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

PJM Staff Whitepaper
December 2016

EXECUTIVE SUMMARY

On October 18, 2016 the PJM Board of Managers approved changes to the Regional Transmission Expansion Plan (RTEP), totaling $43 million for one reliability project.

Since that time PJM has identified additional baseline reliability criteria violations within the planning horizon as part of the 2016 RTEP. Transmission upgrades have been 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 $158.11 million. In addition, a number of previously approved baseline projects have been cancelled or the cost and scope has changed resulting in an increase of $47.26 million. The net impact due to baseline reliability changes is an increase of $205.37 million.

PJM staff has also completed 195 new interconnection queue impact studies and 211 projects have withdrawn from the interconnection queue. The net impact of these changes to the interconnection queue is a net increase in the RTEP of $53.97 million.

The total change in the RTEP to include these baseline RTEP changes and interconnection queue changes is a net increase of $259.34 million.

With these changes, the RTEP will include over $29,321.76 million of transmission additions and upgrades since the first plan was approved by the Board in 2000.

The additional baseline projects and interconnection queue projects are summarized in the following paper and were presented for the Board Reliability Committee's consideration and for recommendation to the Board for approval. At the December 2016 meeting, the PJM Board approved the updated RTEP as requested.

Summary of Results

2016 Baseline Transmission Upgrades Changes and Additions

One aspect of the development of the Regional Transmission Expansion Plan 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 load customers.

Baseline Reliability:

On June 29th of this year PJM opened a 30-day proposal window, which closed on July 29th with additional detailed costs due on August 15th. This window, administered as the PJM 2016 RTEP Proposal Window #2, solicited proposals for a number of PJM reliability criteria violations. The focus for Proposal Window #2 was forecasted Summer 2021 conditions. The PJM reliability criteria violations included Baseline N-1 (thermal and voltage), Generation Deliverability, Common Mode Outage, N-1-1 (thermal and voltage), and Load Deliverability (thermal and voltage) violations. PJM staff identified potential reliability criteria violations associated with 137 flowgates (monitored transmission facility and contingency/outage pairs). Out of the total 137 flowgates, proposals were requested for 71 flowgates. Proposals were not requested for the remaining flowgates as 63 were related to retired generation where the violation will not persist assuming the generator retires as planned, and the remaining 3 were related to suspended generators in the interconnection queue process. Analyses will be updated if the statuses of these generators change.

In response to the 2016 RTEP Proposal Window #2, PJM received 87 baseline proposals to address the reliability criteria violations. The proposals were received from 13 entities, including incumbent Transmission Owners and non-incumbent transmission developers. The non-incumbent transmission developers included Mid-Atlantic MCN, NextEra Energy Transmission, NIPSCO, Northeast Transmission Development/LS Power, Transource Energy, PPL, and Public Service Electric & Gas. Of the total 87 proposals, 41 were Transmission Owner Upgrades and 46 were Greenfield Projects. The locations of the violations associated with Proposal Window #2 are shown below in Figure 1, while Figure 2 identifies the location of the proposals that were submitted for Proposal Window #2.

Figure 1 - 2016 RTEP Proposal Window #2 Violation Locations

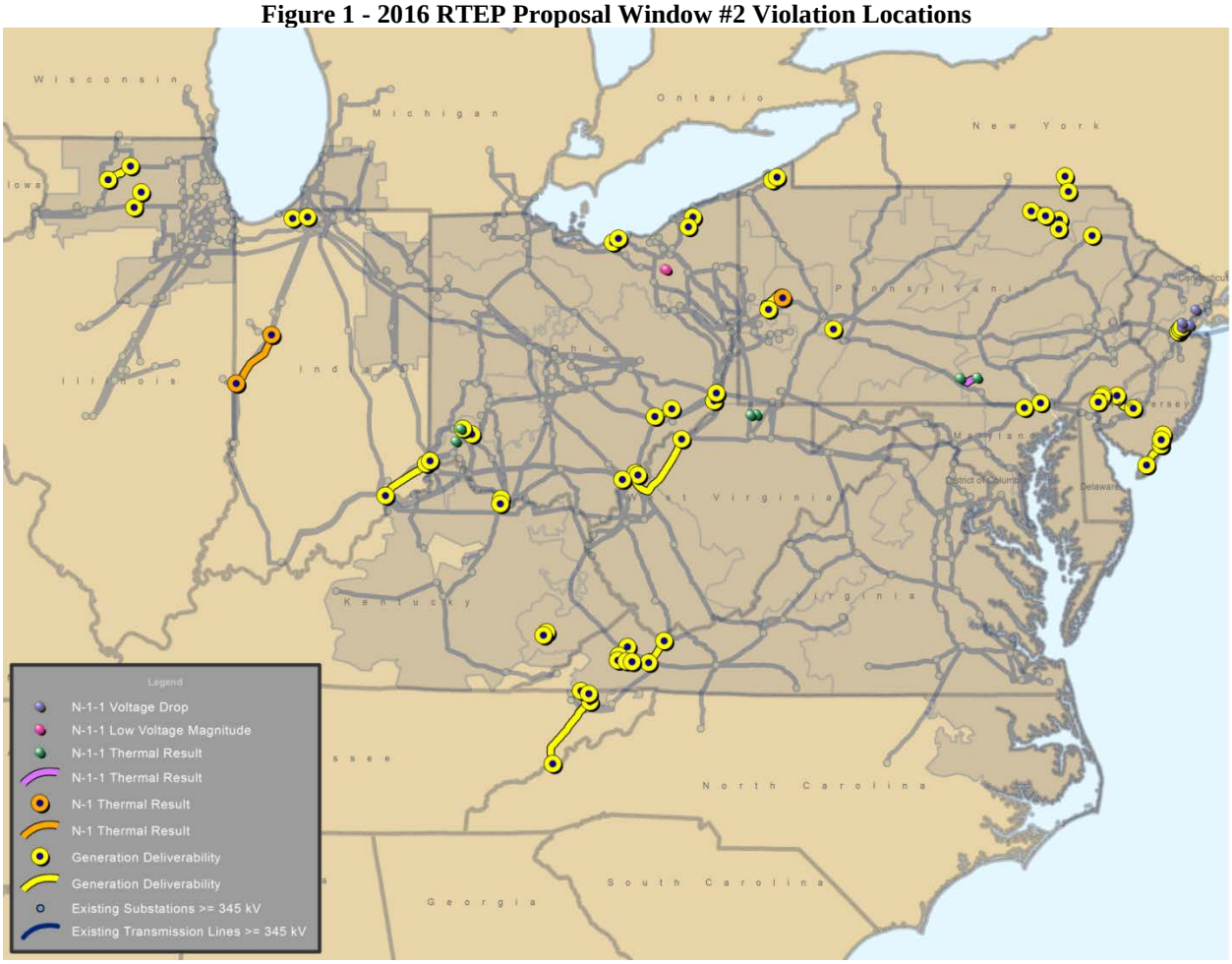
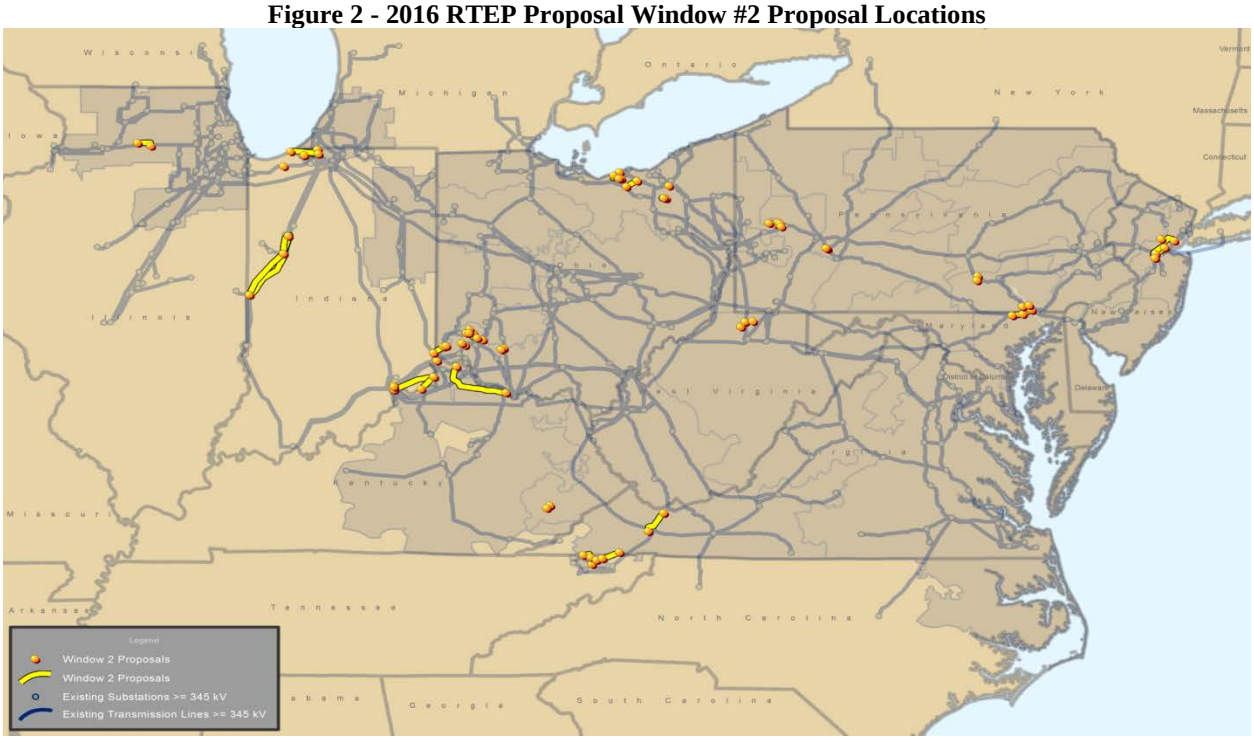


Figure 2 - 2016 RTEP Proposal Window #2 Proposal Locations



PJM staff reviewed details of all proposals, including an evaluation of the effectiveness of each of the proposals, with stakeholders through the Transmission Expansion Advisory Committee (TEAC). PJM completed evaluation of most of the proposals, and is recommending eleven projects at this time. The recommended projects address violations in the following transmission zones. : AEP, APS, ATSI, BGE, Met-Ed, PECO, and Penelec. All of the recommended projects are upgrades to existing facilities that were submitted by the incumbent Transmission Owner. The recommended projects include sag studies, a transformer replacement and addition, transmission line reconductoring, replacement of and upgrades to substation equipment, and the installation of several new circuit breakers. Additional information about the recommended projects is included in this white paper. Evaluation of the remaining Window #2 proposals is in-progress.

Additionally, 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 immediate need projects are being driven by several main categories of criteria drivers. The project drivers include short circuit fault duty issues to which the most efficient solution is typically a Transmission Owner upgrade of the associated breaker, new block load additions, AEP Transmission Owner thermal and voltage criteria violations resulting from the winter reliability criteria assessment, First Energy Transmission Owner thermal and voltage criteria violations due to new additional load, Generation Deliverability issues in the Rochelle Municipal Utilities transmission zone (within the larger ComEd in Illinois) due to line rating updates on the overloaded facility, stability issues in the PPL and JCPL transmission zones, and a PJM operational performance issue.

A summary of the more significant baseline projects with estimated costs equal to or greater than $5 million are detailed below. A complete listing of all of the projects that are being recommended along with their associated cost allocations is included as Attachment A and B to this white paper. The projects with estimated costs less than $5 million include transmission line sag mitigation projects, protection and control upgrades, circuit breaker replacements, transformer upgrades, new capacitors and other upgrades or modifications to existing substations.

Mid-Atlantic Region System Upgrade

- PPL Transmission Zone
  - Install 2% reactors at Martins Creek 230 kV - $10 M

- Penelec Transmission Zone
  - Construct a new 345 kV breaker string with three (3) 345 kV breakers at Homer City and move the North autotransformer connection to this new breaker string - $6.6 M

Western Region System Upgrades

- AEP Transmission Zone
  - Retire Betsy Layne 138/69/43 kV station and replace it with the greenfield Stanville station about a half mile north of the existing Betsy Layne station, and relocate the Betsy Layne capacitor bank to the Stanville 69 kV bus and increase the size to 14.4 MVAR - $14 M
  - Reconductor the entire Dequine - Meadow Lake 345 kV circuit #2 - $6.6 M
  - Reconductor the entire Dequine - Eugene 345 kV circuit #1 - $22.19 M

- AEP and ATSI Transmission Zone
  - George Washington 138/69 kV area improvements - $25 M

