



Transmission Expansion Advisory Committee  
(TEAC)  
Recommendations to the PJM Board

PJM Staff Whitepaper  
December 2015



## EXECUTIVE SUMMARY

The PJM Board of Managers previously approved changes to the Regional Transmission Expansion Plan (RTEP) on October 15, 2015, totaling \$1,282.9 million, based on the completion of 155 System Impact Studies, the withdrawal of 157 interconnection projects and their associated network upgrades, and the addition of a number of baseline upgrades to resolve identified reliability criteria violations.

Since that time PJM identified additional baseline reliability criteria violations within the planning horizon as part of the 2015 RTEP. Transmission upgrades were identified to resolve these reliability criteria violations. The increase in the RTEP to include the upgrades to resolve the new baseline reliability criteria violations is \$567.21 million. In addition, a number of previously approved baseline projects have been cancelled, replaced by alternate projects, or the cost and scope has changed resulting in a decrease of \$77.74 million. The net impact due to baseline reliability changes is an increase of \$489.47 million.

With these changes, the RTEP includes over \$28,278.23 million of transmission additions and upgrades since the first plan was approved by the Board in 2000.

On December 15, 2015, the elements of the 2015 RTEP for the additional baseline upgrades were presented for the Board Reliability Committee's (BRC) consideration and for recommendation to the PJM Board for approval and inclusion in the RTEP. The PJM Board approved the changes as summarized below.



## SUMMARY OF UPGRADES

### 2015 Baseline Transmission Upgrades Changes and Additions

One aspect of the development of the Regional Transmission Expansion Planning Process is an evaluation of the “baseline” system, i.e. the transmission system without any of the generation interconnection requests included in the current planning cycle. This baseline analysis determines the compliance of the existing system with reliability criteria and standards. Transmission upgrades required to maintain a reliable system are identified and reviewed with the Transmission Expansion Advisory Committee (TEAC). The cost of transmission upgrades to mitigate such criteria violations are the responsibility of the PJM loads.

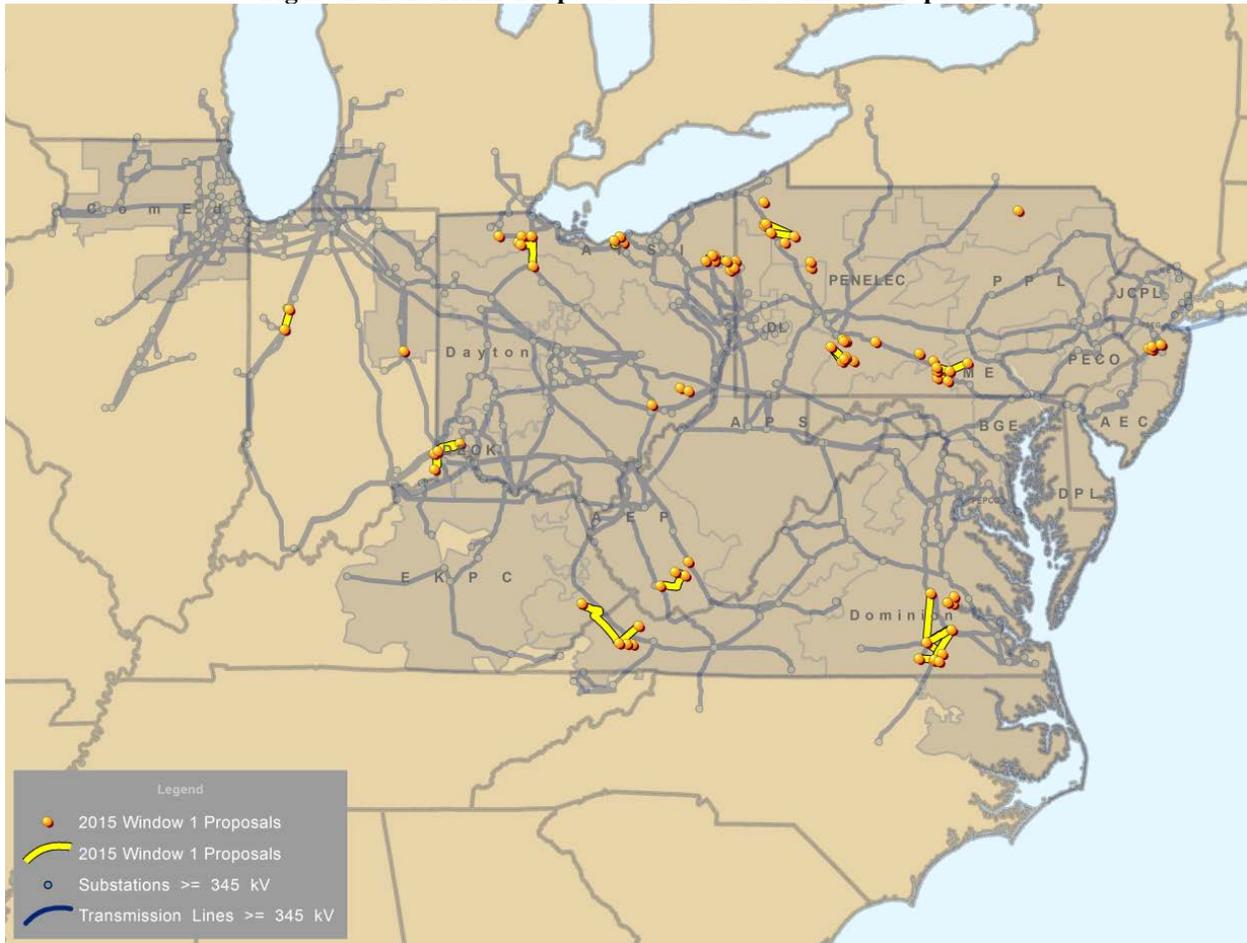
In 2012 PJM filed proposed changes to the Operating Agreement in compliance with FERC Order 1000. Those changes were approved by the FERC and were implemented for the first time as part of the 2014 RTEP. Consistent with the changes to the Operating Agreement, PJM administered two 30 day near-term proposal windows in 2015.

#### Baseline Reliability:

In June of 2015 PJM opened a 30-day proposal window, which was administered as the PJM RTEP Proposal Window #1, to solicit solutions to a number of reliability criteria violations that were identified as part of the 2015 RTEP. The associated reliability test procedures included basecase N-1 thermal, basecase N-1 voltage, Generator Deliverability, Load Deliverability thermal and voltage, and the N-1-1 thermal and voltage tests. PJM staff identified potential reliability criteria violations associated with 292 flowgates (transmission facility and contingency/outage pairs). Thermal reliability criteria violations were identified for approximately 30 individual transmission line facilities due to one or more test procedures. Voltage reliability criteria violations were identified for approximately 60 facilities.

In response to the 2015 RTEP Proposal Window #1, PJM received 91 baseline upgrade proposals to address these reliability criteria violations. The Window produced a wide range of proposals, from 9 different entities including incumbent transmission owners and their affiliates as well as non-incumbent transmission developers. Notably, several affiliates of PJM Transmission Owners proposed “Greenfield Projects” (i.e. new facilities that are not upgrades to existing facilities) in other PJM Transmission Owner zones. The non-incumbent transmission developers included ITC Mid Atlantic, NextEra Energy Transmission, Northeast Transmission Development/LS Power, and Transource Energy. Of the 91 proposals, 26 were Transmission Owner Upgrades and 64 were Greenfield Projects. The locations of the various proposals are shown on the map below.

