• Projected in-service date is 12/01/2014.
AEP Reinforcement

- Perform a sag study to improve the emergency rating on the Carrollton – Sunnyside 138 kV line
- Cost estimate: TBD
- Projected in-service date is 12/01/2014.
• Replace relays at both South Cadiz 138 kV and Tidd 138 kV (existing baseline upgrade b1462)
• Cost estimate: $0.5M
• Projected in-service date: 12/01/2014
• Perform a sag study to improve the emergency rating on the Bethel Church – West Dover 138 kV line
• Cost estimate: TBD
• Projected in-service date is 12/01/2014.
• Replace a switch at South Millersburg switch station
• Cost estimate: TBD
• Projected in-service is 12/01/2014.
AEP Reinforcement

- Reconductor 0.83 miles of the Dale-West Canton 138kV Tie-line and upgrade risers at West Canton 138kV (existing baseline upgrade b1861)
- Cost estimate: $1.7M
- Projected in-service is 6/01/2014.
Reconduct the ATSI portion of South Canton – Harmon 345 kV line
Cost estimate: TBD
Projected in-service date is 6/1/2015.
ATSI Reinforcement

- Build new Toronto 345/138 kV substation by looping in the Sammis – Wylie Ridge 345 kV line and tie in four 138 kV lines.
- Build a new Toronto-Harmon 345kV line
- Cost estimate: TBD
- Projected in-service date is 6/1/2017.
- Short term
  - Open the Dale 138/69 kV transformer after the loss of the South Canton – Harmon 345 kV line.
• Reconductor Inland – Clinic Health Q-11 138 kV line.
• Replace 795 ACSR SCCIR at Jordan substation
• Cost estimate: TBD
• Projected in-service date is 6/1/2015
- New West Freemont – Groton – Hayes 138 kV line
- Cost estimate: TBD
- Projected in-service date is 6/1/2018.
- Short term: Existing operating procedure to open the Lakeview – Greenfield 138 kV line at Greenfield to avoid the overloads
ATSI Reinforcement

- Build a new ATSI/AEP 138 kV substation with a line to Longview
- Cost estimate: TBD
- Projected in-service date: 6/1/2016
ATSI Reinforcement

- Reconductor the Evergreen – Highland #1 138 kV line with 477 ACSS
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
ATSI Reinforcement

- Reconductor the Evergreen – Highland #2 138 kV line with 477 ACSS
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
ATSI Reinforcement

- Reconductor the Highland – Salt Springs 138 kV line with 795 ACSS.
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
ATSI Reinforcement

- Raise the design temperature to increase the thermal ratings on the Highland – 02R.M. 138 kV line
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
ATSI Reinforcement

- New Beaver Valley - Leroy Center 345kV + Mansfield - Leroy Center 345kV lines
- Cost estimate: TBD
- Proposed in-service date: 6-1-2018
- Short term: Temporary Operating Procedure to Open Cloverdale-Barberton 138kV until 345kV lines are built.
• Build 345-138kV Substation at Niles. 1.2 mile 345kV loop of the Highland – Shenango 345 kV line into substation. New 345/138 kV transformer. Project also increased short circuit levels to benefit power quality due to multiple EAF loads in the area
• Cost estimate: TBD
• Projected in-service date is 6/1/2015.
ATSI Reinforcement

- Replace relay on the Highland – G689 138 kV line
- Cost estimate: TBD
- Projected in-service date is 12/31/2012.
ATSI Reinforcement

- Reconductor the Hoytdale – Newcastle 138 kV lines #1 and #2 with 795 ACSS
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
ATSI Reinforcement

• Add 150 MVAR SVC and a 100 MVAR capacitor at New Castle
• Cost estimate: TBD
• Projected in-service date is 6/1/2015.
ATSI Reinforcement

- Install a 50 MVAR capacitor at the Boardman 138 kV bus
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
- Upgrade the Duquesne portion of the Elrama – Mitchell 138 kV line. (May include reconductoring the line and upgrading substation equipment.)
- Cost estimate: TBD
- Projected in-service date is 4/16/2015.
AP Reinforcement