Southern Region System Upgrades

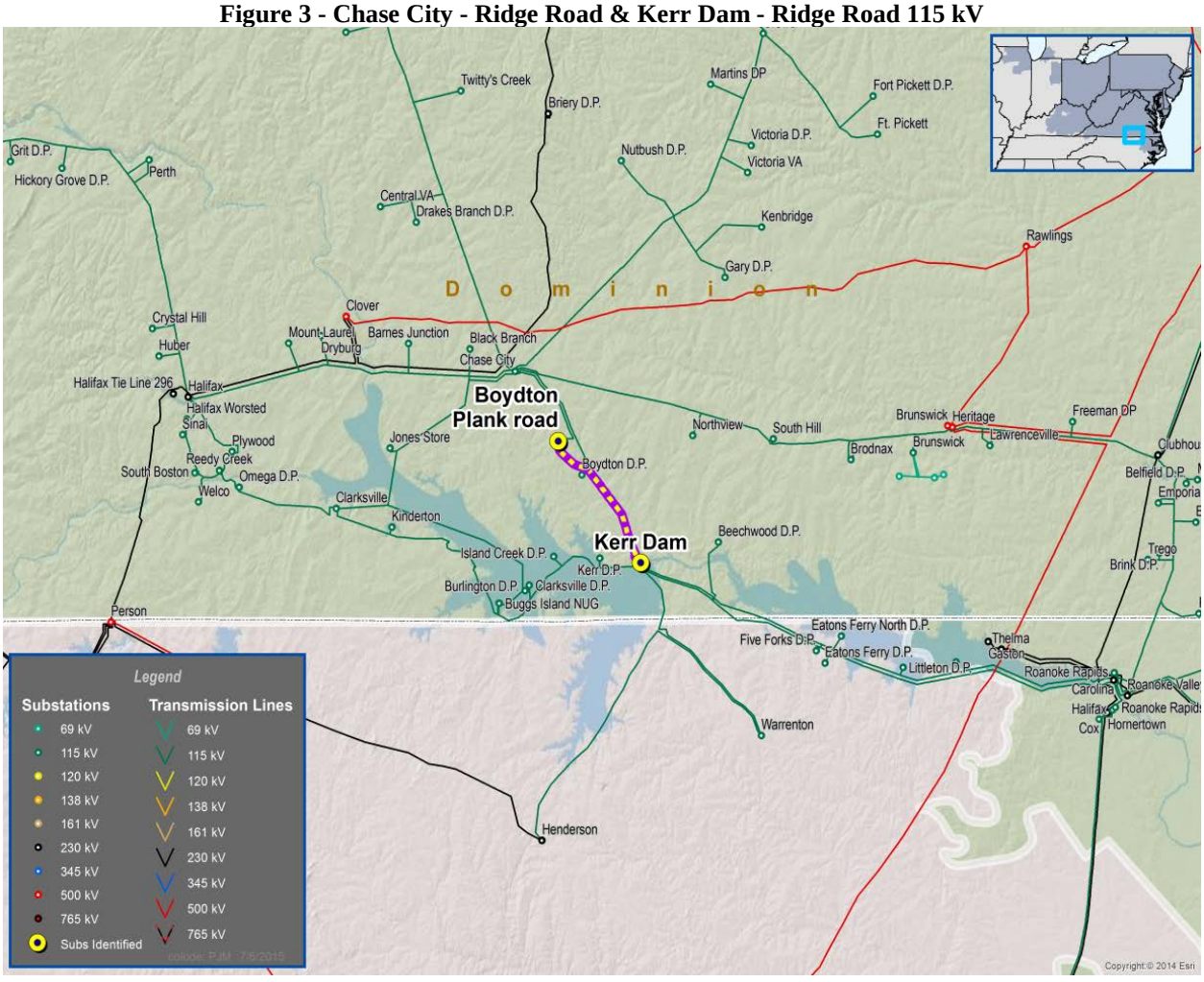
- Dominion Transmission Zone
  - Rebuild 8.0 miles of line #137 Ridge Rd - Kerr Dam 115 kV for 346 MVA summer emergency rating, rebuild 9.5 miles of line #1009 Ridge Rd - Chase City 115 kV for 346 MVA summer emergency rating, and install a second 4.8 MVAR capacitor bank on the 13.8kV bus of each transformer at Ridge Rd - $39 M
  - Install a +/-125 MVAr Statcom at Colington 115kV - $30 M

Following is a more detailed description of the larger scope upgrades that are being 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 Project B2746 – Chase City - Ridge Road and Kerr Dam - Ridge Road 115 kV Rebuild

New block loads are being added at the Ridge Road 115 kV substation in the Dominion transmission zone. The loads are expected to increase by 38 MW in 2017 with an additional 28 MW in 2018. With the addition of the new block loads, the Chase City – Ridge Road 115 kV and Kerr Dam – Ridge Road 115 kV lines are overloaded for various single contingencies. There are also associated low voltage issues that arise at Ridge Road and Boydton Plank 115 kV substations. The recommended solution to address these issues is to rebuild 9.5 miles of the Chase City – Ridge Road 115 kV line, rebuild 8 miles of the Kerr Dam – Ridge Road 115 kV line, and to install a 25 MVAR capacitor bank at Ridge Road 115 kV. The estimated cost for this work is $39 million and the required in service date is June 1, 2018. This upgrade to existing facilities is an immediate need solution where the timing required to include the violations in an RTEP proposal window was infeasible. The local Transmission Owner, Dominion, will be designated to construct the facilities.

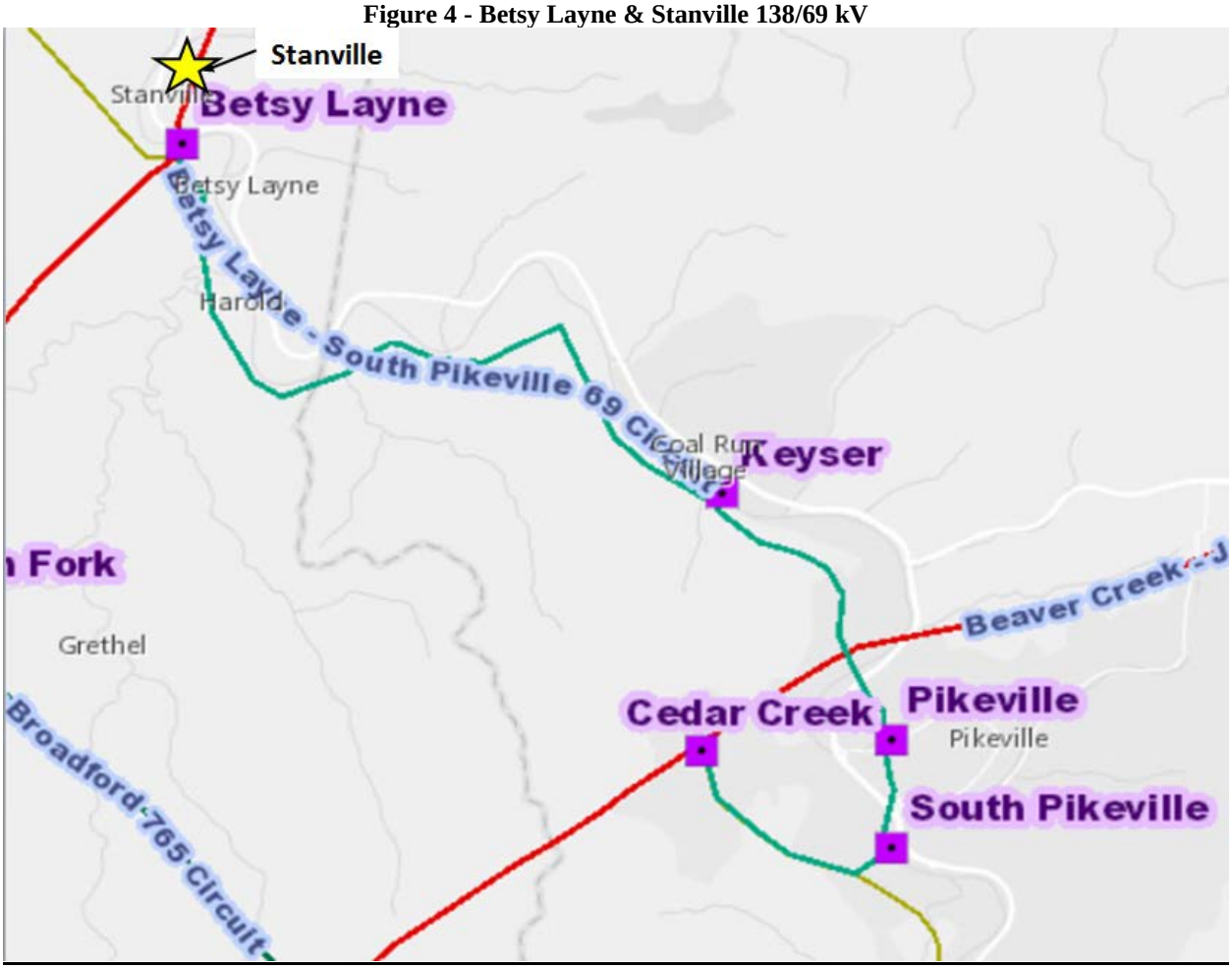
Figure 3 - Chase City - Ridge Road & Kerr Dam - Ridge Road 115 kV



Baseline Project B2750 – Betsy Layne Substation Retirement and Replacement

The Betsy Layne 138/69/46 kV transformer is overloaded and voltage drop violations occur at Pikeville and South Pikeville 69 kV stations for the loss of the Cedar Creek 138/69 kV transformer. These violations were identified pursuant to AEP's FERC Form No. 715 criteria that includes a winter reliability criteria assessment. Several alternatives to address the issues were considered, such as upgrading the size of the 138/69/46 kV transformer at Betsy Lane, and installing a 14.4 MVAR 69 kV capacitor bank. This alternative was not selected for several reasons. The Betsy Layne station has limited space for expansion and the single lane railroad bridge access to the station it would be physically improbably that a larger transformer could be delivered to the existing station site. In addition, the station site is prone to flooding. Another alternative that was considered was to install a redundant 138/69 kV bank at the Cedar Creek station. This solution would solve the violations for the loss of the existing Cedar Creek transformer, but would not resolve the issues for a loss of the Cedar Creek – South Pikeville 69 kV line. The recommended solution to resolve the reliability criteria issues is to retire the existing Betsy Layne station and replace it with a new Stanville station about a half mile north of the existing Betsy Layne station. The capacitor bank, currently located on the 46 kV bus, will be relocated to the 69 kV bus at Stanville and increased in size from 9.6 MVAR to 14.4 MVAR. The estimated cost is $14 million and the required in service date is December 1, 2016. This upgrade is an immediate need solution and the timing required to include the violations in an RTEP proposal window was infeasible. The local Transmission Owner, AEP, will be the entity designated to construct the new facilities.

Figure 4 - Betsy Layne & Stanville 138/69 kV

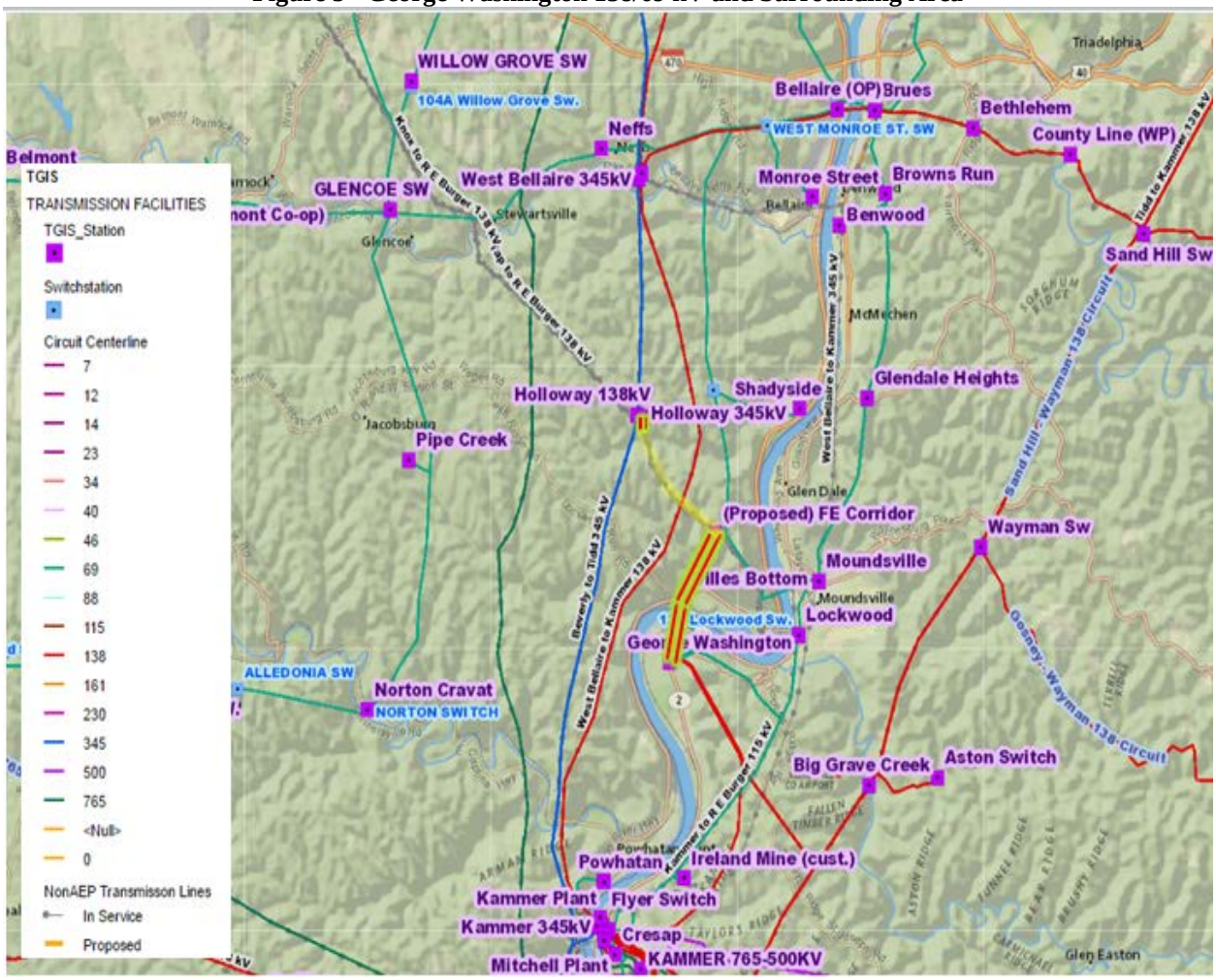


Baseline Project B2753 –George Washington 138/69 kV Area Upgrades

The Moundsville Power IPP queue projects (Y3-068 and Z2-048) combined, have a signed ISA with responsibility of $24,561,400 in network upgrades, which include largely 69 kV upgrades to eliminate violations with otherwise minimal system benefits. The backfeed date is March 1, 2018 and commercial operation date is January 1, 2019. After the ISAs were signed, AEP identified that portions of the George Washington bus conductor is overloaded when the bus tie is open. Consideration was given to upgrading the overloaded bus conductor however, due to tight physical constraints, nearby environmental issues, and the age of the existing structure, this alternative is not being recommended also in part due to the extensive and long duration of outages that would be required on the 138 kV bus at George Washington. Scheduling outages required to complete the work would be even more challenging after the IPP connects. Even if the outages were able to be scheduled the resulting configuration would not be flexible, expandable, or reliable. Other alternatives were considered. The second alternative was to expand the George Washington 138 kV yard to replace the existing yard. The expansion would still need to tie in with existing bus work. In addition, the station is bounded by houses, mountains, and a highway, so there is no space available and the timing is not conducive to expanding and replacing the yard by conventional means. The third alternative was to relocate the essentials of the George Washington 138 kV yard to a new greenfield site.