**Figure 1 - 2015 RTEP Proposal Window #1 Submitted Proposals**



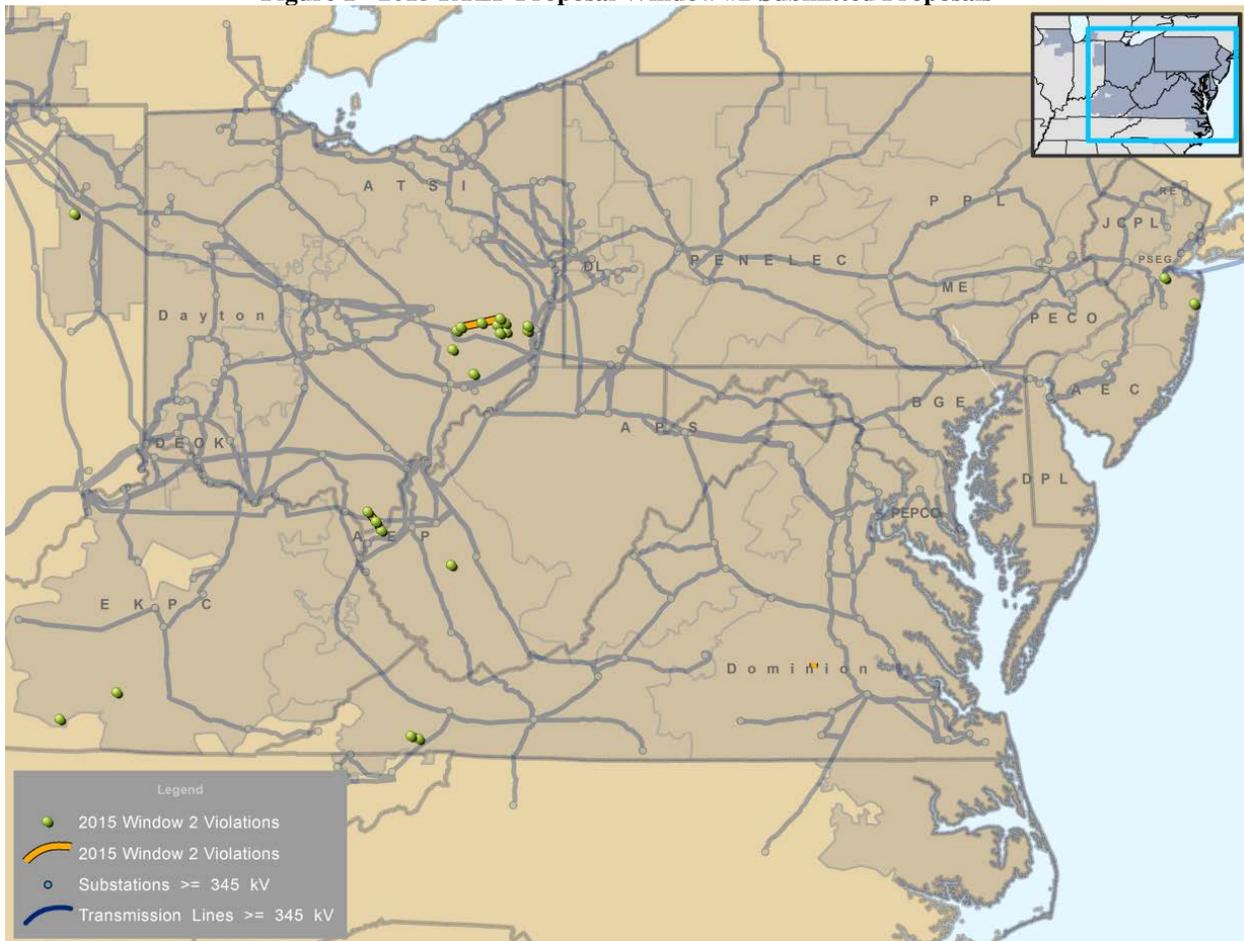
PJM staff reviewed all of the proposals and our evaluation of the effectiveness of each of the proposals with stakeholders through the Transmission Expansion Advisory Committee (TEAC). PJM staff previously recommended 19 of the 91 proposals to resolve reliability criteria violations. The 19 recommended proposals, which were approved by the PJM Board of Managers at their October meeting, resolved all of the reliability criteria violations identified in proposal window #1 except for several voltage violations and a thermal violation on the 138kV system in the AEP transmission zone. PJM is recommending one additional project to address the remaining violations in AEP. The project includes the construction of a new substation, breaker installations at existing substations, and the construction of a new transmission line. The recommended project is a Transmission Owner Upgrade. Additional information about the recommended project is included in this white paper.

In addition to RTEP Proposal Window #1, PJM opened a second 30-day proposal window in August of this year, which was administered as the PJM RTEP Proposal Window #2 to solicit solutions to a number of reliability criteria violations that were identified as part of the 2015 RTEP. The associated reliability test procedures included basecase N-1 thermal and basecase N-1 voltage tests for JCPL, EKPC, and AEP Transmission Owner Criteria. PJM staff identified potential reliability criteria violations associated with 22

flowgates (transmission facility and contingency/outage pairs). Thermal reliability criteria violations were identified for approximately 14 individual transmission line facilities due to one or more test procedures. Voltage reliability criteria violations were identified for approximately 8 facilities.

In response to the 2015 RTEP Proposal Window #2, PJM received 23 proposals to address these reliability criteria violations. The Window included proposals from 4 different entities including incumbent transmission owners and a non-incumbent transmission developer. The only non-incumbent transmission developer was Northeast Transmission Development/LS Power. Of the 23 proposals, 5 were Transmission Owner Upgrades and 18 were Greenfield Projects. The locations of the various proposals are shown on the map below.

**Figure 1 - 2015 RTEP Proposal Window #2 Submitted Proposals**



PJM staff reviewed all of the proposals and our evaluation of the effectiveness of each of the proposals with stakeholders through the Transmission Expansion Advisory Committee (TEAC). PJM staff is recommending 6 of the 23 proposals to resolve reliability criteria violations. The 6 recommended proposals resolved all of the reliability criteria violations identified in proposal window #2 except for a thermal violation on the 69kV system in the AEP transmission zone. The recommended proposals include



the replacement of transformers, a bus and terminal equipment upgrades, a capacitor installation, rebuilding/upgrading of a line, and construction of a new transmission line. The recommended projects are Transmission Owner Upgrades, and additional information about the recommended project is included in this white paper.

Also, 22 projects are being recommended to address immediate need baseline reliability issues. The immediate need baseline reliability projects include transmission enhancements with a need date of 3 years or less. Due to the critical timing of immediate need projects, PJM did not have time to administer a proposal window to solicit alternative solutions from PJM stakeholders for the associated reliability drivers.

The reliability criteria drivers for the immediate need projects include short circuit fault duty to which the only solution is a Transmission Owner upgrade of the associated breaker, Dominion local Transmission Owner criteria for "End of Life" facilities where the associated facilities have already reached their end of life, upgrades associated with generation deactivation within the three year horizon, and several PJM operational performance issues.

A summary of the more significant baseline projects with expected costs greater than \$5 million are detailed below. A complete listing of all of the projects that are being recommended to address baseline reliability is included as Attachment A and B to this white paper. The projects that cost less than \$5 million include circuit switcher installations, CCVT installations on lines, installation and replacement of circuit breakers, SPS removal, transformer replacements, bus and current transformer upgrades, and a capacitor installation.

### Mid-Atlantic Region System Upgrades

- PSEG Transmission Zone
  - Install a 350 MVAR reactor at Roseland 500 kV - \$50.1M
  - Install a 100 MVAR reactor at Bergen 230 kV - \$10.6 M
  - Install a 150 MVAR reactor at Essex 230 kV - \$16.7 M
  - Install a 200 MVAR reactor (variable) at Bergen 345 kV - \$38.3 M
  - Install a 200 MVAR reactor (variable) at Bayway 345 kV - \$26.6 M
  - Install a 100 MVAR reactor at Bayonne 345 kV - \$15.4 M

### Western Region System Upgrades

- AEP Transmission Zone
  - Install a +/- 450 MVAR SVC at Jacksons Ferry 765 kV substation - \$36.5 M
  - Install a 300 MVAR shunt line reactor on the Broadford end of the Broadford - Jacksons Ferry 765 kV line - \$14.5 M
  - Construct Herlan station as breaker and a half configuration with 9-138 kV CB's on 4 strings and with 2-28.8 MVAR capacitor banks - \$15.64 M



- Construct new 138 kV line from Herlan station to Blue Racer station. Estimated approx. 3.2 miles of 1234 ACSS/TW Yukon and OPGW - \$5.78 M
  - Rebuild/upgrade line between Glencoe and Willow Grove Switch 69 kV - \$6.014 M
  - Build approximately 11.5 miles of 34.5 kV line with 556.5 ACSR 26/7 Dove conductor on wood poles from Flushing station to Smyrna station - \$14.355 M
- ComEd Transmission Zone
    - Replace 5 Powerton 345 kV CB's with 2 cycle independent pole operation breakers, install one new 345 kV CB; swap line 0302 and line 0303 bus positions; reconfigure Powerton 345 kV bus as single ring configuration - \$15 M