- Upgrade the AP portion of the Elrama – Mitchell 138 kV line by replace breaker risers on the Mitchell 138 kV bus on the Elrama terminal
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
AP Reinforcement

- Reconductor the Osage-Collins Ferry 138 kV line with 795 ACSS. Upgrade terminal equipment at Osage and Collins Ferry
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
AP Reinforcement

- Raise structures between Lake Lynn and West Run to eliminate the clearance de-rates on the West Run – Lake Lynn 138 kV line
- Cost estimate: TBD
- Projected in-service date is 6/1/2015.
• Raise structures between Collins Ferry and West Run to eliminate the clearance de-rates on the Collins Ferry - West Run 138 kV line
• Cost estimate: TBD
• Projected in-service date is 6/1/2015.
GenOn Deactivations

- Portland Unit 1 & 2
  - Requested deactivation date: 1/7/2015
- Shawville Unit 1, 2, 3 & 4; Titus Unit 1, 2 & 3
  - Requested deactivation date: 4/16/2015
- Glen Gardner CT 1-8
  - Requested deactivation date: 5/1/2015
• Criteria violations
  – N-1 Voltage Magnitude
  – N-1 Voltage drop
  – N-1-1 Thermal
  – N-1-1 Voltage magnitude
  – N-1-1 Voltage drop
  – Generation Deliverability
• Load Deliverability
• Erie South & Erie West
  345kV low voltage violations
• Multiple 115kV, 138kV, &
  230kV low voltage and
  voltage drop violations
• Multiple 115kV & 230kV
  thermal violation
• Erie West 345/115kV
  transformer thermal
  overload
PN Reinforcement

- N-1 Voltage
- Construct a new 345/115 kV substation (Mainesburg) and loop the Mansfield - Everts 115 kV (existing base line upgrade b1608)
- Cost estimate: $13M
- Projected in-service date: 6/1/2014
PN Reinforcement

- N-1 Voltage, Generator Deliverability
- Re-configure the Erie West 345 kV substation, add a new circuit breaker and relocate the Ashtabula line exit (existing base line upgrade b1373)
- Cost estimate: $.955M
- Projected in-service date: 6/1/2012
PN Reinforcement

- N-1 Voltage
- Construct Four Mile Junction 230/115 kV substation. Loop the Erie South - Erie East 230 kV line, Buffalo Road - Corry East and Buffalo Road - Erie South 115 kV lines (existing base line upgrade b1609)
- Cost estimate: $11.1M
- Projected in-service date: 6/1/2014
PN Reinforcement

- N-1 Voltage
- Install a 75 MVAR cap bank on the Four Mile Junction 230 kV bus (existing base line upgrade b1769)
- Cost estimate: $.95M
- Projected in-service date: 6/1/2014
PN Reinforcement

- N-1 Voltage
- Install a 50 MVAR cap bank on the Buffalo Road 115 kV bus (existing base line upgrade b1770)
- Cost estimate: $.75M
- Projected in-service date: 6/1/2015
PN Reinforcement

- N-1 Voltage
- Install a 25 MVAR 115 kV Capacitor at Grandview
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
PN Reinforcement

- Generator Deliverability, N-1-1 Thermal
- Construct Farmers Valley 345/230 kV and 230/115 kV substation. Loop the Homer City-Stolle Road 345 kV line into Farmers Valley
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
• Generator Deliverability
• Reconductor Cambria Slope-Summit 115kV with 795 ACSS Conductor
• Cost estimate: TBD
• Projected in-service date: 6/1/2015
PN Reinforcement

- Generator Deliverability
- Relocate the Erie South 345 kV line terminal
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
PN Reinforcement

- Generator Deliverability
- Convert Lewis Run-Farmers Valley to 230 kV using 1033.5 ACSR conductor. Project to be completed in conjunction with new Farmers Valley 345/230 kV transformation
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
PN Reinforcement

- Generator Deliverability
- Reconductor the New Baltimore - Bedford North 115 kV (existing base line b1607)
- Cost Estimate: $11M
- Projected in-service date: 6/1/2015
• Generator Deliverability
• Change CT Ratio at Claysburg
• Cost estimate: TBD
• Projected in-service date: 6/1/2015
PN Reinforcement