However, as previously described, the station is surrounded by houses, mountains, and a highway, and across the highway is an EPA superfund site which would make any such endeavor prohibitively expensive and time consuming. For all of these reasons, these three alternatives were deemed unacceptable. The recommended solution is to connect two 138 kV six-wired circuits at Holloway from "Point A" (currently de-energized and owned by First Energy), double the capacity of the six-wire Burger – Cloverdale No.2 and Burger – Longview 138 kV lines and connect at Holloway and "Point A" substations, and build a double circuit 138 kV line from Dilles Bottom to "Point A", and tie each new AEP circuit in with a six-wired line at "Point A". This will create a Dilles Bottom – Holloway 138 kV circuit and a George Washington – Holloway circuit. This solution, coupled with associated substation and line upgrades address the violation without adversely impacting the IPP milestones. The estimated cost for the complete project is $49.5 million. The IPP will be responsible for the fixed project cost of their original network upgrades of $24,561,400. The remaining $25 million cost of the project will be allocated to load. The required in service date for this project is January 1, 2019, and this upgrade is an immediate need solution and the timing required to include the violations in an RTEP proposal window was infeasible.

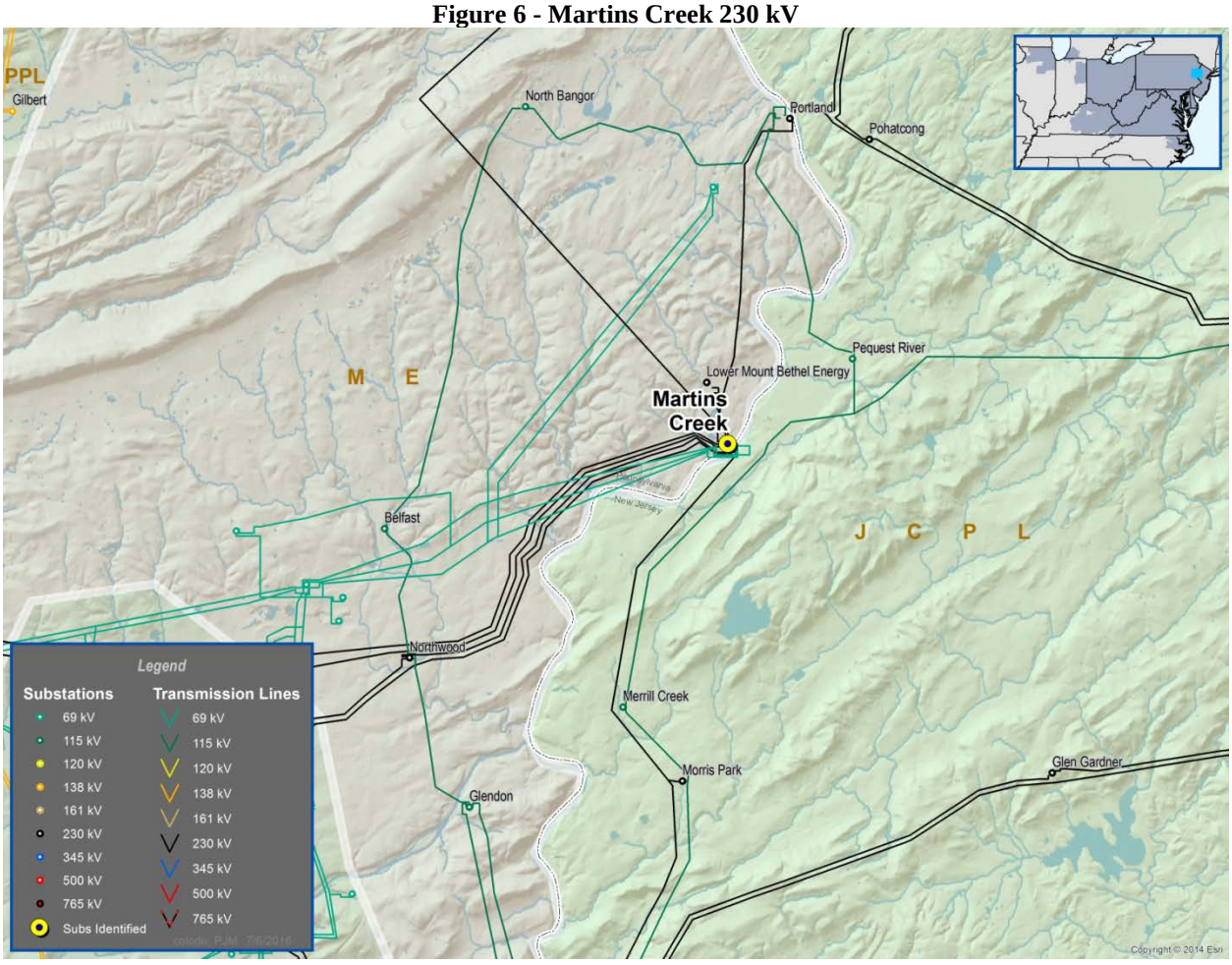
Figure 5 - George Washington 138/69 kV and Surrounding Area



Baseline Project B2756 – Martins Creek 230 kV Reactors

The Martins Creek 230 kV breakers are currently rated at 63 kA, and for a fault at Martins Creek, all of the breakers are overdutied in PJM's short circuit analysis of 2018. Typically, the recommended solution would be to replace the breakers with a higher interrupting capability. However, the breakers as well as everything else in the substation are only designed for 63 kA of fault current. So the bus work, ground grid, and other associated equipment would also need to be replaced to be able to withstand the higher fault current. Given that, the more efficient upgrade is to install the series reactors to limit the fault current from the generators so that the substation doesn't need to be rebuilt. The reactors will be placed in series with the generator and will not have an impact on power flows on the rest of the grid. The recommended solution to install 2% reactors at Martins Creek 230 kV has an estimated cost of $10 million and the required in service date is June 1, 2018. This upgrade is an immediate need solution and the timing required to include the violations in an RTEP proposal window was infeasible, the local Transmission Owner, PPL, will be the designated entity.

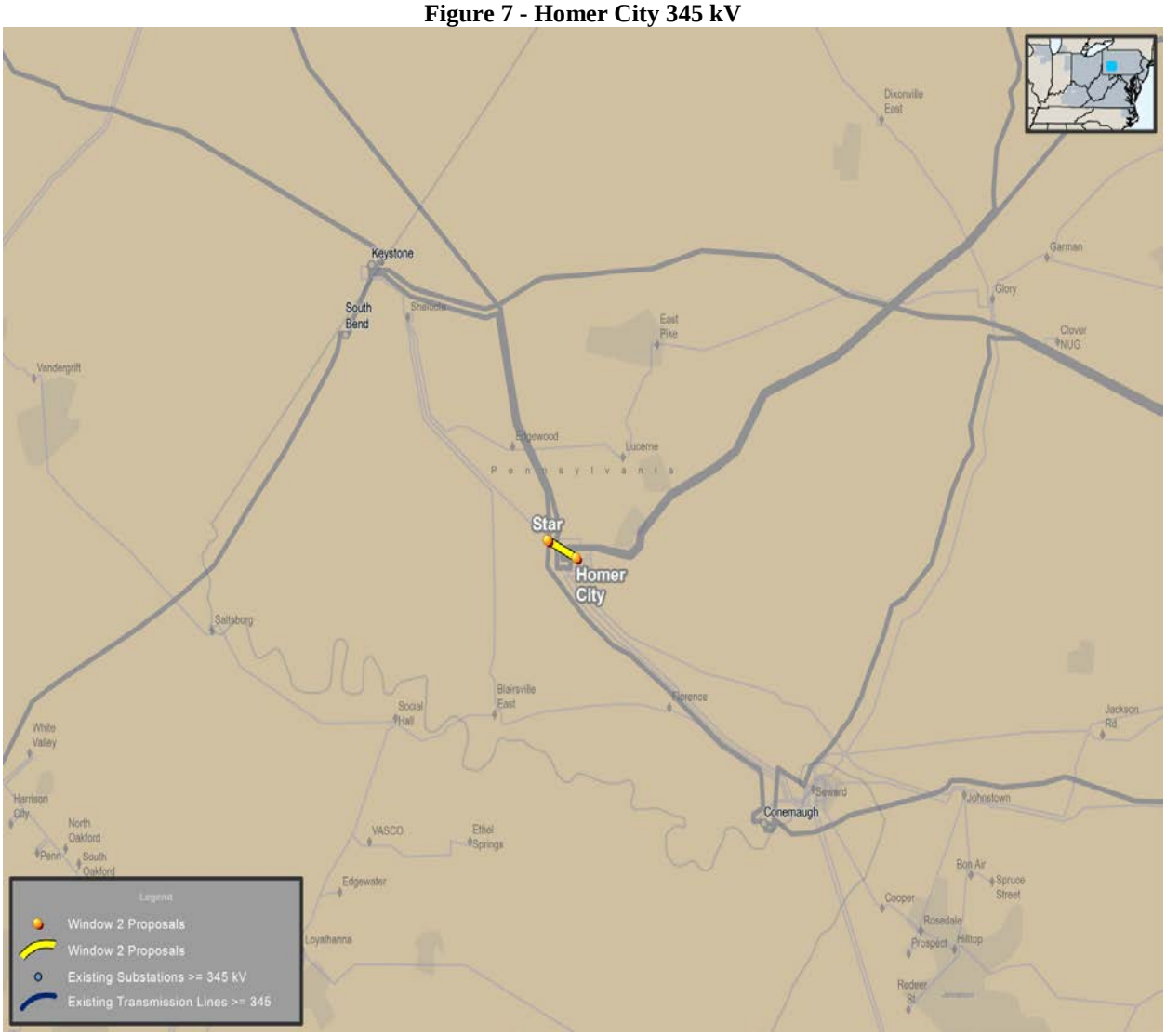
Figure 6 - Martins Creek 230 kV



Baseline Project B2767 – New Homer City 345 kV Breaker String

The Homer City 345/230 kV transformer "S" is overloaded for the line fault stuck breaker contingency loss of the Homer City – Armstrong 345 kV circuit and the Homer City 345/230 kV transformer "N". PJM solicited proposals to address this issue in the 2016 RTEP Proposal Window #2. Three baseline proposals from three separate entities, Transource Energy, First Energy, and Northeast Transmission Development were submitted to address this reliability criteria violation. The cost of proposals ranged from $6.6 million to $36 million. Two of the non-incumbent proposals entailed establishing a new 500/345 kV greenfield substation by tapping the existing Keystone – Conemaugh 500 kV circuit, and constructing a 345 kV line from the new greenfield station to the existing Homer City 345 kV substation. The incumbent Transmission Owner, First Energy (Penelec), proposed an upgrade to construct a new 345 kV breaker string with three 345 kV breakers at Homer City and move the autotransformer "N" connection to the new breaker string. This upgrade resolves the reliability issue, does not require new right-of-way, and is also the most cost effective. For these reasons, the recommended solution is the incumbent Transmission Owner, First Energy's (Penelec's) proposal. The estimated cost is $6.6 million and the required in service date is June 1, 2021.

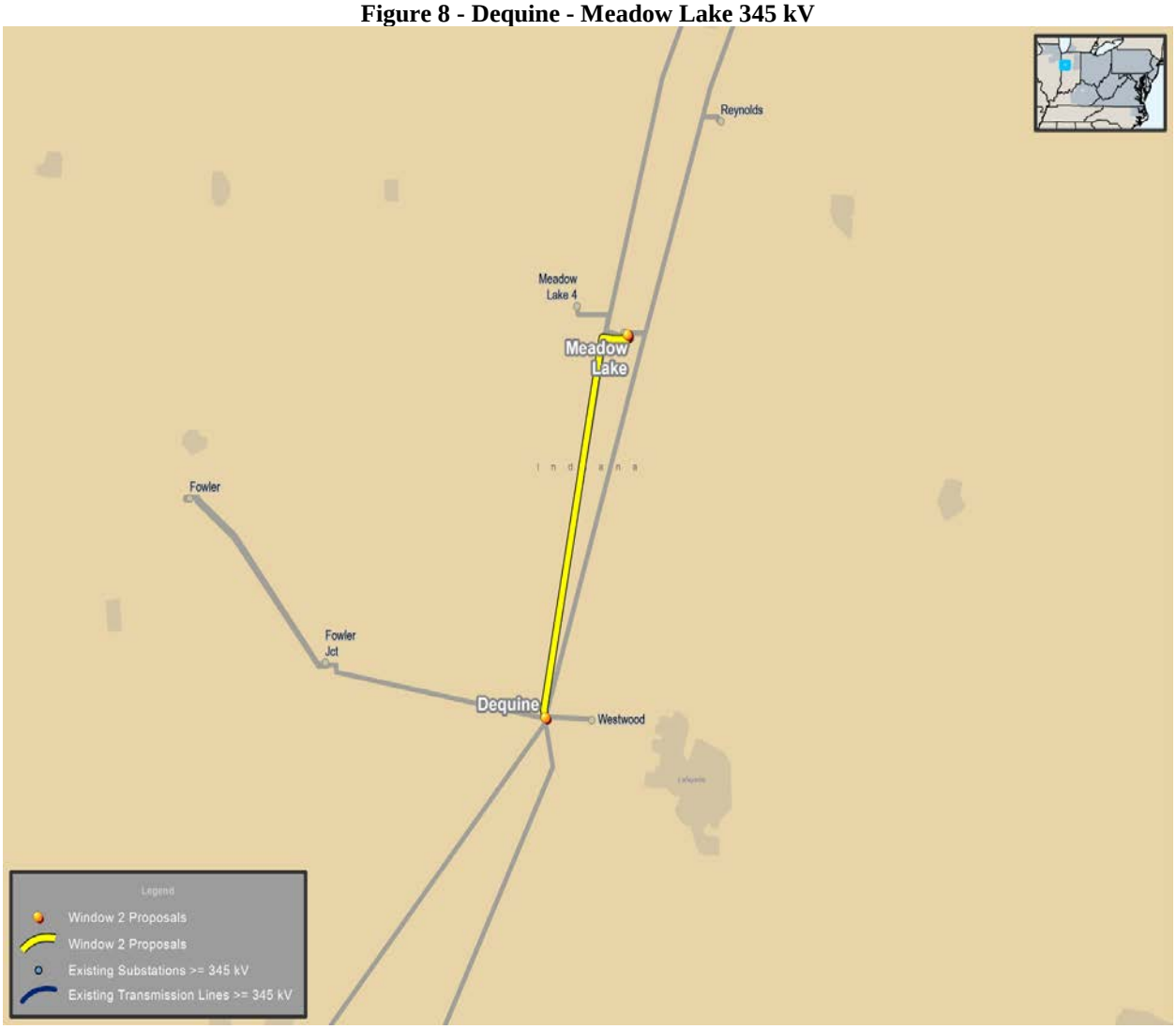
Figure 7 - Homer City 345 kV



Baseline Project B2776 – Reconductor Dequine - Meadow Lake 345 kV

The Dequine – Meadow Lake 345 kV circuit #2 is overloaded for the loss of the Dequine – Meadow Lake 345 kV circuit #1. PJM solicited proposals to address this issue in the 2016 RTEP Proposal Window #2. Eight baseline proposals from four entities, AEP, Northeast Transmission Development, PSE&G, and PPL were submitted to address this reliability criteria violation. The cost of proposals ranged from $6.6 million to $136.9 million. Five out of the eight proposals, proposed by both incumbent and non-incumbent entities, entailed building a new greenfield line from Dequine – Meadow Lake and/or Eugene – Meadow Lake 345 kV. The other three proposals were upgrades proposed by the incumbent Transmission Owner, AEP. These baseline upgrade proposals included rebuilding the Dequine – Meadow Lake 345 kV double circuit corridor using either AEP's new BOLD lattice tower construction or traditional tower construction, or simply reconductoring the Dequine – Meadow Lake 345 kV circuit #2. The recommended solution is to reconductor the Dequine – Meadow Lake 345 kV circuit #2, as it resolves the reliability issue, does not require new right-of-way, and is also the most cost effective. The estimated cost is 6.6 million and the required in service date is June 1, 2021.