### Southern Region System Upgrades

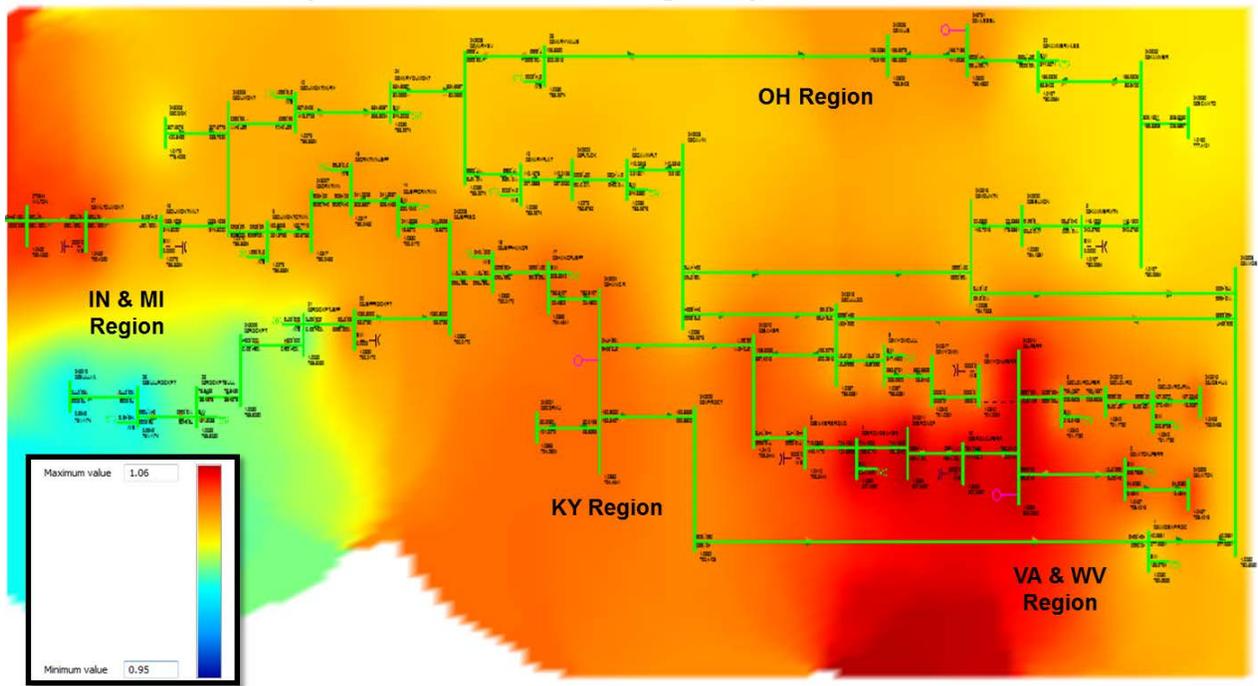
- Dominion Transmission Zone
  - Wreck and rebuild the Chesapeake - Deep Creek - Bowers Hill - Hodges Ferry 115 kV line; minimum rating 239 MVA normal/emergency, 275 MVA load dump rating - \$10 M
  - Rebuild Line #47 between Kings Dominion 115 kV and Fredericksburg 115 kV to current standards with summer emergency rating of 353 MVA at 115 kV - \$51 M
  - Rebuild Line #4 between Bremo and Structure 8474 (4.5 miles) to current standards with a summer emergency rating of 261 MVA at 115kV - \$6.8 M
  - Rebuild 115kV Lines #18 and #145 between Possum Point Generating Station and NOVEC's Smoketown DP (approx. 8.35 miles) to current 230kV standards with a normal continuous summer rating of 524 MVA at 115kV - \$24.7 M
  - Rebuild 115kV Line #48 between Thole Street and Structure 48/71 to current standard. The remaining line to Sewells Point is 2007 vintage. Rebuild 115kV Line #107 line between structure 107/17 and 107/56 to current standard - \$15.3 M
  - Rebuild the 115kV Line #34 between Skiffes Creek and Yorktown and the double circuit portion of 115kV Line # 61 to current standards with a summer emergency rating of 353 MVA at 115 kV - \$24 M
  - Rebuild 115kV Line #1 between Crewe 115kV and Fort Pickett DP 115kV (12.2 miles) to current standards with a summer emergency rating of 261 MVA at 115kV - \$18.3 M
  - Rebuild 115kV Line #82 Everetts – Voice of America (20.8 miles) to current standards with a summer emergency rating of 261 MVA at 115kV - \$24 M
  - Rebuild the 115kV Lines #27 & #67 lines from Greenwich 115kV to Burton 115kV Structure 27/280 to current standard with a summer emergency rating of 262 MVA at 115kV - \$8.85 M
  - Rebuild the Cunningham - Dooms 500 kV line - \$110 M

Following is a more detailed description of the larger scope upgrades that were recommended to the PJM Board for their consideration. A description of the criteria driving the need for the upgrade as well as the required in-service date is provided.

### Baseline Projects to Resolve High Voltage Issues

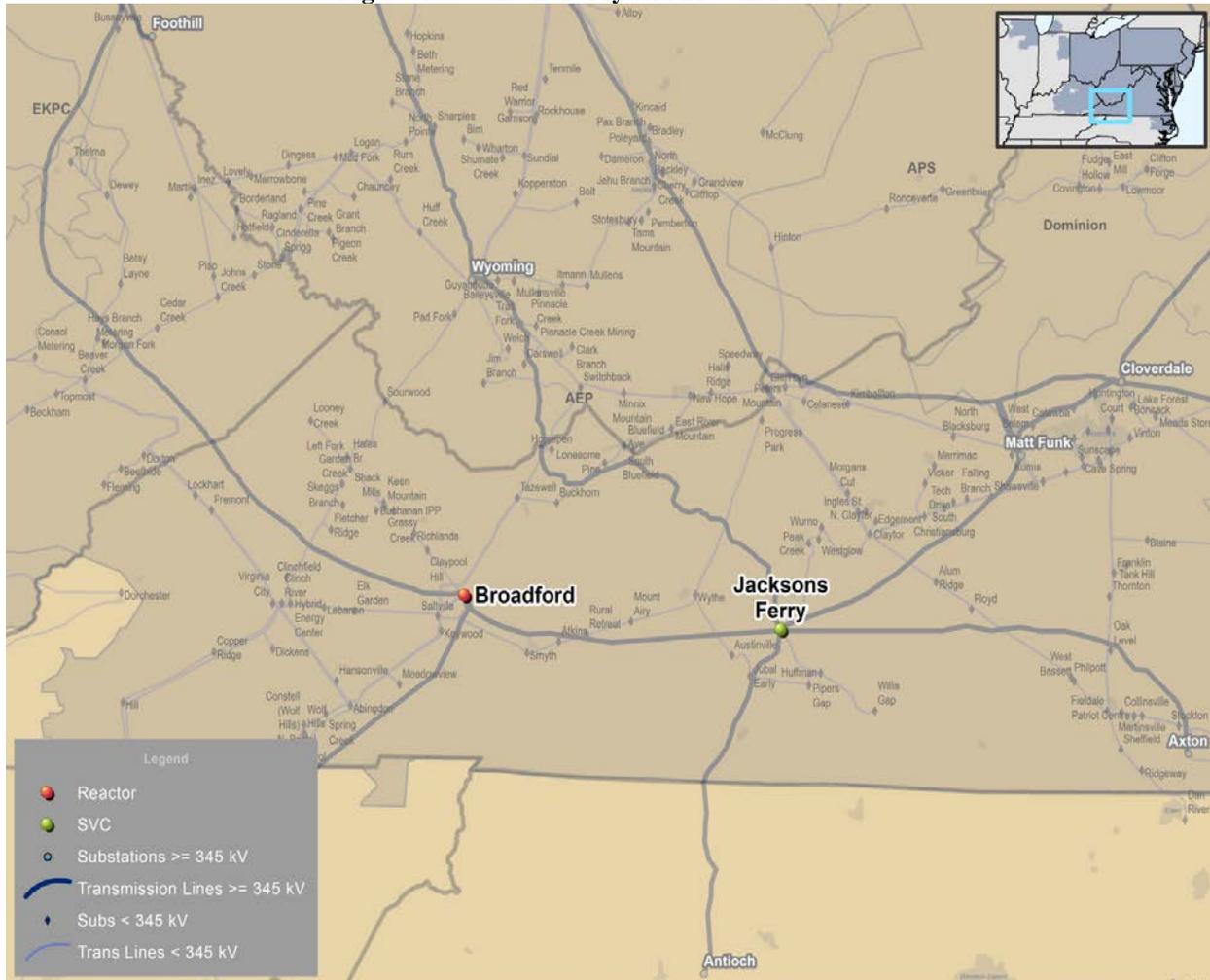
In PJM Operations, the AEP transmission zone and the northeastern Mid-Atlantic regions have experienced a large increase in high voltage alarms over the past year. Additionally, the AEP zone has also experienced a large increase in shunt reactor switching to address both low and high voltage conditions. These conditions, which generally occur during light load periods, have several drivers: changes in dynamic reactive support due to new and deactivated generation, reactive support deficiencies, and increased line charging from new transmission facilities. Approved RTEP reactive devices planned to come in service over the next several years will help lower the voltages to some extent, but anticipated generation deactivations and additional line charging from planned transmission facilities will further aggravate the problem.

**Figure 3 – Simulation of Severe Operating Event in Fall 2014**



In AEP, operating conditions have required 765 kV circuits to be taken out of service in order to manage the high voltage issues. Furthermore, over 5,000 MW of deactivations have occurred in 2015 alone, which has caused a large reduction in dynamic reactive support. In addition, the increased need to switch existing reactors to address both high and low voltage conditions has resulted in multiple failed reactors and reduced life expectancy. PJM staff is recommending installation of a +/- 450 MVAR SVC at Jacksons Ferry 765 kV substation and a 300 MVAR shunt line reactor on the Broadford end of the Broadford – Jacksons Ferry 765 kV line to address the operational performance issues in the AEP transmission zone. The total estimated cost is \$51 million and the projected in service date is June 1, 2018. These upgrades are immediate need solutions as the timing required to include them in an RTEP proposal window is infeasible. As a result the local Transmission Owner, AEP, is the designated entity.