- Generator Deliverability
- Replace 600 Amp Disconnect Switches on Ridgeway-Whetstone 115 kV line with 1200 Amp Disconnects. Reconduct Ridgway and Whetstone 115 kV Bus. Replace Wave Trap at Ridgway. Change CT Ratio at Ridgway
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
PN Reinforcement

- Generator Deliverability
- Replace 600 Amp Disconnect Switches on Dubois-Harvey Run-Whetstone 115 kV line with 1200 Amp Disconnects
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
• Generator Deliverability
• Replace Shawville 115kV breaker '1A XFMR' (existing baseline upgrade b1169)
• Cost estimate: $.313M
• Projected in-service date: 6/1/2015
PN Reinforcement

- Install a 75 MVAR 115 kV Capacitor at Shawville
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
PN Reinforcement

- Install a 250 MVAR SVC at Altoona 230 kV (existing base line upgrade b1801)
- Cost estimate: $43M
- Projected in-service date: 6/1/2015 (no advancement needed)
PN Reinforcement

- Install a 100 MVAR Fast Switched Shunt and 200 MVAR Switched Shunt at Mansfield 345 kV (existing base line upgrade b1802)
- Cost estimate: $6.1M
- Projected in-service date: 6/1/2015 (no advancement necessary)
ME Violations

- Criteria violations
  - N-1-1 Thermal
  - N-1-1 Voltage
  - Generation Deliverability
- Multiple 230kV thermal violations
- Multiple 115kV low voltage violations
- Hunterstown 500kV low voltage
- Hunterstown 500kV and 230kV voltage drop
ME Reinforcement

- Generator Deliverability
- Northwood substation. Replace limiting wave trap, circuit breaker, substation conductor, relay and current transformer components. The revised rating is 221 MVA(Normal)/ 326 MVA(Emergency)
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
ME Reinforcement

- Replace limiting wave trap on the Glendon - Hosensack line. The revised rating is 134 MVA(Normal)/162 MVA(Emergency)
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
ME Reinforcement

- Replace limiting circuit breaker and substation conductor transformer components at Portland 230kV. The revised rating is 233 MVA(Normal)/317 MVA(Emergency)
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
**ME Reinforcement**

- Northwood 230/115 kV Transformer upgrade
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
• N-1-1 voltage
• Install a 500 MVAR SVC at the Hunterstown 500 kV substation (existing base line upgrade b1800)
• Cost estimate: $82M
• Projected in-service date: 6/1/2015 (no advancement needed)
JCPL Violations

• Criteria violations
• N-1-1 Voltage magnitude
• N-1-1 Voltage drop

• Multiple 230kV bus voltage drop violations

• Multiple 115kV and 230kV low voltage violations
JCPL Reinforcement

- Construct a Whippany to Montville 230 kV line (6.4 miles)
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
• Criteria violations
• N-1 Voltage drop

• Multiple 115kV, 138kV and 230kV voltage drop violations
• N-1 voltage drop
• Construct Farmers Valley 345/230 kV and 230/115 kV substation. Loop the Homer City-Stolle Road 345 kV line into Farmers Valley
• Cost estimate: TBD
• Projected in-service date: 6/1/2015
PPL Violations

- **Criteria violations**
  - N-1-1 Thermal
  - N-1-1 Voltage magnitude
  - N-1-1 Voltage drop
  - N-1 Voltage Magnitude
  - N-1 Voltage drop
  - Generation Deliverability
  - Load Deliverability

- Multiple 138kV low voltage violations
- Multiple 230kV line thermal violations
- Multiple 230kV low voltage violations
PPL Reinforcement

- Temporary
- Replace the CTs and switch in South Akron Bay 4 to increase the rating to 493/624 SN/SE MVA.
- Operating procedure to transfer load
- Modify existing SPS
- Cost estimate: $.525M
- Projected in-service date: 6/1/2014
PPL Reinforcement

• Temporary
• Replace the CTs and switch in SAKR Bay 3 to increase the rating of the Millwood-South Akron 230 kV Line to 493/624 SN/SE MVA and increase the rating in Bay 3 to 664/793 SN/SE MVA.
• Operating procedure to transfer load
• Modify existing SPS
• Cost estimate: $.525M
• Projected in-service date: 6/1/2014
PPL Reinforcement