Figure 8 - Dequine - Meadow Lake 345 kV

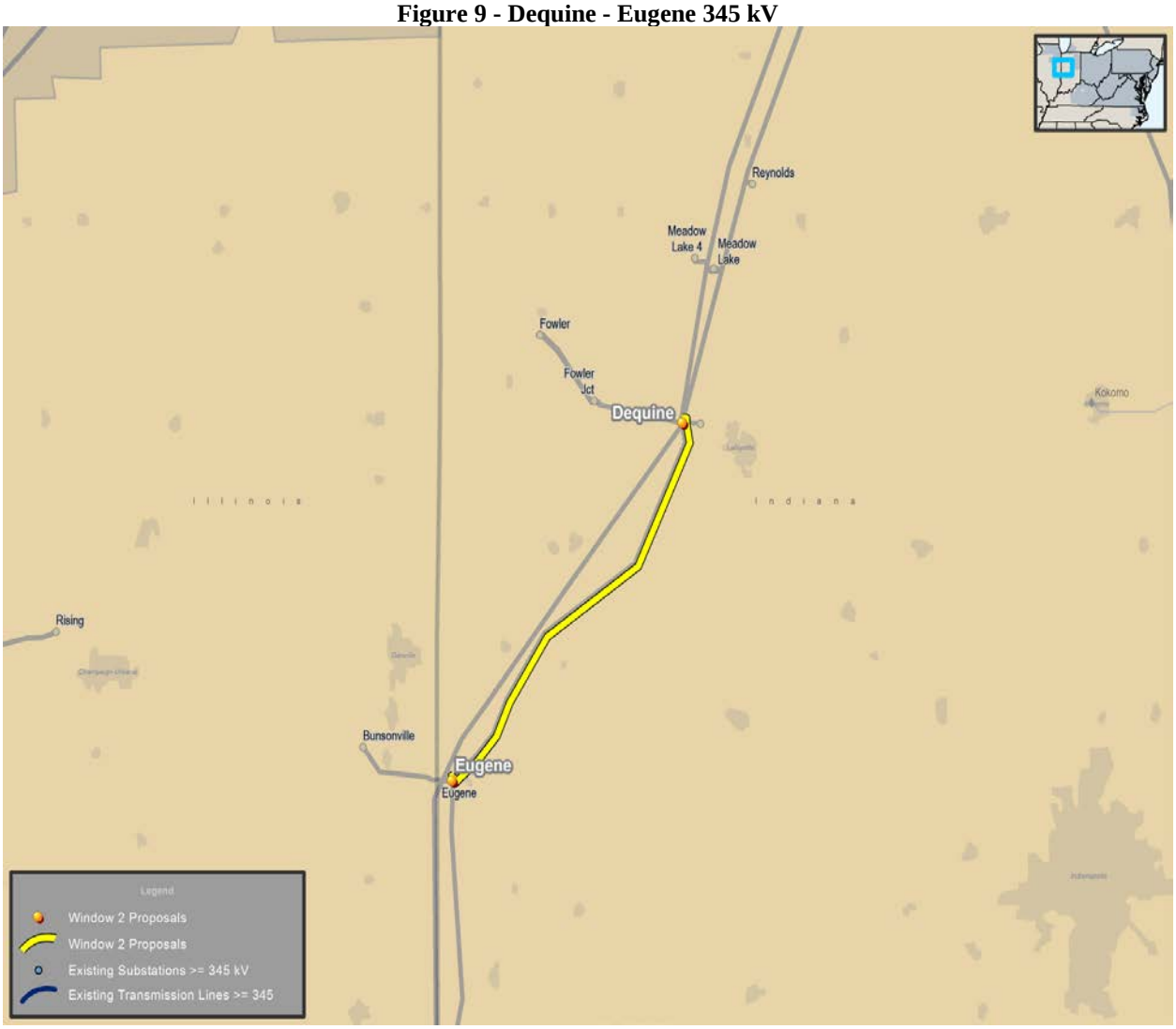


Baseline Project B2777 – Reconductor Dequine - Eugene 345 kV

The Duquine – Eugene 345 kV circuit #1 is overloaded for several single contingencies. PJM solicited proposals to address this issue in the 2016 RTEP Proposal Window #2. Nine baseline proposals from five entities, NextEra Energy, AEP, Northeast Transmission Development, PSE&G, and PPL were submitted to address this reliability criteria violation. The cost of proposals ranged from approximately $22.2 million to $136.9 million. Six out of the total nine proposals, proposed by both incumbent and non-incumbent entities, entailed constructing either one or two new greenfield lines from Dequine – Eugene, Eugene – Meadow Lake, and/or Meadow Lake – Dequine 345 kV. The remaining three proposals were baseline upgrade proposals from the incumbent Transmission Owner, AEP. These baseline upgrade proposals included rebuilding the Dequine – Eugene 345 kV double circuit corridor using either AEP's new BOLD lattice tower construction or traditional tower construction, or simply reconductoring the Dequine – Eugene 345 kV circuit #1. The recommended solution is to reconductoring the Dequine – Eugene 345 kV circuit #1, as it resolves

the reliability issue, does not require new right-of-way, and is also the most cost effective. The estimated cost is $22.19 million and the required in service date is June 1, 2021.

Figure 9 - Dequine - Eugene 345 kV



Changes to Previously Approved Projects

Cost and scope of a number of previously approved RTEP baseline projects have changed. In addition, a project has been cancelled as it is no longer required. The net result of these changes to previously approved baseline projects is a net increase in the RTEP of $47.26 million. Some of the more significant cost changes are noted below.

The cost of the previously approved RTEP project B1690 in the JCPL transmission zone to build a new third 230 kV line into the Red Bank 230 kV substation from the NJT Aberdeen 230 kV substation has increased. The original $22 million cost estimate was a planning level estimate for a conceptual 8 mile 230 kV transmission line with an undefined route. The assumptions for the transmission line included 700' spans (60 structures), typical concrete foundations, and minimal access road issues and did not include fully loaded costs. However, First Energy has now completed additional engineering, and was able to provide a more refined estimated cost based on specific equipment quotes and also including fully loaded costs. The preferred transmission line route, pending NJ BPU approval, is now 10.1 miles in length and routed along the NJ Transit railway. With the preferred transmission line route, it is assumed that greater than 100 structures, using shorter spans, will be needed due to the curvature of the railway corridor and transmission design requirement to help maintain conductor (minimum) clearances within the 100-foot railway corridor. Helical or micropile foundations are also now required due to the proximity of the railway tracks (a solution developed jointly with NJ Transit to avoid major ground disturbances near the railway tracks). More extensive access roads are also needed along the railway corridor, as the NJ Transit corridor in the area has very limited accessible areas to accommodate large construction vehicular traffic. The project management and construction management costs were increased as well based on recent NJ transmission projects which involve significant support to manage municipal, property owner, commercial, and environmental impacts. In addition, project costs now include associated substation work at Taylor Lane substation and 2.1 miles of 34.5kV transmission line rearrangement work required within the NJ Transit corridor. Finally, there have been added right-of-way costs for acquisition of required vegetation clearing from private property owners adjoining the railway corridor. For all of the above reasons, the estimated cost has increased by $89 million, making the total cost approximately $111 million.

The cost of the previously board approved RTEP project B1696 in the Dominion transmission zone to install a breaker and half scheme at Idylwood 230kV has increased. Dominion has provide a more detailed cost estimate which includes the additional cost due to the GIS breakers, security wall, transmission structures, labor, and permitting. Rebuilding the 230kV bus using GIS equipment was required due to space limitations and to maximize the utilization of space at Idylwood substation, ensuring that it will continue to support the regional growth while minimizing impact to the surrounding communities. For these reasons, the estimated cost has increased by $68 million, making the total cost approximately $80 million.

The scope and cost of the previously approved RTEP project B1792 in the Dominion transmission zone to rebuild 26 miles of the Halifax – Chase City 230kV line and install a 230 kV four breaker ring bus to eliminate the motor operator schemes has been modified. The original plan was to expand the Halifax 230 kV substation. However, it was determined that the Halifax substation should not be expanded with the considering that it is located in the flood plain. The new proposed scope is to rebuild the Halifax – Chase City 230kV line, retire the existing Halifax switching station located within a flood plain, and relocate the Halifax facilities to a new Sedge Hill substation. The Sedge Hill substation will be built with a 230 kV four

breaker ring and 115 kV breaker and a half scheme with seven breakers. Due to the scope change, the estimated cost has increased by $24.2 million, making the total cost approximately $50.2 million.

The scope and cost of the previously approved RTEP Thorofare Project B2609.4 in the AEP transmission zone has been modified. The project has been modified to construct 25 miles of new 138 kV line from Thorofare Creek to the new 138 kV tap substation, instead of the original 15 miles. The Public Service Commission of West Virginia ordered an addition 10 miles be added to support the future enhancement of the reliability of the APCO distribution system. The new line will be routed to accommodate the future Walton 138 kV substation. Due to the scope modification, the cost has increased by $12.5 million, making the total cost approximately $72 million.

The scope and cost of the previously approved RTEP project B2628 in the Dominion transmission zone to rebuild 20.8 miles of the Everetts – Voice of America 115kV line to current standards with a summer emergency rating of 261 MVA at 115kV has been modified. Dominion recently provided a more refined detailed cost estimate which includes additional scope suggested by stakeholders based on more detailed engineering, which has resulted in a cost increase. The new scope is to rebuild 19.1 miles of the Everetts – Leggetts Crossroads DP 115 kV portion of the line to a higher summer emergency rating of 353 MVA at 115kV. Stakeholders (ODEC and NCEMC) suggested building the line to the higher rating given the minimal incremental cost to rebuild the line to a higher rated 115kV standard (353 MVA instead of 261 MVA). Also, the last 1.75 miles section of the Leggetts Crossroad DP – Voice of America 115 kV line was removed from this project due to minimal load at Voice of America, and because there is a possibility that this line section will be removed in the future for the load to be served from the distribution system. It is important to note that the majority of the cost increases are due to the difference between the planning estimates and the refined detailed cost estimates, and have resulted in a cost increase of $8.1 million, making the total cost approximately $32.1 million.

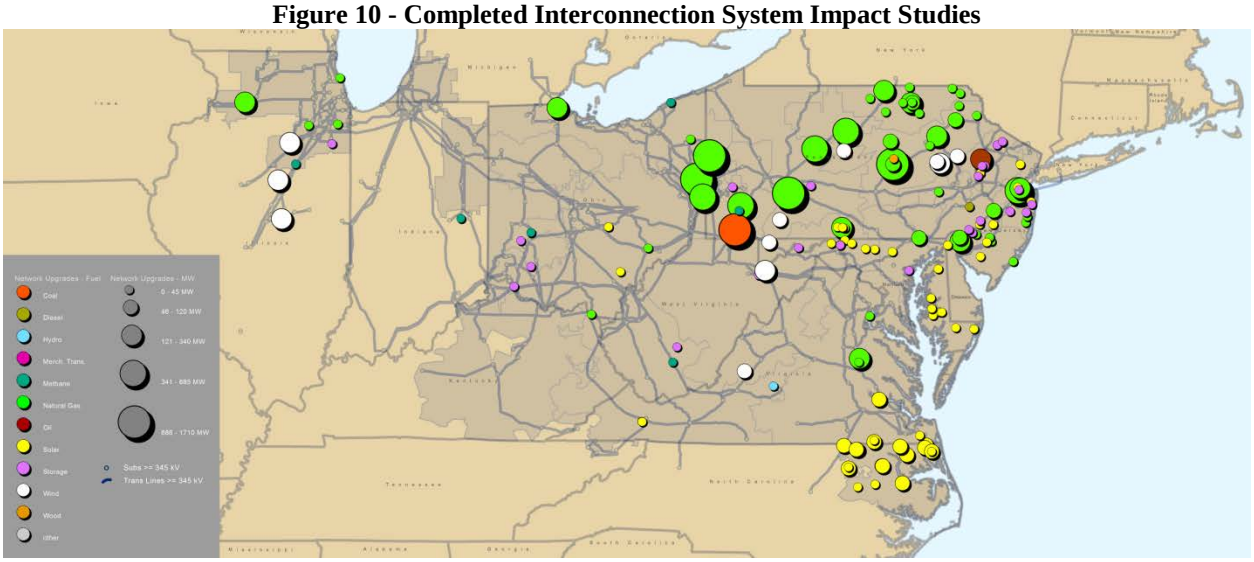
The scope and cost of the previously approved RTEP project B2458 in the Dominion transmission zone to replace wood H-frame structures and 2.5 miles of static wire on the Carolina – Woodland 115 kV line, and to replace wood H-frame structures and 4.5 miles of conductor (with a minimum 174 MVA summer STE rating) on the Carolina – Jackson DP 115 kV line has been modified. Broken conductor strands at multiple locations along the Carolina - Woodland 115 kV circuit were discovered during construction and needs to be replaced (note the original scope only included replacing static wire). Also, in addition to replacing 4.5 miles of the conductor from Carolina – Jackson DP 115 kV, there is a need to reconductor 22.4 miles of this line for a minimum 174 MVA summer STE rating to address thermal violations that were subsequently identified. For these reasons, the cost has increased by $7 million, making the total cost approximately $13.9 million.