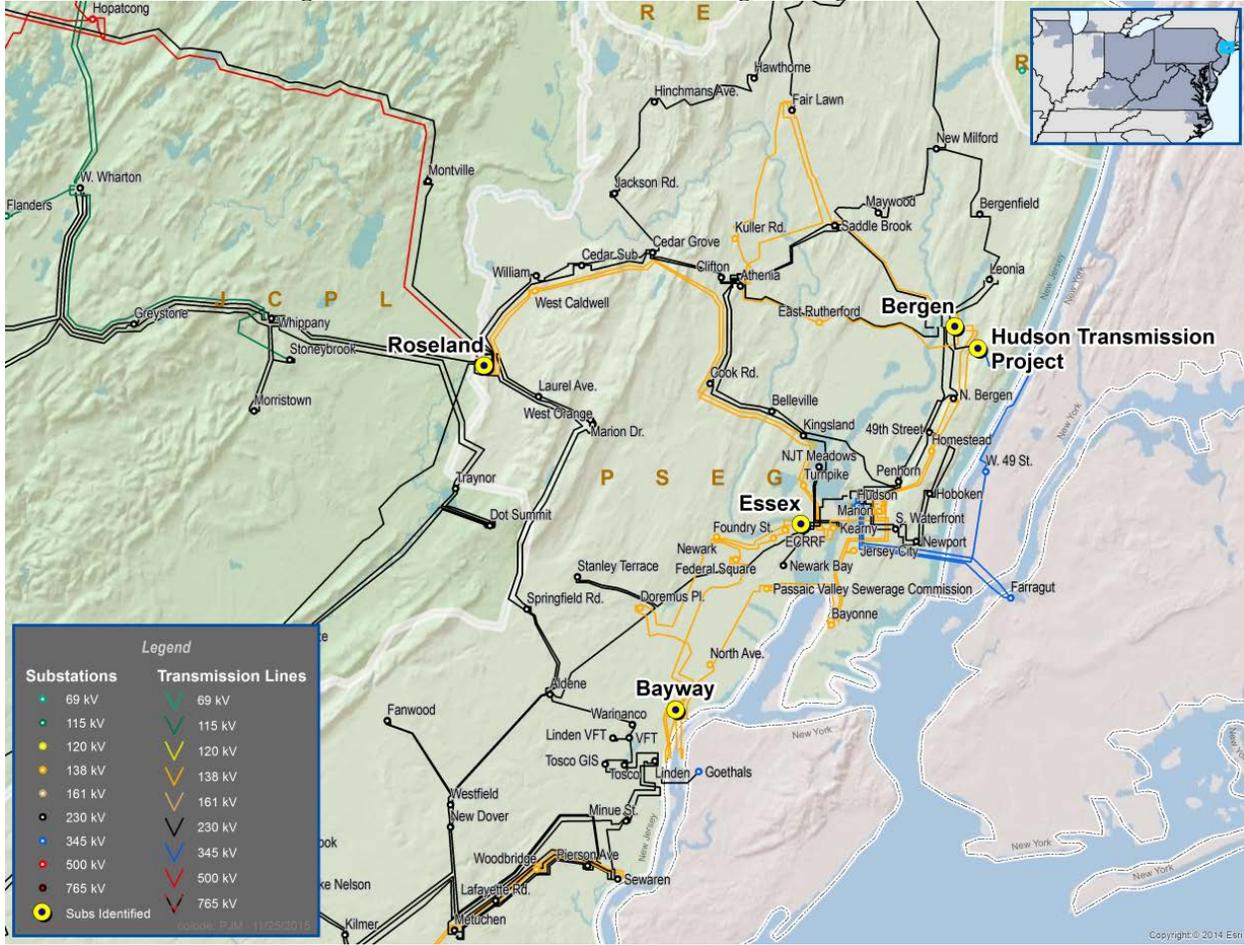
**Figure 4 – Jacksons Ferry and Broadford 765 kV**



PJM Operations has also encountered high voltage conditions in the northeastern Mid Atlantic region. The most significant drivers for the high voltage conditions are increased line charging from new required RTEP upgrades located mostly in the PSEG area along with the loss of dynamic MVARs from generation deactivations. Approximately 1,500 MVARs of approved reactors and SVCs slated to go in service in 2015 and 2016 will greatly improve the voltage profile. However, planning studies show that future planned transmission will require additional reactive devices to control voltages in PSEG. The recommended solution to address these high voltage conditions is to install six new static shunt reactors in PSEG. The first is a 350 MVAR reactor at Roseland 500 kV with an estimated cost of \$50.1 million. The second is a 100 MVAR reactor at Bergen 230 kV with an estimated cost of \$10.6 million. The third is a 150 MVAR reactor at Essex 230 kV with an estimated cost of \$16.7 million. The fourth is a 200 MVAR reactor at Bergen 345 kV with an estimated cost of \$38.3 million. The fifth is a 200 MVAR reactor at Bayway 345 kV with an estimated cost of \$26.6 million. The last is a 100 MVAR reactor at Bayonne 345 kV with an estimated cost of \$15.4 million. The first three devices are required as soon as possible to address ongoing operational performance issues, while the remaining three devices at the 345 kV stations will be staged to in coordination with the addition of the Bergen to Linden Corridor 345 kV project. As such the

projected in service date for these upgrades is June 1, 2016. Since these upgrades are immediate need solutions and the timing required to include them in an RTEP proposal window is infeasible, the local Transmission Owner, PSEG, is the designated entity.

**Figure 5 – Northeastern Mid-Atlantic High Voltage Locations**

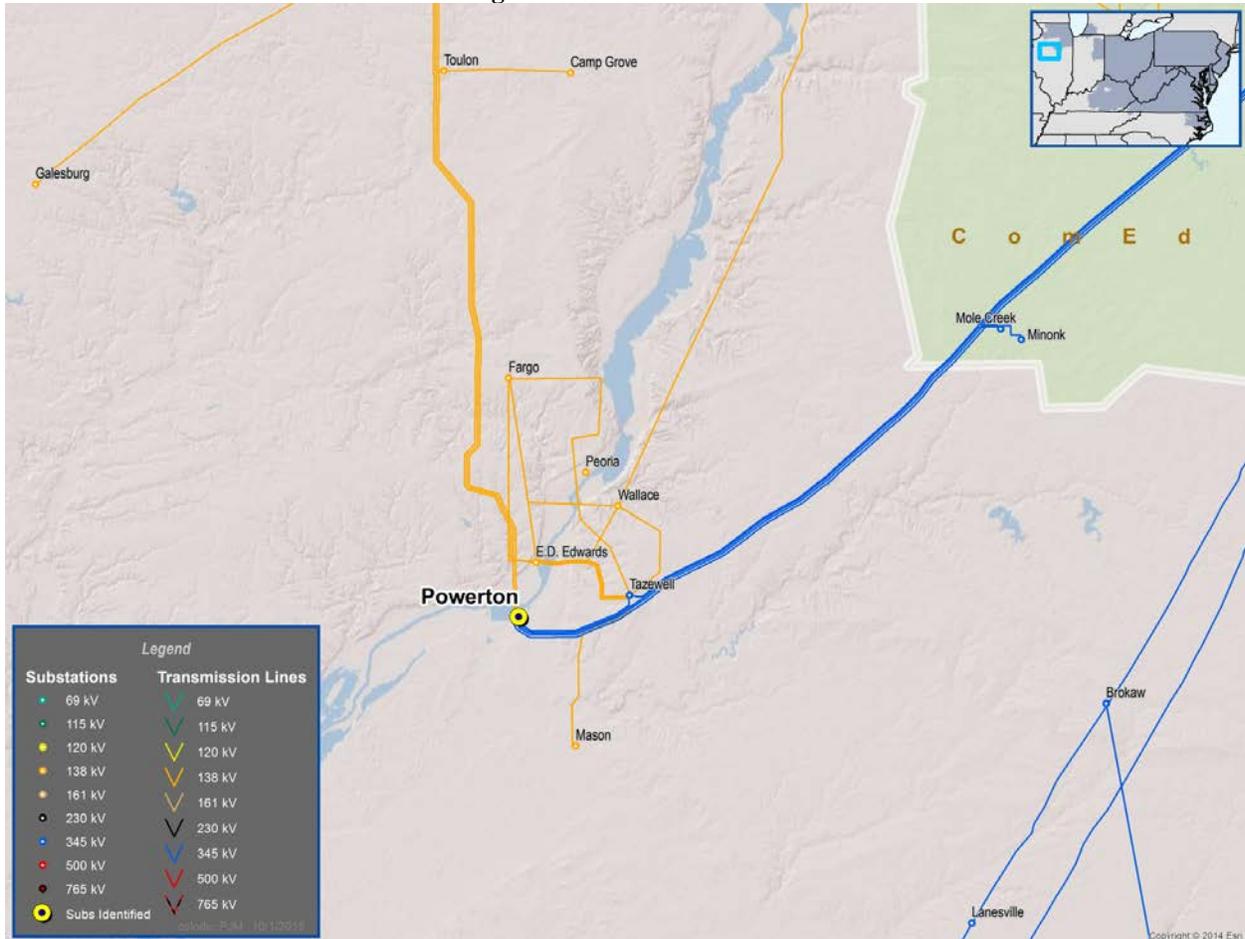


**Baseline Project B2699.1 – Powerton 345 kV Upgrade to Minimize SPS**

The area around the Powerton station in the ComEd transmission zone has historically been constrained due to generator stability and requires a complex Special Protection System (SPS) to maintain stability. Recent baseline stability studies have shown that the existing SPS scheme is not sufficient for all criteria tests. Rather than further complicate the existing SPS, PJM staff is recommending a project to reconfigure the Powerton substation and greatly simplify the existing SPS scheme. The recommended solution includes the replacement of five Powerton 345 kV circuit breakers with 2 cycle independent pole operation (IPO) breakers, the installation of one new 345 kV circuit breaker, swapping the line 0302 and line 0303 bus positions, and the reconfiguration of the Powerton 345 kV bus as a single ring configuration. Additionally, PJM recommends the removal of the SPS logic that trips generators or sectionalizes the bus under normal conditions, which will significantly simplify the existing SPS logic. The estimated cost for this work is \$15 million and the projected in service date is June 1, 2018. As the timing required for an RTEP

proposal window is infeasible, this project is immediate need and the local Transmission Owner, ComEd, is the Designated Entity.