- Permanent
- Install North Lancaster 500/230 kV substation
- Cost estimate: $42M
- Projected in-service date: 6/1/2017
- N-1-1 voltage
- Install a 90 MVAR capacitor bank at the Frackville 230 kV Substation (bus 207973)
- Cost estimate: $3M
- Projected in-service date: 6/1/2015
• Criteria violations
  – N-1-1 Thermal
  – Generation Deliverability

• Multiple 138kV thermal violations
• Multiple 230kV thermal violations
• Reconductor Richmond – Waneeta 230 kV and replace terminal equipments at Waneeta substation (existing baseline b1398.8)
• Cost Estimate: $4M
• Projected in-service date: 6/1/2015
• Reconductor the underground portion of the Richmond - Waneeta 230 kV and replace terminal equipments (existing baseline upgrade b1591)
• Cost estimate: $12M
• Additionally, the scope of b1591 will be increased to include replacing three 230 kV circuit breakers. (Replacing the three 230 kV circuit breakers is estimated to cost $867K.) This will result in a new emergency rating of 1195 MVA.
• Projected in-service date: 6/1/2016
• Upgrade the PECO portion of the Camden - Richmond 230 kV to a six wire conductor (existing base line upgrade b1590.1)
  • Cost estimate: $2.7M
• Replace terminal equipment at Richmond (Camden - Richmond 230 kV) (existing base line upgrade b1590.2)
  • Cost estimate: $0.8M
• Projected in-service date: 6/1/2015 (advance from 2016)
PSEG Violations

- Criteria violations
  - N-1-1 Thermal
  - Generation Deliverability

- Multiple 230kV thermal violations
*Solution under review*

- Tosco – G22_MTX5: Re-conductor 0.3 miles of the circuit
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
*Solution under review*

- Reconducto the Eagle Point - Gloucester 230 kV circuit #1 and #2 (existing base line upgrade b1588)
- Cost estimate: TBD
- May require an SPS From 6/1/2015 to 6/1/2016
- Projected in-service date: 6/1/2015 - 6/1/2016
*Solution under review*

- Reconductor the B and F circuits of the Cedar Grove - Roseland 230kV line
- Cost estimate: TBD
- Projected in-service date: 6/1/2015
PEPCO Violations

• Criteria violations
  – Generation Deliverability

• 230kV thermal violation
The Station H – Quince Orchard 032 230kV line gets overloaded to 101.88% of its emergency rating for a tower contingency.

Reconductor feeder 23032 and 23034 (these feeders share common towers and cross arms would need to be raised) to the high temperature conductor (10 miles).

Cost estimate: $16M
Projected in-service date: 6/1/2015
Deactivation Studies - Next Steps

- Avon Lake and AEP deactivation analysis underway
  - Potential aggravation of existing violations
- Finalize 2015 plan for all current deactivations
- Consider 2016, 2017 & 2018 effects
2012 RTEP
Scenario and Sensitivity Analyses
2012 RTEP - Renewable Portfolio Standards Scenarios
Renewable Portfolio Standards (RPS)

• Status
  – RPS targets (MWh) update
  – Wind capacity factor update
  – Nameplate MW update
Renewable Portfolio Standards

• 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
  
  – 2012 PJM Load Forecast Report
    • 15 Year Load Forecast
    • Include Demand Response (DR) and Energy Efficiency (EE)
  
  – Incorporate findings from 2011 RTEP RPS scenario studies
RPS – Scenario #1

• Assumptions
  – Assume RPS supply from PJM resources
  – 7 GW Offshore
  – Study year: 2027

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

• Result
  – Thermally overloaded facilities
  – Congestion $’s
  – Develop transmission overlay
RPS – Scenario #2

• Assumptions
  – 0 GW Offshore
  – Otherwise, same as RPS – Scenario #1 but with a 0 GW offshore assumption
  – The remainder of the state target RPS will be sourced from inland PJM resources
• Assumptions
  – **RPS Source from Neighboring Entities**
  – Otherwise, same as RPS – Scenario #2 (assume 0 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
2012 RTEP - High Load Growth Scenario
Moody’s High Economic Load Growth Scenario