The previously approved RTEP project b1254 in the BGE transmission zone to build a new Hanover Pike 500/230 kV substation and to rebuild the Hanover Pike - North West 230 kV circuits is being recommended to be cancelled. The Hanover Pike project was added to the RTEP in 2010 to address thermal and voltage violations in the BGE transmission zone. Subsequent studies which included updated assumptions about generation, load and the availability of demand response suggested the project was no longer required. The planned Hanover Pike facility was not included in the 2016 RTEP models as a sensitivity to determine the continued need for this facility. The latest analysis shows that there are no RTEP violations or drivers that would require the Hanover Pike upgrade. As a result, the baseline upgrade has been cancelled as it is no longer required. The estimated cost of this project was a total of $113 million.

Interconnection Projects

Since the last review of the PJM Interconnection Projects by the PJM Board of Managers in October 2015, PJM has completed 195 interconnection System Impact Studies and 211 interconnection projects have withdrawn. The changes associated with the new and withdrawn projects resulted in a net increase in the RTEP of $53.97 million for the network upgrades. Figure 13 below shows the location of the new units associated with the completed interconnection System Impact Studies along with the fuel type and relative size. A listing of the projects with recently completed impact studies is provided in Attachment C to this white paper. A listing of the network upgrades associated with these projects is shown in Attachment D to this report. The cost for the network upgrades associated with these interconnection projects is the responsibility of the developer.

Figure 10 - Completed Interconnection System Impact Studies



Summary of Interconnection Queue Activity (MW)

The following table shows the status of all of the generation projects in the Interconnection Queues.

Status of Generation Interconnection Queues

Queue	Active	Suspended	Under Construction	In-Service*	Withdrawn	Total MW Request**
A-U2	0	1,848	3,661	36,665	217,198	259,372
U3	100	0	20	334	2,515	2,969
U4	300	200	0	85	4,445	5,030
V1	40	250	0	98	2,383	2,771
V2	150	0	22	990	3,469	4,631
V3	200	300	745	187	3,523	4,955
V4	200	5	3	746	3,874	4,828
W1	0	14	476	217	5,139	5,844
W2	73	3	128	265	2,939	3,408
W3	860	556	78	458	7,280	9,231
W4	12	259	597	1,068	3,686	5,622
X1	1,500	293	670	1,089	3,753	7,304
X2	189	50	1,678	2,453	5,526	9,897
X3	0	2	940	86	6,747	7,775
X4	0	0	2,934	95	2,339	5,368
Y1	145	520	1,837	122	5,652	8,276
Y2	1,079	267	827	258	8,864	11,294
Y3	53	549	1,356	297	3,954	6,209
Z1	851	40	3,132	139	3,963	8,125
Z2	284	42	2,661	285	2,913	6,186
AA1	5,404	72	3,042	112	3,372	12,002
AA2	8,403	84	410	1	7,174	16,073
AB1	13,339	50	648	24	6,422	20,483
AB2	12,730	0	0	0	2,706	15,436
AC1	2,521	0	0	0	196	2,718
TOTAL	48,432	5,405	25,865	46,073	320,032	445,806

* In-service MW can and do change to account for units that are phased into commercial operation
**Total MW Requests can change due to MW reduction in certain phases of the study process
Data Valid as of:
8/31/2016

Review by the Transmission Expansion Advisory Committee (TEAC)

The need for the projects was reviewed with stakeholders at several meetings throughout 2016, most recently at the November 2016 TEAC meeting. Written comments were requested to be submitted to PJM to communicate any concerns with the recommendations and any alternative transmission solutions for consideration.

Cost Allocation

Preliminary cost allocations for the projects being recommended are shown in Attachment A for projects that will be allocated to a single transmission zone and in Attachment B for 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 the 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, and recommend to the PJM Board of Managers, approval of the baseline upgrades to the 2016 RTEP. The PJM Board Reliability Committee also recommended the endorsement of the new interconnection related network upgrades, and the PJM Board of Managers have approved all recommended changes to the RTEP.

Reliability Project Single Zone Allocations

Upgrade ID	Description	Cost Estimate ($M)	Trans Owner	Cost Responsibility	Required IS Date
b1696.1	Replace the Idylwood 230 kV '25112' breaker with 50 kA breaker	$0.35	Dominion	Dominion	6/1/2017
b1696.2	Replace the Idylwood 230 kV '209712' breaker with 50 kA breaker	$0.35	Dominion	Dominion	6/1/2017
b2712	Replace the Bergen 138 kV '40P' breaker with 80kA breaker	$3.27	PSEG	PSEG	6/1/2018
b2713	Replace the Bergen 138 kV '90P' breaker with 80kA breaker	$3.27	PSEG	PSEG	6/1/2018
b2723.1	Replace the Mickleton 69kV breaker PCB A with 63kA breaker	$0.36	AEC	AEC	6/1/2018
b2723.2	Replace the Mickleton 69kV breaker PCB B with 63kA breaker	$0.36	AEC	AEC	6/1/2018
b2723.3	Replace the Mickleton 69kV breaker PCB C with 63kA breaker	$0.36	AEC	AEC	6/1/2018
b2723.4	Replace the Mickleton 69kV breaker PCB Q with 63kA breaker	$0.36	AEC	AEC	6/1/2018
b2727	Replace the South Canton 138 kV breakers 'K', 'J','J1', and 'J2' with 80 kA breakers.	$1.20	AEP	AEP	6/1/2018
b2735	Replace the Warren 115kV 'NO.2 XFMR' breaker with 40kA breaker	$0.23	PENELEC	PENELEC	6/1/2018
b2736	Replace the Warren 115 kV 'Warren#1' breaker with 40 kA breaker	$0.23	PENELEC	PENELEC	6/1/2018
b2737	Replace the Warren 115 kV 'A TX#1' breaker with 40 kA breaker	$0.23	PENELEC	PENELEC	6/1/2018
b2738	Replace the Warren 115 kV 'A TX#2' breaker with 40 kA breaker	$0.23	PENELEC	PENELEC	6/1/2018
b2739	Replace the Warren 115 kV 'Warren#2' breaker with 40 kA breaker	$0.23	PENELEC	PENELEC	6/1/2018
b2740	Revise the reclosing of the Hooversville 115 kV 'Ralphton' breaker	$0.01	PENELEC	PENELEC	6/1/2018
b2741	Revise the reclosing of the Hooversville 115 kV 'Statler HIII' breaker	$0.01	PENELEC	PENELEC	6/1/2018
b2742	Replace the Hoytdale 138 kV '83-B-26' and '83-B-30' breakers with 63 kA breakers	$0.41	ATSI	ATSI	6/1/2017
b2746.1	Rebuild Line #137 Ridge Rd - Kerr Dam 115 kV, 8.0 miles, for 346 MVA summer emergency rating	$39.00	Dominion	Dominion	6/1/2018
b2746.2	Rebuild Line #1009 Ridge Rd - Chase City 115 kV, 9.5 miles, for 346 MVA summer emergency rating	$0.00	Dominion	Dominion	6/1/2018
b2746.3	Install a second 4.8 MVAR capacitor bank on the 13.8kV bus of each	$0.00	Dominion	Dominion	6/1/2018

	transformer at Ridge Rd				
b2747	Install a Motor Operated Switch and SCADA control between Dominion's Gordonsville 115kV bus and FirstEnergy's 115kV line	$0.35	Dominion	Dominion	6/1/2018
b2748	Install two 28 MVAR capacitors at Tiffany 115 kV substation	$2.50	PENELEC	PENELEC	6/2/2017
b2749	Replace relay at West Boyertown 69 kV station on the West Boyertown - North Boyertown 69 kV circuit	$0.05	ME	ME	6/1/2017
b2750.1	Retire Betsy Layne 138/69/43 kV station and replace it with the greenfield Stanville station about a half mile north of the existing Betsy Layne station	$14.00	AEP	AEP	12/1/2016
b2750.2	Relocate the Betsy Layne capacitor bank to the Stanville 69 kV bus and increase the size to 14.4 MVAr	$0.00	AEP	AEP	12/1/2016
b2751	Rebuild/Resag the H440 – H440 Tap 138 kV Line 16914-2 (Hays Road - SW 1403 138 kV)	$3.50	RMU	RMU	6/1/2016
b2753.1	Replace existing George Washington station 138 kV yard with GIS 138 kV breaker and a half yard in existing station footprint. Install 138 kV revenue metering for new IPP connection.	$0.00	AEP	AEP	1/1/2019
b2753.2	Replace Dilles Bottom 69/4 kV Distribution station as breaker and a half 138 kV yard design including AEP Distribution facilities but initial configuration will constitute a 3 breaker ring bus.	$9.00	AEP	AEP	1/1/2019
b2753.3	Connect two 138 kV 6-wired circuits from "Point A" (currently de-energized and owned by First Energy) in circuit positions previously designated Burger #1 & Burger #2 138 kV. Install interconnection settlement metering on both circuits exiting Holloway st	$2.00	AEP	AEP	1/1/2019
b2753.4	Double capacity for 6 wire "Burger-Cloverdale No. 2" 138 kV line and connect at Holloway and "Point A"	$0.25	ATSI	ATSI	1/1/2019
b2753.5	Double capacity for 6 wire "Burger-Longview" 138 kV line and connect at Holloway and "Point A"	$0.25	ATSI	ATSI	1/1/2019
b2753.6	Build double circuit 138 kV line from Dilles Bottom to "Point A". Tie each new AEP circuit in with a 6 wired line at Point A. This will create a Dilles Bottom - Holloway 138 kV circuit and a George Washington - Holloway 138 kV circuit.	$5.00	AEP	AEP	1/1/2019

b2753.7	Retire line sections (Dilles Bottom - Bellaire and Moundsville - Dilles Bottom 69 kV lines) south of First Energy 138 kV line corridor, near “Point A”. Tie George Washington - Moundsville 69 kV circuit to George Washington - West Bellaire 69 kV circuit.	$4.96	AEP	AEP	1/1/2019
b2753.8	Rebuild existing 69 kV line as double circuit from George Washington - Dilles Bottom 138 kV. One circuit will cut into Dilles Bottom 138 kV initially and the other will go past with future plans to cut in.	$3.56	AEP	AEP	1/1/2019
b2754.1	Install 7 mi of optical ground wire (OPGW) between Gilbert and Springfield 230 kV substations	$0.84	PPL	PPL	6/1/2017
b2754.2	Install 5 mi of optical ground wire (OPGW) between Gilbert and Springfield 230 kV substations	$0.59	JCPL	JCPL	6/1/2017
b2754.3	Install 7 mi of all-dielectric self-supporting (ADSS) fiber optic cable between Morris Park and Northwood 230 kV substations	$0.58	JCPL	JCPL	6/1/2017
b2754.4	Use ~ 40 route mi. of existing fibers on PPL 230 kV system to establish direct fiber circuits	$0.02	PPL	PPL	6/1/2017
b2754.5	Upgrade relaying at Martins Creek 230 kV	$0.14	PPL	PPL	6/1/2017
b2754.6	Upgrade relaying at Morris Park 230 kV	$0.14	JCPL	JCPL	6/1/2017
b2754.7	Upgrade relaying at Gilbert 230 kV	$0.14	JCPL	JCPL	6/1/2017
b2756	Install 2% reactors at Martins Creek 230 kV	$10.00	PPL	PPL	6/1/2018
b2760	Perform a Sag Study of the Saltville - Tazewell 138 kV line to increase the thermal rating of the line	$0.10	AEP	AEP	6/1/2021
b2761.1	Replace the Hazard 161/138 kV transformer	$2.30	AEP	AEP	6/1/2021
b2761.2	Perform a Sag Study of the Hazard – Wooten 161 kV line to increase the thermal rating of the line	$0.00	AEP	AEP	6/1/2021
b2762	Perform a Sag Study of Nagel - West Kingsport 138 kV line to increase the thermal rating of the line	$0.10	AEP	AEP	6/1/2021
b2763	Replace the breaker risers and wavetrap at Bredinville 138 kV substation on the Cabrey Junction 138 kV terminal	$0.97	APS	APS	6/1/2021
b2764	Upgrade Fairview 138 kV breaker risers and disconnect leads; Replace 500 CU breaker risers and 556 ACSR disconnect leads with 795 ACSR	$0.03	APS	APS	6/1/2021

b2765	Upgrade bus conductor at Gardners 115 kV substation; Upgrade bus conductor and adjust CT ratios at Carlisle Pike 115 kV	$0.10	ME	ME	6/1/2021
b2767	Construct a new 345 kV breaker string with three (3) 345 kV breakers at Homer City and move the North autotransformer connection to this new breaker string	$6.60	PENELEC	PENELEC	6/1/2021
b2776	Reconductor the entire Dequine - Meadow Lake 345 kV circuit #2	$6.60	AEP	AEP	6/1/2021
b2777	Reconductor the enitre Dequine - Eugene 345 kV circuit #1	$22.19	AEP	AEP	6/1/2021
b2778	Add 2nd 345/138 kV transformer at Chamberlin substation	$3.80	ATSI	ATSI	6/2/2021