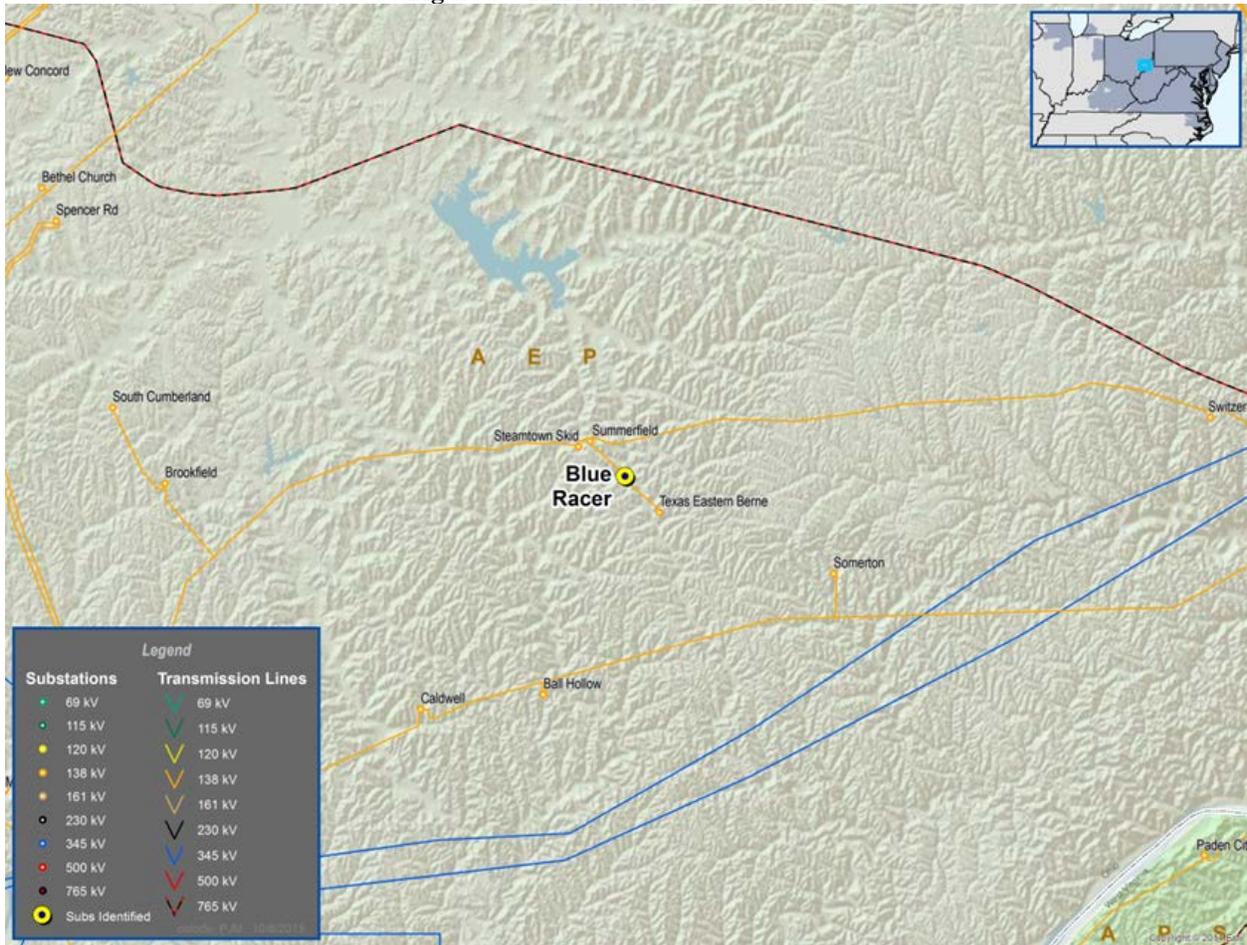
**Figure 6 – Powerton 345 kV**



**Baseline Project B2701 – Harlan - Blue Racer 138 kV**

In 2020, the AEP transmission zone experiences low voltages conditions at South Cumberland, Summerfield, South Caldwell, and Steamtown 138 kV substations and voltage drop violations at South Caldwell and South Cumberland 138 kV substations for several contingency pairs. In addition, the South Caldwell – Muskingum 138 kV circuit is overloaded for several contingencies. These violations were identified and included as part of the 2015 RTEP Window #1. The recommended solution to address the issues includes construction of a Harlan station as a breaker and a half configuration with nine 138 kV circuit breakers with two 28.8 MVAR capacitor banks, and the construction of a new 138 kV line from Harlan to Blue Racer 138 kV with approximately 3.2 miles of 1234 ACSS/RW Yukon and OPGW. A 138 kV circuit breaker will be added at Blue Racer to terminate the new Harlan circuit. The total estimated cost is \$21.74 million and the required in service date is June 1, 2020.

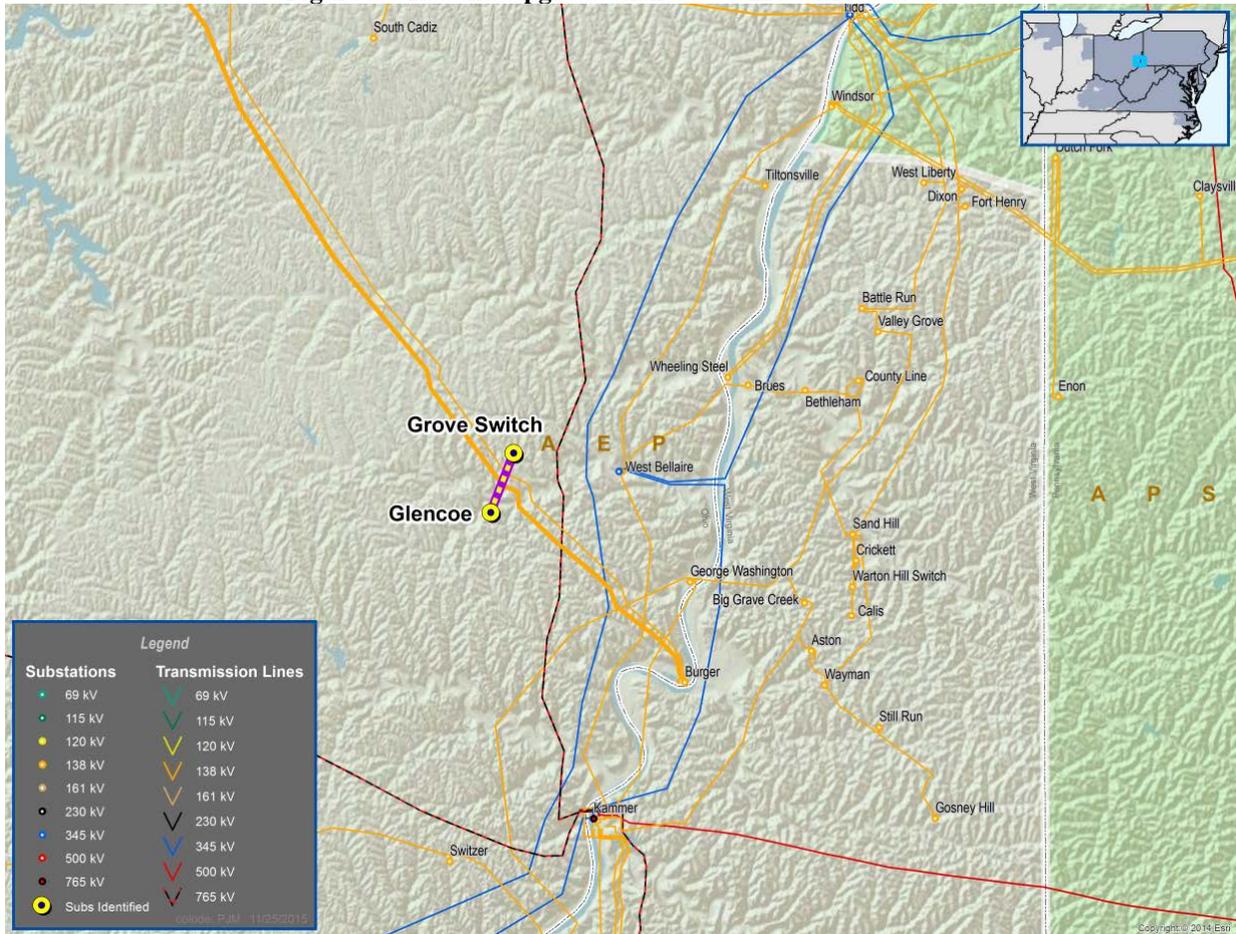
**Figure 7 – Harlan - Blue Racer 138 kV**



**Baseline Project B2714 – Rebuild/Upgrade Glencoe – Willow Grove 69 kV**

The Glencoe – Willow Grove 69 kV line in the AEP zone is overloaded for multiple contingencies in 2020. This overload was included as part of the 2015 RTEP Window #2. The recommended solution to address the issue is to rebuild/upgrade the line between Glencoe and Willow Grove Switch 69 kV. The estimated cost is \$6.014 million and the required service date is June 1, 2020.