Moody’s High Economic Load Growth Compared to RTEP Assumption
• Overall Assumptions
  – 2012 PJM Load Forecast Report
    • 15 Year Load Forecast
    • Include Demand Response (DR) and Energy Efficiency (EE)
  – PJM Load Forecast based on Moody’s High Economic Growth Forecast
  – 2017 RTEP Base Case

• Analysis
  – Reliability Analysis
    • 15 Year Analysis

• Result
  – Thermally overloaded facilities with and without the high load growth forecast that demonstrate the relative impact of the alternate forecast
2012 RTEP - At Risk Generation Scenarios
Past / Future Retirements

- Over 8,900 MW deactivated since 2002
- Over 15,000 announced retirements pending deactivation
At-Risk Generation

• At-Risk MW in addition to known Deactivation Notifications

• At-Risk machine list posted with 4/12/2012 TEAC materials
At-Risk Generation

• Purpose
  – Identify potential regional and local reliability concerns

• Overall Assumptions
  – 2016 RTEP Base Case
  – 2012 PJM Load Forecast Report
    • Include Demand Response (DR) and Energy Efficiency (EE)

• At-risk generation
  – Announced retirements
  – Coal Plant Size and Age
  – State agency feedback
  – Media publication
  – Other at-risk
• Assumptions
  – Same as 2012 RTEP base except “at-risk” generation

• Analysis
  – Reliability Analysis
    • Generator Deliverability (50/50 load level)
    • Common Mode Outage test (50/50 load level)
    • N-1-1 outage test (50/50 load level)
    • Load Deliverability (90/10 load level)

• Result
  – Thermal overloads & voltage violations
2012 PJM Baseline Reliability
AEP Transmission Zone

- NERC Category B Violation
  - Loss of the South Bend 138/69 kV transformer overloads Lake Street – Lake Head 69 kV Tap and Lake Head Tap – Niles 69 kV lines beyond their emergency ratings
  - Loss of the Laport Junction 138-69/34.5 kV transformer causes the voltage on the Laport Junction's 69 kV bus to fall below 0.92 PU causing voltage levels at New Buffalo and Springville stations to fall below 0.92 PU.

- Convert S0411.1 – 0411.5 to baseline
- Cancel S0411.1 – 0411.5
  - Construct a new 138-69 Michiana Station near Bridgman by taping the New Carlisle – Main Street 138 kV line and the Bridgman – Buchanan Hydro 69 kV line. (B1904.1)
  - Establish a new 138/12 kV New Galien station by taping the Olive – Hickory Creek 138 kV line. (B1904.2)
  - Retire the existing Galien station and move its distribution load to New Galien station. Retire the Buchanan Hydro – New Carlisle 34.5 kV line. (B1904.3)
  - Implement an in and out scheme at Cook 69 kV by eliminating the Cook 69 kV tap point and by installing two new 69 kV circuit breakers. (B1904.4)
  - Rebuild the Bridgman – Cook 69 kV line and the Derby – Cook 69 kV. (B1904.5)

- Estimated Cost: $30M
- Expected IS date: 12/31/2014
• **Project Scope/Cost Change**

• **B1302**

**Old Scope:**
- b1032.1 Construct a new 345/138kV station on the Marquis-Bixby 345kV line near the intersection with Ross - Highland 69kV
- b1032.2 Construct two 138kV outlets to Delano 138kV station and to Camp Sherman station
- b1032.3 Convert Camp Sherman - Circleville 69kV to 138kV
- b1032.4 Install 138/69kV transformer at new station and connect in the Ross - Highland 69kV line
  - Cost Estimate: $50M