Reliability Project Multiple Zone Allocations

Upgrade ID	Description	Cost Estimate ($M)	Trans Owner	Cost Responsibility	Required IS Date
b2766.1	Upgrade substation equipment at Conastone 500 kV (on the Peach Bottom – Conastone 500 kV circuit) to increase facility rating to 2826 MVA normal and 3525 MVA emergency	$2.70	BGE	AEC - 0.81%, AEP - 7.59%, APS - 8.52%, ATSI - 3.8%, BGE - 13.23%, COMED - 6.19%, ConEd - 0.28%, DAYTON - 2.1%, DEOK - 3.67%, DL - 0.86%, DPL - 1.36%, DVP - 6.65%, ECP - 0.61%, EKPC - 2.04%, JCPL - 7.2%, ME - 0.86%, NEPTUNE - 0.77%, HTP - 0.65%, POSEIDON - 0.32%, PECO - 2.49%, PENELEC - 0.96%, PEPCO - 11.41%, PPL - 2.48%, PSEG - 14.58%, RE - 0.59%	6/1/2021
b2766.2	Upgrade substation equipment at Peach Bottom 500 kV (on the Peach Bottom – Conastone 500 kV circuit) to increase facility rating to 2826 MVA normal and 3525 MVA emergency	$4.30	PECO	AEC - 0.81%, AEP - 7.59%, APS - 8.52%, ATSI - 3.8%, BGE - 13.23%, COMED - 6.19%, ConEd - 0.28%, DAYTON - 2.1%, DEOK - 3.67%, DL - 0.86%, DPL - 1.36%, DVP - 6.65%, ECP - 0.61%, EKPC - 2.04%, JCPL - 7.2%, ME - 0.86%, NEPTUNE - 0.77%, HTP - 0.65%, POSEIDON - 0.32%, PECO - 2.49%, PENELEC - 0.96%, PEPCO - 11.41%, PPL - 2.48%, PSEG - 14.58%, RE - 0.59%	6/1/2021

Transmission Owner	Queue Position	Fuel Type	MW Capacity (FTIR/FTWR)	MW Energy (nFTIR/nFTWR)
AEC	AA1-104	Storage	0	20
AEC	AA1-108	Natural Gas	158	158
AEC	AA2-044	Solar	7.3	13.5
AEC	AB1-030	Natural Gas	3.5	7.5
AEC	AB1-116	Natural Gas	0	0.787
AEC	AB1-119	Natural Gas	0	0.735
AEC	AB2-105	Natural Gas	0	0.21
AEP	AA1-063	Methane	3.6	3.6
AEP	AA2-116	Natural Gas	994	994
AEP	AA2-137	Natural Gas	45	45
AEP	AA2-138	Natural Gas	45	45
AEP	AA2-141	Natural Gas	45	45
AEP	AB1-032	Solar	1.2	3.3
AEP	AB1-055	Storage	0	2
AEP	AB1-174	Solar	6.6	10
AEP	AB1-180	Methane	2.4	3.2
AEP	AB2-010	Solar	2.5	5
AEP	AB2-011	Solar	2.5	5
AEP	AB2-109	Hydro	4	12.5
APS	AA1-015	Natural Gas	5	5
APS	AA1-045	Natural Gas	308	308
APS	AA1-047	Wind	9.1	69.6
APS	AA1-062	Wind	29	224
APS	AA1-070	Coal	1590	1710
APS	AA1-085	Wind	10.66	82
APS	AA1-092	Solar	8	12
APS	AA1-095	Solar	6.67	10
APS	AA1-100	Storage	0	11
APS	AA1-109	Solar	4.5	9
APS	AA1-122	Solar	3.8	10
APS	AA2-084	Solar	1.5	4
APS	AA2-085	Solar	3.8	10
APS	AA2-103	Storage	0	20
APS	AA2-119	Natural Gas	550	550
APS	AA2-121	Natural Gas	685	685
APS	AA2-131	Natural Gas	18	0
APS	AA2-139	Natural Gas	45	45
APS	AA2-143	Solar	2.7	4
APS	AA2-145	Solar	10.9	20

APS	AA2-146	Solar	10.9	20
APS	AA2-153	Solar	2.7	4
APS	AA2-155	Solar	2.7	4
APS	AA2-159	Solar	8.7	16
APS	AA2-161	Natural Gas	513	541
APS	AA2-173	Natural Gas	515	515
APS	AB1-064	Methane	2	4
APS	AB1-072	Solar	0.95	2.5
APS	AB1-078	Storage	0	2
APS	AB1-096	Solar	3.8	9.9
APS	AB1-126	Solar	7.6	20
APS	AB1-127	Solar	7.6	20
APS	AB1-128	Solar	7.6	20
APS	AB1-129	Solar	5.7	15
ARR	AA1-035		5.7	15
ARR	AA1-090		5.7	15
ARR	AA1-119		5.7	15
ATSI	AA1-044	Natural Gas	870	1000
ATSI	AA1-056	Natural Gas	46	161
ATSI	AA1-123	Natural Gas	1105	1152
ATSI	AA2-166	Natural Gas	19.9	19.9
ATSI	AB1-015	Natural Gas	0	16.5
ATSI	AB1-095	Methane	0	0.85
ATSI	AB1-115	Methane	2.5	3.1
BGE	AA2-054	Merch. Trans.	2.5	3.1
BGE	AB1-075	Storage	0	20
ComEd	AA1-018	Wind	19.5	150
ComEd	AA1-040	Natural Gas	20	20
ComEd	AA1-078	Natural Gas	20	20
ComEd	AA1-086	Wind	26	200
ComEd	AA1-116	Storage	0	20
ComEd	AA1-117	Storage	0	20
ComEd	AA1-129	Natural Gas	27	27
ComEd	AA1-146	Natural Gas	157	190
ComEd	AA2-123	Storage	0	20
ComEd	Z2-081	Methane	13.3	13.3
ComEd	Z2-087	Wind	26	200
Dayton	AA1-101	Storage	0	20
DEOK	AA1-099	Storage	0	4
DEOK	AA2-100	Methane	4.8	4.8
DEOK	AB2-178	Storage	0	19.8

DL	AB1-166	Storage	0	20
Dominion	AA1-038	Wind	10.1	78.2
Dominion	AA1-049	Solar	14	20
Dominion	AA1-050	Solar	25.6	0
Dominion	AA1-063A	Solar	50.9	74.9
Dominion	AA1-064	Solar	56	80
Dominion	AA1-065	Solar	56	80
Dominion	AA1-067	Solar	10.5	15
Dominion	AA1-083	Natural Gas	20	20
Dominion	AA1-132	Solar	42	60
Dominion	AA1-133	Solar	56	80
Dominion	AA1-134	Solar	56	80
Dominion	AA1-135	Solar	56	80
Dominion	AA1-138	Solar	56	80
Dominion	AA1-139	Solar	84	120
Dominion	AA1-145	Natural Gas	340	340
Dominion	AA2-053	Solar	52.4	74.9
Dominion	AA2-057	Solar	44.7	66
Dominion	AA2-068	Solar	13.7	20
Dominion	AA2-079	Natural Gas	0	28
Dominion	AA2-086	Solar	3.1	4.5
Dominion	AA2-088	Solar	38	100
Dominion	AA2-127	Natural Gas	32.2	7
Dominion	AA2-165	Solar	50	8.9
Dominion	AA2-169	Solar	13.7	20
Dominion	AA2-174	Solar	2.4	5
Dominion	AA2-177	Solar	56	80
Dominion	AA2-178	Solar	56	80
Dominion	AA2-180	Solar	14	20
DPL	AA1-033	Natural Gas	80	80
DPL	AA1-061	Solar	13.4	20
DPL	AA1-140	Solar	7.6	20
DPL	AA1-141	Solar	5.7	15
DPL	AA1-142	Solar	7.6	20
DPL	AA1-143	Solar	7.6	20
DPL	AA2-069	Natural Gas	451	451
DPL	AA2-144	Solar	6.8	10
DPL	AA2-147	Solar	2.7	4
DPL	AA2-150	Solar	6.8	10
DPL	AB1-183	Solar	0	0
JCPL	AA1-060	Storage	0	20

JCPL	AA1-098	Natural Gas	560	560
JCPL	AA1-124	Solar	0.5	1.5
JCPL	AA2-048	Storage	5.3	14
JCPL	AA2-049	Storage	0	3
JCPL	AA2-060	Storage	0	6
JCPL	AA2-061	Storage	0	8
JCPL	AA2-062	Storage	0	7
JCPL	AA2-063	Storage	0	8
JCPL	AA2-064	Storage	0	17
JCPL	AA2-065	Storage	0	8
JCPL	AA2-082	Storage	0	20
JCPL	AA2-114	Storage	0	20
JCPL	AA2-117	Storage	0	16
JCPL	AA2-122	Storage	0	20
JCPL	AA2-128	Natural Gas	70	175
JCPL	AA2-184	Solar	0	20
JCPL	AB1-034	Natural Gas	0	0.6
JCPL	AB2-014	Natural Gas	8.1	0
JCPL	AB2-058	Solar	3.6	0
LTF	AA2-033		3.6	0
LTF	AA2-034		3.6	0
LTF	AA2-038		3.6	0
LTF	AA2-074		3.6	0
LTF	AA2-089		3.6	0
LTF	AA2-090		3.6	0
LTF	AA2-092		3.6	0
LTF	AA2-101		3.6	0
LTF	AA2-102		3.6	0
ME	AA1-016	Oil	158	158
ME	AA1-017	Oil	243	243
ME	AA1-043	Natural Gas	34.1	34.1
ME	AA2-115	Natural Gas	450	450
PECO	AA1-034	Natural Gas	70	120
PECO	AA1-079	Natural Gas	74	74
PECO	AB1-033	Diesel	6.1	6.1
PECO	AB1-073	Storage	0	20
PECO	AB1-074	Storage	0	20
PENELEC	AA1-042	Natural Gas	52.5	0
PENELEC	AA1-046	Wind	10.4	80
PENELEC	AA1-076	Natural Gas	1000	1050
PENELEC	AA1-082	Natural Gas	0	57.5

PENELEC	AA1-087	Merch. Trans.	0	57.5
PENELEC	AA1-106	Natural Gas	19.9	19.9
PENELEC	AA1-111	Natural Gas	463	463
PENELEC	AA1-115	Storage	0	20
PENELEC	AA1-144	Natural Gas	163	163
PENELEC	AA2-081	Natural Gas	19.9	19.9
PENELEC	AA2-083	Natural Gas	19.9	19.9
PENELEC	AA2-104	Storage	0	20
PENELEC	AA2-112	Natural Gas	19.9	19.9
PENELEC	AA2-120	Natural Gas	250	250
PENELEC	AA2-132	Natural Gas	19.9	19.9
PENELEC	AA2-133	Natural Gas	19.9	19.9
PENELEC	AA2-135	Natural Gas	19.9	19.9
PENELEC	AA2-167	Natural Gas	19.9	19.9
PENELEC	AB1-144	Natural Gas	590	590
PEPCO	AA2-170	Natural Gas	92	111.1
PPL	AA1-057	Wood	16	16
PPL	AA1-066	Natural Gas	80	0
PPL	AA1-077	Natural Gas	34	113
PPL	AA1-103	Wind	27	208.5
PPL	AA1-114	Wind	7.72	60
PPL	AA2-008	Natural Gas	0	57
PPL	AA2-017	Wind	12.7	98
PPL	AA2-171	Natural Gas	60	97
PPL	AA2-182	Natural Gas	977	1030
PPL	AB1-084	Natural Gas	19.9	19.9
PPL	AB2-012	Natural Gas	19.9	19.9
PSEG	AB1-021	Solar	0.3	2
PSEG	AB1-025	Solar	2.6	6.8
PSEG	AB1-063	Solar	0	0.4
PSEG	AB1-139	Solar	2.5	6.6
PSEG	AB2-020	Merch. Trans.	2.5	6.6
UGI	AA1-036	Natural Gas	180	180

Upgrade ID	Description	Transmission Owner	Cost Estimate ($M)	Required IS Date
n1464	Replace 138kV risers on the T131 line, replace the 138kV 600A switch on the eT131 line at North Delphos Substation	AEP	0.187	10/30/2010
n1465	Replace 138kV riser on the S73 line at Lincoln Substation	AEP	0.007	10/30/2010
n1466	Replace 138kV riser on the R49 line and replace the bus at Haviland Substation	AEP	0.265	10/30/2010
n1467	Rebuild the circuit between Lincoln and Anthony Substations i.e. 17 miles of 138kV circuit	AEP	26	10/30/2010
n1468	Replace 138kV risers on both the Tillman and Harper lines at Milan station, replace the 138kV 600A switch	AEP	0.22	10/30/2010
n1469	Rebuild 10.72 of 69kV between Haviland and Paulding Substations	AEP	3.87	10/30/2010
n1501	Rebuild, reconductor and replace towers in the approx. 8 mile 138kV circuit between Haviland and Milan Substations	AEP	12	10/31/2010
n1502	Replace risers and a 600A 138kV disconnect switch on the Tillman terminal at Milan Substation	AEP	0.21	10/31/2010
n1503	Replace risers on the Harper terminal at Milan Substation	AEP	0.01	10/31/2010
n1504	Rebuild, reconductor and replace towers of approx. 17 mile 138kV circuit between Lincoln and North Delphos Substations	AEP	26	10/31/2010
n1505	Replace risers on the R49 terminal at Haviland Substation	AEP	0.265	10/31/2010
n3154	Conastone 500 reconfig	BGE	10	12/31/2017
n3900	Break Eldred-Frackville 230kV line to tie in new substation.	PPL	2.98	7/4/2015
n3901	Oversight, testing, and commissioning related to a new 230kV substation along the Eldred-Frackville 230kV line. The substation will be constructed under Option to Build provisions.	PPL	0.66	7/4/2016
n3902	Install dual fiber optics on the Eldred-Frackville 230kV line.	PPL	3.56	7/4/2015
n3903	Protection system modifications at Eldred substation 230kV substation	PPL	0.25	7/4/2015
n3905	Replace wave trap and protective relays associated with Montour-Milton 230kV line	PPL	0.25	7/4/2015