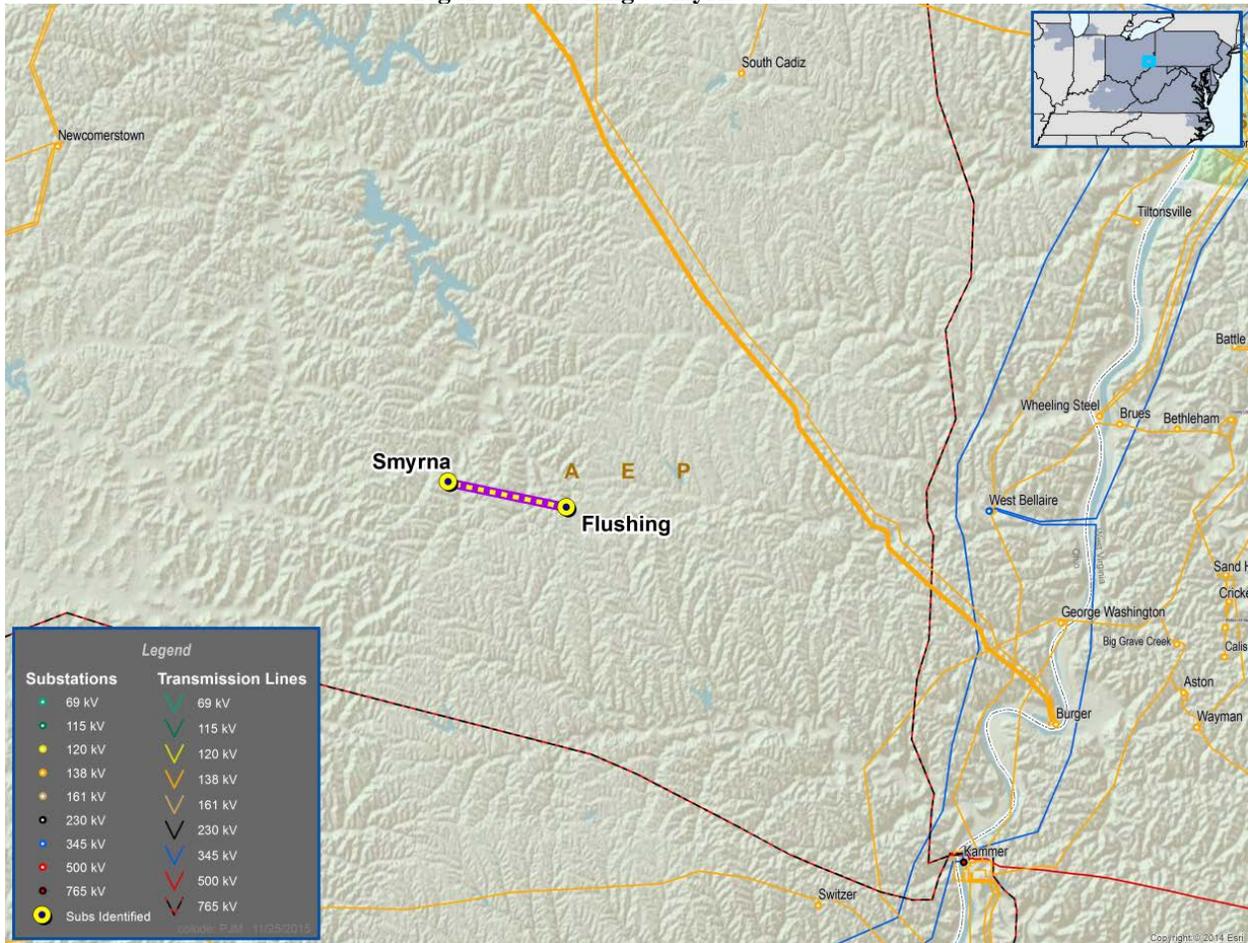
**Figure 8 – Rebuild/Upgrade Glencoe - Willow Grove 69 kV**



**Baseline Project B2715 – Flushing - Smyrna 34.5 kV**

The East Cambridge – Old Washington – Antrim 34.5 kV circuit in the AEP zone is overloaded in the 2020 RTEP case. In addition low voltage magnitude violations are expected at Antrim Switch, Antrim (G.M. Co-op), Vail Switch, and Smyrna 69 kV for the basecase pre-contingency condition. These violations were included as part of the 2015 RTEP Window #2. The recommended solution is to build approximately 11.5 miles of 34.5 kV line with 556.5 ACSR 26/7 Dove conductor on wood poles from Flushing station to Smyrna station. The estimated cost is \$14.355 million and the required in service date is June 1, 2020.

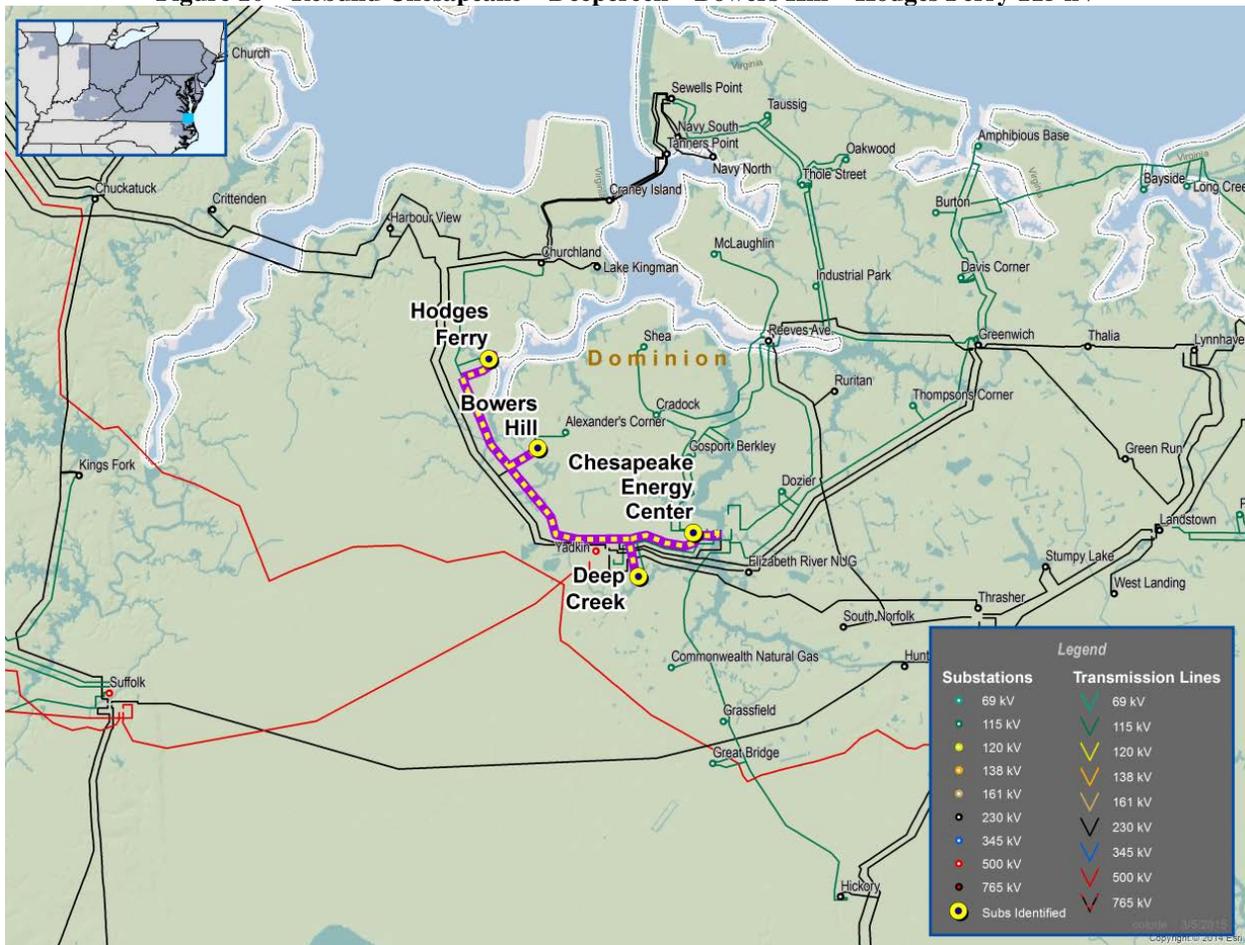
**Figure 9 – Flushing - Smyrna 34.5 kV**



**Baseline Project B2620 – Rebuild Chesapeake - Deepcreek - Bowers Hill - Hodges Ferry 115 kV**

Due to the deactivation the Lake Kingman generation in 2016, the Dominion system experiences an overload on the Chesapeake – Deepcreek – Bowers Hill – Hodges Ferry 115 kV line for various generation deliverability and N-1-1 contingencies. The recommended solution to address these issues is to wreck and rebuild the Chesapeake – Deepcreek – Bowers Hill – Hodges Ferry 115 kV line with a minimum normal/emergency rating of 239 MVA and a load dump rating of 275 MVA. Given the generator is expected to deactivate in 2016 an RTEP proposal window is infeasible. This project is immediate need and the local Transmission Owner, Dominion Virginia Power, is the Designated Entity.

**Figure 10 – Rebuild Chesapeake – Deepcreek – Bowers Hill – Hodges Ferry 115 kV**



**Baseline Projects to Resolve Dominion End of Life Criteria Violations**

In 2014, Dominion added an end-of-life / aging infrastructure criteria to their Transmission Owner criteria. The criterion includes among other things a condition assessment of the equipment and an evaluation of the impact of retiring and permanently removing the facility.