**New Scope:**
- B1032.1 Construct a new 345/138/69 kV station on the Marquis-Bixby 345 kV line near the intersection with Ross-Highland 69 kV
- b1032.2 Construct two 138 kV outlets to Delano 138 kV station (via new 138/12 kV Hopetown station, a replacement for Camp Sherman station) and to Circleville station. Install new 138 kV breaker string at Delano station to terminate new line.
- b1032.3 convert Camp Sherman-Circleville 69 kV to 138 kV or build new 138 kV in the clear and retire the 69 kV line
- b1032.4 Install 138/69 kV transformer at new station and connect in the Ross-Highland 69 kV line with two 69 kV exits.
  - Cost Estimate: $89.345 M
• Project Cost Change

• B1454
• Perform an electrical clearance study on the Ross - Delano - Scioto Trail 138kV line to determine if the emergency rating can be utilized

• Old Cost Estimate: $0.064M

• New Cost Estimate: $0.3041M
AEP Transmission Zone

- **Project Cost Change**

- **B1458**

  - Install three new 345kV breakers at Bixby to separate the Marquis 345kV line and transformer #2. Operate Circleville - Harrison 138kV and Harrison - Zuber 138kV up to conductor emergency ratings.

  - Old Cost Estimate: $0.078M

  - New Cost Estimate: $3.8914M
**APS Transmission Zone**

- **Project Replacement**

- **Cancel B0676.1:**
  - Reconductor Doubs - Lime Kiln (#207) 230kV
  - Estimated Cost: $3.5M
  - Expected IS Date: 06/01/2013

- **Replaced with B1832:**
  - Replace the 1200 A line side and bus side disconnect switches with 1600 A switches, replace bus side, line side, and disconnect leads at Lime Kiln SS on the Doubs-Lime Kiln 1 (207) 230 kV line terminal..
  - Estimated Cost: $0.15M
  - Expected IS date: 06/01/2016
• **Project Replacement**

• **Withdrawal of B0676.2:**
  - Reconductor Doubs - Lime Kiln (#231) 230kV
  - Estimated Cost: $3.1M
  - Expected IS Date: 06/01/2013

• **Replaced by B1833:**
  - Replace the 1200 A line side and bus side disconnect switches with 1600 A switches, replace bus side, line side, and disconnect leads at Lime Kiln SS on the Doubs-Lime Kiln 2 (231) 230 kV line terminal.
  - Estimated Cost: $0.15M
  - Expected IS date: 06/01/2016
• Project Cancellation

• Cancel B1171.3:
  – Install four 500 kV breakers and remove BOL1 500 kV breaker at Black Oak
  – Estimated Cost: $9.17M
  – Expected IS Date: 06/01/2013
Supplemental Projects
<table>
<thead>
<tr>
<th>Upgrade ID</th>
<th>Required IS Date</th>
<th>Description</th>
<th>Cost Estimate (millions)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0184</td>
<td>12/1/2013</td>
<td>Replace the WK-1, WK-2, WK-3, WK-4, WK-5 and WK-6 345 kV breakers at Wylie Ridge</td>
<td>N/A</td>
<td>Cancel</td>
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<tr>
<td>S0194</td>
<td>12/1/2014</td>
<td>Replace the BDL-1, BDL-2 and BDL-3 500 kV breakers at Bedington</td>
<td>N/A</td>
<td>Cancel</td>
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<tr>
<td>S0195</td>
<td>12/1/2013</td>
<td>Replace the BOL-1, BOL-2 and BOL-3 500 kV breakers at Black Oak</td>
<td>N/A</td>
<td>Cancel</td>
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<tr>
<td>S0193</td>
<td>12/1/2012</td>
<td>Replace the DL-50 500 kV breaker at Doubs</td>
<td>N/A</td>
<td>Cancel</td>
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<tr>
<td>S0202</td>
<td>6/1/2017</td>
<td>Reconductor approximately 24.93 miles of Doubs - Monocacy 230kV with 1622 ACSS TW; upgrade terminal equipment at Doubs and MonocacyR</td>
<td>N/A</td>
<td>Cancel</td>
</tr>
</tbody>
</table>
Supplemental project

Install a fourth 345 kV breaker to allow the Conesville 345 kV line to be relocated from the end bus to a breaker string similar to what’s being done with the Biers Run (aka North Fork) line & T#2 (S0426)

Cost Estimate: $1.243M

Expected IS date: 12/31/2014
Questions?

Email: RTEP@pjm.com