n3907	Install a second 900MVA 500-230kV transformer and associated equipment.	PPL	25	7/4/2015
n4058	Perform a sag study on the Stillwell - Dumont 345 kV line	AEP	0.03	6/1/2016
n4106	Perform a sag study on the 345 kV line between Jefferson and Clifty Creek.	AEP	1.96	
n4228.1	Upgrade bus relaying/conductors	ComEd	2.324816	7/8/2005
n4228.2	New line section for generator lead	ComEd	1.549878	7/8/2005
n4260	Raritan River - Fiber optic communication work on G1047 230kV Transmission Line.	JCPL	8.331	6/30/2009
n4336.1	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker BVLY2-GEN1	ATSI	0.9697	6/1/2018
n4336.2	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker BVLY2-S. BUS	ATSI	0.9697	6/1/2018
n4336.3	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker BVLY2-GEN1	ATSI	0.9697	4/29/2019
n4337	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker CRESENT-S. B	ATSI	0.9697	6/1/2018
n4337.1	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker BVLY2-S. BUS	ATSI	0.9697	4/29/2019
n4337.2	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker CHAMB-S. BUS	ATSI	0.9697	4/29/2019
n4337.3	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker CRESENT-S. B	ATSI	0.9697	4/29/2019
n4338.1	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker GEN NO 1-N.	ATSI	0.9697	6/1/2018
n4338.2	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker GEN NO 2-N.	ATSI	0.9697	6/1/2018
n4338.3	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker GEN NO 3-N.	ATSI	0.9697	6/1/2018
n4339.1	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker GEN2-CHAMB	ATSI	0.9697	6/1/2018
n4339.2	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield	ATSI	0.9697	6/1/2018

	breaker GEN3-S. BUS			
n4339.3	Replace 3 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker HIGH-CRESCEN	ATSI	0.9697	6/1/2018
n4340.1	Replace 2 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker HIGH-N. BUS	ATSI	0.9722	6/1/2018
n4340.2	Replace 2 overdutied 345kV circuit breakers with 80kA circuit breakers. @ Bruce Mansfield breaker HOYT-N. BUS	ATSI	0.9722	6/1/2018
n4354	Construct new transmission line between W3-022 230kV switchyard and Y2-015 POI	PPL	0.62519	12/1/2015
n4355	Expand the W3-022 230kV switchyard to accommodate the connection of Y2-015	PPL	3.47754	12/1/2015
n4356	Install new 500/230kV substation on of Y2-015	PPL	102.9	12/1/2015
n4357	Expand the W3-022 230kV switchyard to accommodate the connection to Catawissa	PPL	5.17131	12/1/2015
n4358	Tie in W3-022 230kV switchyard to Catawissa/Frackville 230kV line	PPL	10.420204	12/1/2015
n4359	Upgrade "Eldred South" circuit breaker	PPL	0.46	12/1/2015
n4484	Add a new bay at Earlevs 230kV substation with 2 new breaker to accommodate the new generator	Dominion	2	12/31/2015
n4488	Install two current limiting reactors at Tosco (GIS) 230 kV	PSEG	0.08	6/1/2017
n4561	On the Ridgeley 138 kV terminal, replace the 1200A wave trap with a 2000A wave trap and replace the 954 breaker risers with 1272 ACSR.	APS	0.0458	12/1/2017
n4562	On the Cumberland 138 kV terminal, replace the 1200A wave trap with a 2000A wave trap and replace the 954 breaker risers with 1272 ACSR.	APS	0.0458	12/1/2017
n4601	Replace 1 overdutied 138 kV breaker with a 63 kA breaker at NELSON B4 bus. Breaker name: 155 15507	ComEd	1.65	6/1/2016
n4606.1	Cumberland Substation: On the Ridgeley 138 kV terminal, replace the 1200A wave trap with a 2000A wave trap and replace the 954 ACSR breaker risers with 1272 ACSR	APS	0.0363	12/1/2017
n4606.2	Ridgeley Substation: On the Cumberland 138 kV terminal, replace the 1200A wave trap with a 2000A wave trap and replace the 954 ACSR breaker risers with 1272 ACSR	APS	0.0363	12/1/2017
n4611	Build new 345kV 3-breaker ring bus substation	ATSI	7.4677	6/1/2018

	for the AA1-044 project.			
n4612	Tie in the new substation for AA1-044 to the Shenango-Hoytdate 345kV line.	ATSI	3.4104	6/1/2018
n4613	Install two single channel transfer trip transmitters.	ATSI	0.1869	6/1/2018
n4614	Install two single channel transfer trip transmitters.	ATSI	0.1869	6/1/2018
n4618	Construct a 69 kV terminal position on the 69 kV ring bus at Worcester Substation. The additional position will require a 69 kV circuit breaker, instrument transformers, substation bus equipment, structures, and disconnect switches.	DPL	1.2	12/1/2016
n4629	Construct a 69 kV terminal position on the 69 kV ring bus at Kenney Substation. The additional position will require a 69 kV circuit breaker, instrument transformers, substation bus equipment, structures, and disconnect switches.	DPL	1.2	12/1/2016
n4630	Install new 115kV 3 breaker ring bus substation for the AA1-046 project.	PENELEC	4.8775	12/1/2017
n4631	Tie in the new 3 breaker ring bus for the AA1-046 project to the Somerset-Allegheny 115kV line.	PENELEC	0.3498	12/1/2017
n4632	Install carrier equipment at Somerset.	PENELEC	0.3251	12/1/2017
n4633	Install carrier equipment at Allegheny.	PENELEC	0.4907	12/1/2017
n4634	Install carrier equipment at New Baltimore.	PENELEC	0.0791	12/1/2017
n4635	Protection changes at Bedford North	PENELEC	0.0131	12/1/2017
n4636	Install 3rd Lackawanna 500/230 kV transformer	UGI	20	12/1/2017
n4637	Expand the existing 3-breaker ring bus substation to a 4-breaker ring bus. 115 kV Thirty first street substation	PENELEC	1.0696	6/1/2016
n4650	Protection and communication work at Milton substation	PPL	0.068865	6/1/2015
n4651	The project was evaluated as a 16.0 MW injection at the Viking 69kV substation in the PPL area. Protection and communication work at Sunbury substation and Milton substation is required.	PPL	0.068865	6/1/2015
n4656	Reconductor the Rockwood – Somerset 115 kV line and upgrade terminal equipment at Rockwood and Somerset.	APS	10.8944	9/25/2017
n4657	Change connection point for 220-36 line (213489-213588) at Chichester substation	PECO	1.4	6/1/2015

	from bus #1 (213489) to bus #2 (213490).			
n4658	Change the connection point of the 220-56 line (Eddington to Holmesburg 230 kV to Richmond) at Richmond substation from its current position between circuit breakers #475 and #575 to a new position between circuit breakers #185 and #285	PECO	3.7	6/1/2015
n4659	Build new 34kV line tap to connect AA1-060 to the Great Adventure-Great Adventure Tap line.	JCPL	0.4529	6/1/2015
n4660	Adding a new 500/345kV transformer and constructing a 500 kV yard in breaker and a half layout is required. The proposed 500kV yard will tap into the existing Keystone – Conemaugh 500kV line.	PENELEC	33.8454	12/1/2015
n4660.1	Replace Keystone 500 kV breaker NO.14 CABOT from 40 kA to 63 kA breaker	APS	1.329	12/29/2017
n4660.2	Replace Keystone 500 kV breaker NO.16 CABOT from 40 kA to 63 kA breaker	APS	1.329	12/29/2017
n4660.3	Replace Keystone 500 kV breaker #1 from 40 kA to 63 kA breaker	APS	1.329	12/29/2017
n4660.4	Replace Keystone 500 kV breaker Juniata from 40 kA to 63 kA breaker	APS	1.329	12/29/2017
n4660.5	Replace Keystone 500 kV breaker NO.3 TRANSFO from 40 kA to 63 kA breaker	APS	1.329	12/29/2017
n4661	Upgrade line relaying for AA1-098 Interconnection.	JCPL	0.1955	5/30/2018
n4662	Upgrade line relaying for AA1-098 Interconnection.	JCPL	0.1955	5/30/2018
n4663	Replace existing 2000A Circuit Switcher with 3000A Circuit Switcher on Lake Nelson line exit.	JCPL	0.2779	5/30/2018
n4664	Reconductor a 1.4 mile section of the Parlin-South River Jct. (G1047) 230 kV line w/ single 1590 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR conductor.	JCPL	2.3168	5/30/2018
n4665	Replace existing 2000A Circuit Switcher with 3000A Circuit Switcher on Lake Nelson line exit.	JCPL	0.0927	5/30/2018
n4666	Reconductor the 11 mile Freneau-Parlin (K1025) 230 kV line w/ single 1590 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR conductor.	JCPL	23.5263	5/30/2018
n4667	Upgrade line drops, auxiliary CTs (and related settings changes), and wavetrap on Parlin line	JCPL	0.174	5/30/2018

	exit.			
n4668	Upgrade line drops, auxiliary CTs (and related settings changes), and wavetrap on Parlin line exit.	JCPL	0.174	5/30/2018
n4669	Assumes re-attachment of Fiber at 15 steel poles needing replaced.	JCPL	0.1737	5/30/2018
n4670	Reconductor the 18.5 mile Atlantic-South River Jct. (P1030) 230 kV line w/ single 1590 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR conductor.	JCPL	33.4959	5/30/2018
n4671	Assumes re-attachment of Fiber at 35 towers needing Reinforcements.	JCPL	0.4053	5/30/2018
n4672	Reconductor the 7.9 mile Lake Nelson-Raritan River (I1023) 230kV line w/ single 1590 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR conductor (I1023).	JCPL	14.0265	5/30/2018
n4673	Reconductor the 7.9 mile Raritan River-Kilmer (W1037) 230kV line w/ single 1590 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR conductor (W1037).	JCPL	10.4932	5/30/2018
n4674	Assumes re-attachment of Fiber at 35 towers needing Reinforcements.	JCPL	0.1389	5/30/2018
n4675	Reconductor a 2.35 mile section of the Hartle-Raritan River (T1034) 230kV line w/ twin bundled 795 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR conductor.	JCPL	2.7466	5/30/2018
n4676	Rebuild the 2.6 mile Raritan River-Red Oak section of the Parlin-Raritan River (G1047) 230kV line w/ twin bundled 795 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR. The new structures shall be steel poles w/ foundations.	JCPL	14.8863	5/30/2018
n4677	Reconductor an approx. 1.0 mile section of the Hartle-South River Jct. (T1034) 230kV line w/ single 1590 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR conductor.	JCPL	1.9516	5/30/2018
n4678	Assumes re-attachment of Fiber at 10 towers needing Reinforcements.	JCPL	0.1158	5/30/2018
n4679.1	Replace breaker BT by a 63 kA breaker at South River 230 kV substation	JCPL	0.273	5/30/2018
n4679.2	Replace breaker PA by a 63 kA breaker at South River 230 kV substation	JCPL	0.273	5/30/2018
n4679.3	Replace breaker TA by a 63 kA breaker at South River 230 kV substation	JCPL	0.273	5/30/2018

n4679.4	Replace breaker PB by a 63 kA breaker at South River 230 kV substation	JCPL	0.273	5/30/2018
n4680	Replacing two disconnected switches with 3000A rating and two breakers with 4000A rating is required along with upgrading relays and communication.	BGE	4	6/1/2017
n4680.1	Replace breaker 780-B-298 with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.10	Replace breaker HIGHL-W. BUS with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.11	Replace breaker S. CAN-W. BU with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.12	Replace breaker S.CAN-GEN.5 with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.13	Replace breaker STAR-GEN.4 : with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.14	Replace breaker STAR-W. BUS with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.15	Replace breaker WR-GEN.6 : B with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.16	Replace breaker WR-W. BUS : with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.2	Replace breaker BVR VLY-GEN with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.3	Replace breaker BVR VLY-W. B with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.4	Replace breaker GEN.3-E. BUS with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.5	Replace breaker GEN.4-E. BUS with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.6	Replace breaker GEN.5-E. BUS with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.7	Replace breaker GEN.6-E. BUS with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2018
n4680.8	Replace breaker GEN.7-E. BUS with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4680.9	Replace breaker HIGHL-GEN.3 BUS with a 80 kA breaker at Sammis 345 kV substation	ATSI	0.765	12/1/2020
n4681	Replacing 5 motor-operated disconnected switches is required.	PECO	2	6/1/2017
n4682	Construct new 500kV 3 breaker ring bus substation to connect the AA1-076 project.	PENELEC	15.2352	10/1/2019
n4683	Tie in substation built for AA1-076 to the Hunterstown-Conemaugh 500kV line.	PENELEC	4.1958	10/1/2019
n4684	Protection system modifications at	PENELEC	0.2	10/1/2019

	Conemaugh substation			
n4685	Protection system modifications at Hunterstown substation	PENELEC	0.2	10/1/2019
n4686	Construct new 230kV 5 breaker ring bus substation.	JCPL	6.3349	5/30/2018
n4687	Tie in new substation to Raritan River-South River Junction.	JCPL	2.2488	5/30/2018
n4688	Replace relaying at Raritan River.	JCPL	0.1955	5/30/2018
n4689	Replace relaying at Red Oak	JCPL	0.1955	5/30/2018
n4690	Construct a three-position 69 kV ring bus along Line 6719 between Jacktown Substation and East New Market Substation. See notes for more info	DPL	2.6	12/1/2016
n4691	Reconfigure Line 6719 to accommodate the new line terminal positions at the new substation between Jacktown Substation and East New Market Substation.	DPL	0.35	12/1/2016
n4692	Replace equipment, wave trap at Four Rivers and line switches at St. Johns	Dominion	0.15	3/1/2017
n4693	Replace equipment, wave trap at Four Rivers and line switches at Hanover	Dominion	0.25	3/1/2017
n4694	Build new 345kV, 3-breaker ring bus for the AA1-123 project.	ATSI	8.3632	12/1/2019
n4695	Tie in new substation for AA1-123 to the Highland-Sammis 345kV line	ATSI	2.6693	12/1/2019
n4696	Protection system modifications at Highland substation.	ATSI	0.4594	12/1/2019
n4697	Protection system modifications at Sammis substation.	ATSI	0.4193	12/1/2019
n4698	Build new 230kV 3-breaker ring bus for the AA1-144 project	PENELEC	7.8944	12/29/2017
n4699	Tie in new substation for AA1-144 to the East Towanda-Marshall 230kV line	PENELEC	0.6132	12/29/2017
n4700	Protection work at East Towanda	PENELEC	0.1558	12/29/2017
n4701	Protection work at Marhsall	PENELEC	0.0803	12/29/2017
n4702	Install new fiber optic communication line along the East Towanda-Marhsall 230kV line	PENELEC	0.2991	12/29/2017
n4703	Tap the Catoctin - Troutville 34.5 kV and install 2 34.5 kV air switches and appropriate metering	APS	0.2164	12/31/2016
n4704	Catoctin SS: Revise relay settings on the Monocacy 34.5 kV line	APS	0.0137	12/31/2016
n4705	Carroll SS: Revise relay settings on the Monocacy 34.5 kV line	APS	0.0137	12/31/2016
n4706	Monocacy SS: Revise relay settings on the	APS	0.0137	12/31/2016