The 500 kV line from Cunningham to Dooms was evaluated and identified by a third party as nearing or has reached its end of life. PJM performed an additional reliability assessment and validated several N-1 and N-1-1 (NERC TPL-001-4 P3 and P4) violations without the line. The recommended solution is to rebuild the Cunningham to Dooms 500 kV line. This is an immediate need project as the condition assessment indicates the facility is at or beyond it’s end of life. Due to the immediate need for the project a proposal window was not feasible. The estimated cost is \$110 million, and the projected in service date is June 2020.

Since adding the criteria in 2014, several 115 kV circuits have been identified using the End of Life Criteria. Two 115 kV reliability problems were identified due to the use of Corten steel in tower construction in the 1960s. Field reports and condition assessments indicate the Corten structures are in poor condition. The

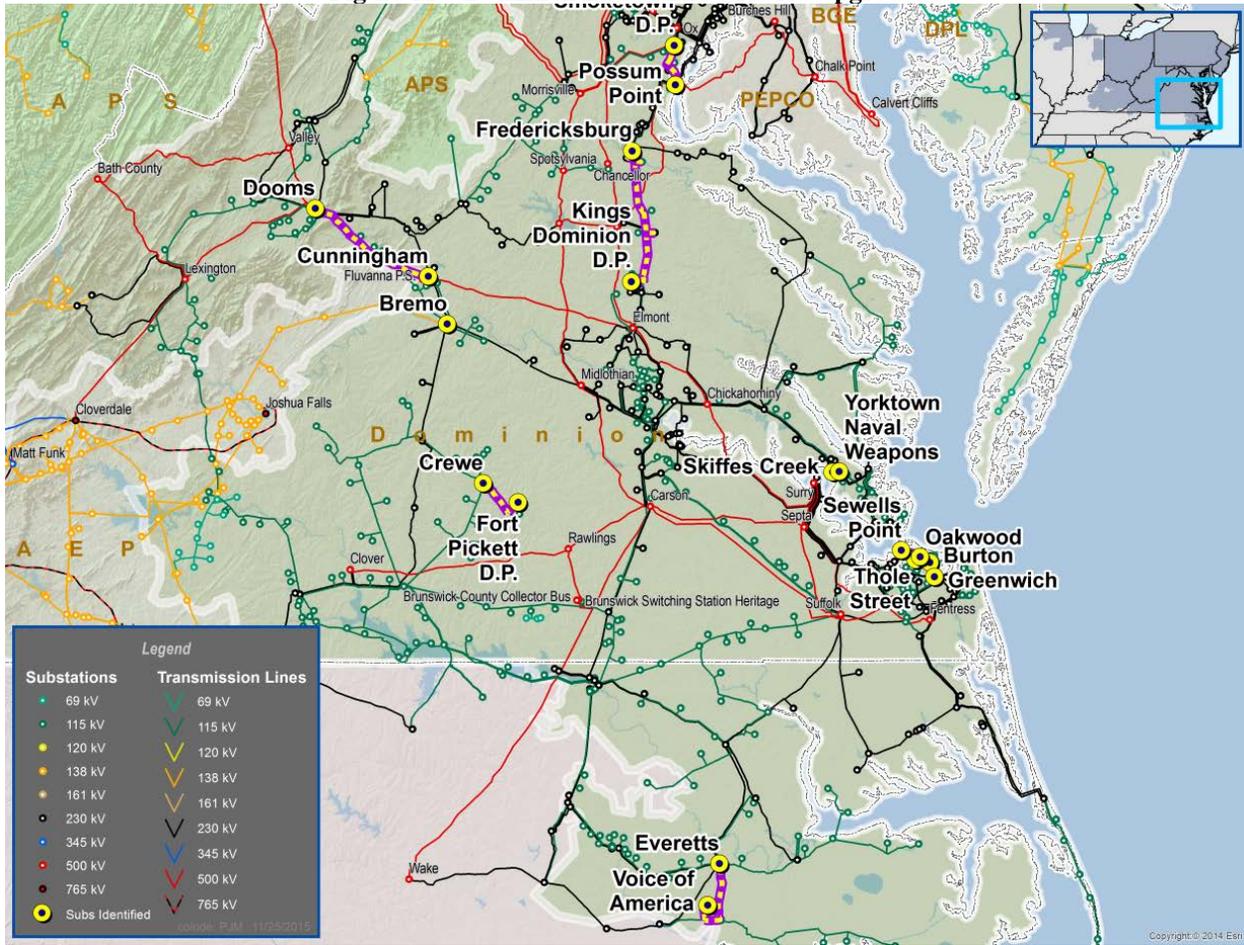


first identified is the Sewells Point to Thole and Sewells Point to Oakwood double circuit lines. The recommended solution is to rebuild the #48 (Sewells Point to Thole Street) line between Thole Street and structure 48/71. The remaining line to Sewells Point is 2007 vintage construction. Also, rebuild the #107 (Sewells Point to Oakwood) line between structures 107/17 and 107/56 to current standards. The estimated cost for this work is \$15.3 million and the projected in service date is December 31, 2018. The second identified are two lines from Greenwich to Burton. The estimated cost to rebuild these lines with summer emergency rating of 262 MVA at 115 kV is \$8.85 million and the projected in service date is December 31, 2019.

Six other 115 kV reliability issues were identified as a result of the Dominion End of Life Criteria. The circuits were constructed primarily of wood H-frame structures and built in the 1950s and 1960s and have reached their end of life. The first circuit is the 34 mile section of the #47 line between Kings Dominion and Fredericksburg. The estimated cost to rebuild this line to current standards with a summer emergency rating of 353 MVA at 115 kV is \$51 million and the projected in service date is December 31, 2017. The second circuit identified was the #4 line between Bremono and Structure 8474. The estimated cost to rebuild this line to current standards with summer emergency rating of 261 MVA at 115 kV is \$6.8 million and the projected in service date is December 31, 2016. The third issue was identified on double circuit lines between Possum Point Generating Station and NOVEC's Smoketown DP. The estimated cost to rebuild the lines to current 230 kV standards with a normal continuous summer rating of 524 MVA at 115 kV is \$24.7 million and the projected in service date is December 31, 2016. The fourth concern is the 13 mile line from Skiffes Creek to Yorktown and the first 4.5 miles of double circuit out of Yorktown. The estimated cost to rebuild these lines to current standards with a summer emergency rating of 353 MVA at 115 kV is \$24 million and the projected in service date is December 31, 2018. The fifth circuit is the #1 line between Crewe and the Fort Pickett DP. The estimated cost to rebuild this line to current standards with a summer emergency rating of 261 MVA at 115 kV is \$18.3 million and the projected in service date is December 31, 2016. The last identified circuit is the #82 line from Everetts to Voice of America. The estimated cost to rebuild this line to current standards with a summer emergency rating of 261 MVA at 115 kV is \$24 million and the projected in service date is December 31, 2017.

All of the above rebuild projects are immediate need solutions as the timing required to include them in an RTEP proposal window is infeasible. As a result the local Transmission Owner, Dominion, is the designated entity.

**Figure 11 – Dominion End of Life Criteria Upgrades**



### Changes to Previously Approved Projects

Cost and scope of a number of previously approved RTEP baseline projects have been changed. In addition, a number of projects have been cancelled as they are no longer required. The net result of these changes to previously approved baseline projects is a net decrease in the RTEP of \$77.74 million. Some of the more significant cost changes are noted below.

The scope of the previously approved RTEP project B2637 to convert Middletown Junction 230 kV substation to a nine bay double breaker configuration has been modified to relocate the line terminals for four 230 kV lines and installation of three new 230 kV circuit breakers at Middletown Junction. Two of the breakers will be installed on the high sides of the #1 and #2 230/115 kV transformers, and the third will be installed on the high side of the #3 230/69 kV transformer. The estimated change in cost is a net decrease of \$7.70 million.

Also, the Jacks Mountain 500 kV baseline RTEP project is being recommended to be cancelled and removed from the RTEP. The facility was not included in the 2015 RTEP as to determine the continued



need for this facility. The latest analysis shows that there are no longer RTEP reliability drivers that would require the Jacks Mountain upgrade. The estimated net change in cost due to all cancellations included in this approval is a decrease of \$70 million.

### **Review by the Transmission Expansion Advisory Committee (TEAC)**

The results of the analyses summarized in this report were reviewed with the TEAC and Subregional RTEP Committees over several meetings throughout 2015. The most recent analysis, along with recommended solutions, were reviewed at the November 5, 2015 TEAC meeting. Written comments were requested to be submitted to PJM communicating any concerns with the recommendation and any alternative transmission solutions for consideration.

### **Cost Allocation**

Preliminary cost allocations for the projects that were recommended are shown in Attachment A for the projects that will be allocated to a single transmission zone and in Attachment B for the projects that will be allocated to multiple transmission zones.

Cost allocations for the projects were calculated in accordance with the Schedule 12 of the OATT. Baseline reliability project allocations are calculated using a distribution factor methodology that allocates the cost to the load zones that contribute to the loading on the new facility. The allocations will be filed at FERC 30 days following approval by the Board.

### **Board Approval**

The PJM Board Reliability Committee endorsed the new baseline reliability projects and associated cost allocations. The PJM Board Reliability Committee recommended to the Board the approval of the baseline upgrades to the 2015 RTEP, and the PJM Board of Managers have approved the changes to the RTEP.



Attachment A – Single Zone Baseline Cost Allocations

Reliability Project Single Zone Allocations

Upgrade ID	Description	Cost Estimate (\$M)	Construction Designee	Cost Responsibility	Required IS Date
b2006.4	Replace the South Reading 69kV '81342' breaker with 40kA breaker	\$0.20	ME	ME	6/1/2016
b2006.5	Replace the South Reading 69kV '82842' breaker with 40kA breaker	\$0.20	ME	ME	6/1/2016
b2222.1	Replace the Eddystone 138 kV #205 breaker with 63kA breaker	\$0.32	Exelon Generation	PECO	6/1/2017
b2620	Wreck and rebuild the Chesapeake - Deep Creek - Bowers Hill - Hodges Ferry 115 kV line; minimum rating 239 MVA normal/emergency, 275 MVA load dump rating	\$10.00	Dominion	Dominion	6/1/2016
b2622	Rebuild Line #47 between Kings Dominion 115 kV and Fredericksburg 115 kV to current standards with summer emergency rating of 353 MVA at 115 kV	\$51.00	Dominion	Dominion	6/1/2018
b2623	Rebuild Line #4 between Bremono and Structure 8474 (4.5 miles) to current standards with a summer emergency rating of 261 MVA at 115kV	\$6.80	Dominion	Dominion	12/31/2016
b2624	Rebuild 115kV Lines #18 and #145 between Possum Point Generating Station and NOVEC's Smoketown DP (approx. 8.35 miles) to current 230kV standards with a normal continuous summer rating of 524 MVA at 1	\$24.70	Dominion	Dominion	12/31/2016
b2625	Rebuild 115kV Line #48 between Thole Street and Structure 48/71 to current standard. The remaining line to Sewells Point is 2007 vintage. Rebuild 115kV Line #107 line between structure 107/17 and 107/	\$15.30	Dominion	Dominion	12/31/2018
b2626	Rebuild the 115kV Line #34 between Skiffes Creek and Yorktown and the double circuit portion of 115kV Line # 61 to current standards with a summer emergency rating of 353 MVA at 115 kV	\$24.00	Dominion	Dominion	12/31/2018



Attachment A – Single Zone Baseline Cost Allocations

b2627	Rebuild 115kV Line #1 between Crewe 115kV and Fort Pickett DP 115kV (12.2 miles) to current standards with a summer emergency rating of 261 MVA at 115kV	\$18.30	Dominion	Dominion	12/31/2016
b2628	Rebuild 115kV Line #82 Everetts – Voice of America (20.8 miles) to current standards with a summer emergency rating of 261 MVA at 115kV	\$24.00	Dominion	Dominion	12/31/2017
b2629	Rebuild the 115kV Lines #27 & #67 lines from Greenwich 115kV to Burton 115kV Structure 27/280 to current standard with a summer emergency rating of 262 MVA at 115kV	\$8.85	Dominion	Dominion	12/31/2019
b2630	Install circuit switchers on Gravel Neck Power Station GSU units #4 and #5. Install two 230kV CCVT's on Lines #2407 and #2408 for loss of source sensing	\$0.66	Dominion	Dominion	5/31/2015
b2699.1	Replace 5 Powerton 345 kV CB's with 2 cycle IPO breakers, install one new 345 kV CB; swap line 0302 and line 0303 bus positions; reconfigure Powerton 345 kV bus as single ring configuration	\$15.00	ComEd	ComEd	6/1/2018
b2699.2	Remove SPS logic at Powerton that trips generators or sectionalizes bus under normal conditions; minimal SPS logic will remain	\$0.00	ComEd	ComEd	6/1/2018
b2700	Remove existing Black Oak SPS	\$0.10	AEP	AEP	12/1/2015
b2701.1	Construct Herlan station as breaker and a half configuration with 9-138 kV CB's on 4 strings and with 2-28.8 MVAR capacitor banks	\$15.64	AEP	AEP	6/1/2020
b2701.2	Construct new 138 kV line from Herlan station to Blue Racer station. Estimated approx. 3.2 miles of 1234 ACSS/TW Yukon and OPGW	\$5.78	AEP	AEP	6/1/2020
b2701.3	Install 1-138 kV CB at Blue Racer to terminate new Herlan circuit	\$0.32	AEP	AEP	6/1/2020
b2703	Install a 100 MVAR reactor at Bergen 230 kV	\$10.60	PSEG	PSEG	6/1/2016
b2704	Install a 150 MVAR reactor at Essex 230 kV	\$16.70	PSEG	PSEG	6/1/2016
b2705	Install a 200 MVAR reactor (variable) at Bergen 345 kV	\$38.30	PSEG	PSEG	6/1/2016



Attachment A – Single Zone Baseline Cost Allocations

b2706	Install a 200 MVAR reactor (variable) at Bayway 345 kV	\$26.60	PSEG	PSEG	6/1/2016
b2707	Install a 100 MVAR reactor at Bayonne 345 kV	\$15.40	PSEG	PSEG	6/1/2016
b2708	Replace the Oceanview 230/34.5 kV transformer #1	\$4.07	JCPL	JCPL	6/1/2020
b2709	Replace the Deep Run 230/34.5 kV #1	\$2.43	JCPL	JCPL	6/1/2020
b2710	Upgrade the Summer Shade bus and CT associated with the 161/69 kV transformer #1	\$0.08	EKPC	EKPC	6/1/2020
b2711	Install 25.5 MVAR 69 kV capacitor at Sewellton Junction 69 kV substation	\$0.40	EKPC	EKPC	6/1/2020
b2714	Rebuild/upgrade line between Glencoe and Willow Grove Switch 69 kV	\$6.01	AEP	AEP	6/1/2020
b2715	Build approximately 11.5 miles of 34.5 kV line with 556.5 ACSR 26/7 Dove conductor on wood poles from Flushing station to Smyrna station	\$14.36	AEP	AEP	6/1/2020

Reliability Project Multiple Zone Allocations

Upgrade ID	Description	Cost Estimate (\$M)	Construction Designee	Cost Responsibility	Required IS Date
b2665	Rebuild the Cunningham - Dooms 500 kV line	\$110.00	Dominion	AEC - 0.77%, AEP - 7.66%, APS - 2.94%, ATSI - 3.88%, BGE - 2.09%, COMED - 6.19%, ConEd - 0.29%, DAYTON - 1.01%, DEOK - 1.61%, DL - 0.85%, DPL - 1.22%, Dominion - 42.12%, ECP - 0.10%, EKPC - 1.08%, JCPL - 1.77%, ME - 0.89%, NEPTUNE - 0.21%, HTP - 0.10%, PECO - 2.59%, PENELEC - 0.96%, PEPCO - 16.08%, PPL - 2.53%, PSEG - 2.99%, RE - 0.13%	6/1/2020
b2687.1	Install a +/- 450 MVAR SVC at Jacksons Ferry 765 kV substation	\$36.50	AEP	AEC - 0.77%, AEP - 57.66%, APS - 2.94%, ATSI - 3.88%, BGE - 2.09%, COMED - 6.19%, ConEd - 0.29%, DAYTON - 1.01%, DEOK - 1.61%, DL - 0.85%, DPL - 1.22%, Dominion - 6.21%, ECP - 0.10%, EKPC - 1.08%, JCPL - 1.77%, ME - 0.89%, NEPTUNE - 0.21%, HTP - 0.10%, PECO - 2.59%, PENELEC - 0.96%, PEPCO - 1.99%, PPL - 2.53%, PSEG - 2.99%, RE - 0.13%	6/1/2018

b2687.2	Install a 300 MVAR shunt line reactor on the Broadford end of the Broadford - Jacksons Ferry 765 kV line	\$14.50	AEP	AEC - 0.77%, AEP - 57.66%, APS - 2.94%, ATSI - 3.88%, BGE - 2.09%, COMED - 6.19%, ConEd - 0.29%, DAYTON - 1.01%, DEOK - 1.61%, DL - 0.85%, DPL - 1.22%, Dominion - 6.21%, ECP - 0.10%, EKPC - 1.08%, JCPL - 1.77%, ME - 0.89%, NEPTUNE - 0.21%, HTP - 0.10%, PECO - 2.59%, PENELEC - 0.96%, PEPCO - 1.99%, PPL - 2.53%, PSEG - 2.99%, RE - 0.13%	6/1/2018
b2702	Install a 350 MVAR reactor at Roseland 500 kV	\$50.10	PSEG	AEC - 0.77%, AEP - 7.66%, APS - 2.94%, ATSI - 3.88%, BGE - 2.09%, COMED - 6.19%, ConEd - 0.29%, DAYTON - 1.01%, DEOK - 1.61%, DL - 0.85%, DPL - 1.22%, Dominion - 6.21%, ECP - 0.10%, EKPC - 1.08%, JCPL - 1.77%, ME - 0.89%, NEPTUNE - 0.21%, HTP - 0.10%, PECO - 2.59%, PENELEC - 0.96%, PEPCO - 1.99%, PPL - 2.53%, PSEG - 52.99%, RE - 0.13%	6/1/2016