	Catoctin 34.5 kV line			
n4708	Raise 138 kV Berlin Lake-Nile 138kV and Bluebell-Highland 138kV Lines for Generation Attachment Line crossing clearance	ATSI	1.1873	4/29/2019
n4709	Upgrade Sammis 345kV substation line relaying to new Z2-028 interconnection bus	ATSI	0.008	4/29/2019
n4710	Upgrade Mansfield 345kV substation line relaying to new Z2-028 interconnection bus	ATSI	0.008	4/29/2019
n4711.1	Replace breaker W-3 at WYLIE RG 139 kV bus with a 80 kA breaker	APS	0.55	12/1/2019
n4711.2	Replace breaker W-8 at WYLIE RG 139 kV bus with a 80 kA breaker	APS	0.55	12/1/2019
n4713	Rebuild 2.83 miles of the existing Howe – Sturgis 69 kV line (AEP/MISO tie line).	AEP	3.4	12/1/2015
n4714	Build 230kV switching station (3 breaker ring bus) and loop the 230kV circuit between Shawboro and Hickory into the new switching station	Dominion	5.6	10/31/2015
n4715	Loop the existing 230kV circuit between Winfall and Sunbury substations into the new Switching Station (Acorn Hill 230kV) for the generator	Dominion	1.65	10/31/2015
n4716	Upgrade Relay Settings and Communication Equipment at Shawboro and Hickory 230kV Substations to accommodate the generator	Dominion	0.127	10/31/2015
n4717	Build 230kV switching station (3 breaker ring bus) and loop the 230kV circuit between Fentress and Shawboro into the new switching station	Dominion	5.6	10/31/2015
n4718	Loop the existing 230kV circuit between Fentress and Sligo substations into the new Switching Station for the generator	Dominion	1.65	10/31/2015
n4719	Upgrade Relay Settings and Communication Equipment at Fentress and Sligo 230kV Substations to accommodate the generator	Dominion	0.627	10/31/2015
n4720	Build 500kV switching station (3 breaker ring bus) and loop the 500kV circuit between Wake and Heritage into the new switching station	Dominion	16	12/31/2015
n4721	Loop the existing 230kV circuit between Wake and Heritage substations into the new Switching Station for the generator	Dominion	1.85	12/31/2015
N4722	Upgrade Relay Settings and Communication Equipment at Wake and Heritage 500kV Substations to accommodate the generator	Dominion	0.627	12/31/2015

n4726	Transmission Tie in work between AA1-018 interconnection substation and Line 0303	ComEd	3	12/31/2017
n4727	Install new AA1-018 345kV Interconnection substation	ComEd	18	12/31/2017
n4728	Raise 93503 and 0302 for 0303 line crossing	ComEd	2	12/31/2017
n4740	Rebuild 2.76 miles of the existing Howe – Sturgis 69 kV line (AEP portion)	Not Specified	2.208	12/1/2015
n4741	Rebuild of 1.91 miles of existing Howe – Sturgis 69 kV line	Not Specified	1.524	12/1/2015
n4742	Construct Interconnection Substation with Revenue Metering between Dumont and Greentown 765kV Circuit	AEP	30.092	12/1/2015
n4743	Modify relaying at Dumont 765 kV Station	AEP	0.554	12/1/2015
n4744	Modify relaying at Greentown 765 kV Station	AEP	0.7274	12/1/2015
n4761	Remote-end relay upgrade	ComEd	1.5	12/31/2013
n4782	Add additional breaker in the ring bus configuration of Four River 230kV substation to accommodate the generator	Dominion	0.6	3/1/2017
n4806	Install (1)-12.5 kV 300A disconnect switch and one span 336 ACSR span to dead end.	APS	0.022	9/15/2016
n4807	Procure and install FE 12.5 kV metering equipment in the developer's collector Substation. Developer to provide mounting structures and phone line	APS	0.033	9/15/2016
n4808	Balance the Catoctin – Catoctin Furnace 12.5 kV circuit	APS	0.0015	9/15/2016
n4809	Change controllers on the Catoctin Substation 12.5 kV bus regulator	APS	0.0458	9/15/2016
n4811	Build one attachment span, 336 ACSR, from distribution line tap to dead end POI.	APS	0.01	9/5/2016
n4812	Install (1)-12.5 kV 600A disconnect switch in attachment span.	APS	0.012	9/5/2016
n4813	Procure and install FE 12.5 kV metering equipment in the developer's collector Substation. Developer to provide mounting structures and phone line	APS	0.033	9/5/2016
n4814	Extend General Office 12.5 kV Bus and Install new feeder bay.	APS	0.2983	9/5/2016
n4815	Install 200ft, 750 AL, underground substation exist.	APS	0.01	9/5/2016
n4816	Change the No. 1 XFMR LTC controller	APS	0.01	9/5/2016
n4817	Build single span of 336 ACSR from distribution line to Interconnection Customer's POI.	APS	0.0805	11/1/2016
n4818	Metering package in interconnection	APS	0.01075	11/1/2016

	customer's facilities.			
n4819	Tap 34.5 kV line between Carroll and Mt. Airy substations and Install two (2) 1200 A, 34.5 kV line switches.	APS	0.10145	11/1/2016
n4820	Remote end relay, protection and metering settings adjustments.	APS	0.0123	11/1/2016
n4821	Install 34.5 kV metering package in interconnection customer's facilities.	APS	0.01	6/30/2017
n4822	Tap 34.5 kV line between Saint Thomas - Guilford substations and install a single tap switch.	APS	0.02	6/30/2017
n4823	Install two (2) 34.5 kV manual line switches.	APS	0.0568	6/30/2017
n4824	Install new relay panel on the Guilford 34.5kV line (Mercersburg SS)	APS	0.0859	6/30/2017
n4825	Install new relay panel on the Mercersburg 34.5kV line (Guilford SS)	APS	0.0859	6/30/2017
n4826	Install new relay panel on the Mercersburg 34.5kV line (McConnellsburg SS)	APS	0.0859	6/30/2017
n4832	Install 34.5 kV metering package in interconnection customer's facilities.	APS	0.01	6/30/2017
n4833	Tap 34.5 kV line between Saint Thomas - Mercersburg substations and install a single tap switch.	APS	0.02	6/30/2017
n4834	Install two (2) 34.5 kV manual line switches at the point of interconnection i.e. Saint Thomas and Mercersburg 34.5kV Substation	APS	0.0568	6/30/2017
n4835	Install new relay panel on the Guilford 34.5kV line (Mercersburg SS)	APS	0.0859	6/30/2017
n4836	Install new relay panel on the Mercersburg 34.5kV line (Guilford SS)	APS	0.0859	6/30/2017
n4837	Install new relay panel on the Mercersburg 34.5kV line (McConnellsburg SS)	APS	0.0859	6/30/2017
n4843	Metering and relay settings adjustments at Oak Grove 138kV Substation		0	
n4844	Upgrade relay settings at Cartanza and Red Lion 230 kV buses	DPL	0.01	6/1/2018
n4849	Adjust remote Relay and Metering Settings at Back Bone Mountain 138kV Substation	APS	0.0091	12/30/2016
n4850	William SS. Replace the (spare) No.1 138/69 kV transformer with a 40/50/60 MVA transformer and place it normally in-service with the No.2 transformer	APS	2.2712	12/30/2016
n4850.1	William Substation. Replace the No.1 138-69 kV transformer with a 40/50/60 MVA transformer	APS	2.14	11/2/2017

n4850.2	William Substation. Replace the No. 1 69 kV Capacitor circuit switcher with a 72kV Capswitcher	APS	0.15	11/2/2017
n4851	Glen Falls SS: - Grade and extend fence and ground grid approx. 50' x 180'. - Install attachment line from 138 kV SF6 breaker to POI	APS	0.075	6/1/2020
n4852	Glenn Falls 138kV Substation - Extend 138 kV bus and install 138 kV SF6 breaker, bus/line disconnects, foundations, control cable and associated facilities.	APS	1.21	6/1/2020
n4853	Glenn Falls 138kV Substation - 16' x 16' expansion of concrete control building. ESTIMATE DOES NOT INCLUDE PROPERTY ACQUISITION NECESSARY FOR EXPANSION.	APS	0.5133	6/1/2020
n4854	Glen Falls SS. Replace the Buckhannon 50, Barnetts Run 406, Oak Mound 4, No. 1 & No. 4 transf. and 138 kV Bust tie breakers with 63 kA, 3000 A units. Install 3 new foundations, 4 switches, cable trench, control cable and all as	APS	1.9153	6/1/2020
n4855	Rebuild 2.5 miles of the Glen Falls-Oak Mound 138 kV line and upgrade terminal equipment at both Glen Falls & Oak Mound substations.	APS	9.482	6/1/2020
n4856	Install attachment line between TO facilities and POI and install one (1) disconnect switch.	ME	0.045	7/1/2019
n4857	Construct a new three (3) breaker ring bus interconnection substation near the South Reading - North Boyertown 230kV Line; Location South Reading - North Boyertown 230kV Line	ME	7.6262	7/1/2019
n4858	Upgrade line carrier and transfer trip relaying/equipment affected by the AA2-115 interconnection; Location South Reading 230kV Substation	ME	0.4546	7/1/2019
n4859	Upgrade line carrier and transfer trip relaying/equipment affected by the AA2-115 interconnection; Location: Hosensack 230kV Substation	ME	0.4308	7/1/2019
n4860	Upgrade carrier relaying affected by the AA2-115 interconnection; Location: North Boyertown 230kV Substation.	ME	0.419	7/1/2019
n4861	Loop the South Reading-North Boyertown 230kV Line into the new AA2-115 interconnection substation (Approximately	ME	0.6796	7/1/2019

	200' in length); Location South Reading- North Boyertown 230kV Line.			
n4862	(1) Replace the transformer with a new 168 MVA transformer; (2) Install a new 230 kV high side circuit breaker on the new transformer. At North Boyertown Substation	ME	3.598	7/1/2019
n4863	Upgrade limiting OC facilities in order to increase the thermal ratings of the bank. Constraining Equipment @ Location: South Reading Substation: (1) OC IAC, (2) OC IBC51A Constraining Facility: South Reading 230/69	ME	0.1593	7/1/2019
n4864	Upgrade limiting OC facilities in order to increase the thermal ratings of the bank. Constraining Equipment @ Location: South Reading Substation: (1) OC IBC51A Constraining Facility: South Reading 230/69kV #8 Bank	ME	0.1593	7/1/2019
n4865	Upgrade the overdutied circuit breaker at South Reading Substation	ME	0.7375	7/1/2019
n4874	Adjust remote end relaying and metering settings at Ronco 500kV Substation.	APS	0.0127	10/1/2016
n4875	Adjust remote, relaying, and metering settings	JCPL	0.01	12/1/2015
n4876	Build a new 34.5kV Tap off The Branchville - Sussex #1 34.5 kV Line	JCPL	0.4409	12/1/2015
n4877	Build a new 34.5kV Tap off The Gilbert - Phillipsburg 34.5 kV Line	JCPL	0.441	4/1/2016
n4878	Adjust Remote Relay and Metering Settings.	JCPL	0.0129	4/1/2016
n4903	Attachment line from POI to inside the of Hatfield 500kV substation.	APS	0.0105	
n4904	Install fully rated disconnect switch in attachment line connecting Hatfield 500kV Substation	APS	0.0055	
n4905	Expand the bus and install two breakers at Hatfield 500kV Substation to Accommodate the generator	APS	8.5491	
n4907	Build a new 34.5kV Tap off The Branchville - Sussex #2 34.5 kV Line (Q745-3)	JCPL	0.4409	12/1/2015
n4913	Thompson SS. Installing anti-islanding and voltage sync check	PENELEC	0.2593	6/1/2017
n4913	Incorrect NUN. Remove from DB	PENELEC	0.2593	6/1/2017
n4913.9	Incorrect NUN. Remove from DB	PENELEC	0.2593	6/1/2017
n4914	Install tap from Franklin Forks 34.5 kV line	PENELEC	0.1065	6/1/2017
n4914	Incorrect NUN. Remove from DB	PENELEC	0.1065	6/1/2017
n4915	Tiffany SS. 34.5kV Relaying Upgrade for AA2-	PENELEC	0.4011	6/1/2017

	112 Generation Interconnection			
n4915	Incorrect NUN. Remove from DB	PENELEC	0.4011	6/1/2017
n4916	Build a new 34.5kV Tap off The Branchville - N. Newton 34.5 kV Line (F708)	JCPL	0.4304	12/1/2015
n4917	Oakland SS. 34.5kV Relaying Upgrade for AA2-112 Generation Interconnection.	PENELEC	0.3778	6/1/2017
n4917	Incorrect NUN. Remove from DB	PENELEC	0.3778	6/1/2017
n4918	34.5 k Pole Recloser Work.	PENELEC	0.0266	6/1/2017
n4918	Incorrect NUN. Remove from DB	PENELEC	0.0266	6/1/2017
n4920	Adjust remote, relaying, and metering settings	JCPL	0	12/1/2015
n4921	Replacing the existing breaker and waver trap at East Towanda 115 kV bus, and replacing the wave trap at the North Meshoppen	PENELEC	0.2428	12/31/2019
n4922	Replacing the wave trap on the E. Towanda with an emergency rating of 615 MVA	PENELEC	0.0846	12/31/2019
n4923	Replacing the wave trap on the Hillside with an emergency rating of 615 MVA is required	PENELEC	0.0656	12/31/2019
n4924	Rebuilding the line with 1590 ACSS	PENELEC	30.4768	12/31/2019
n4925	Replacing North Meshoppen #3 230/115 KV transformer with an emergency rating of 300 MVA.updating the existing RTU are required	PENELEC	4.88	12/31/2019
n4926	Reconductoring line with 1033 ACSS conductor and replacing the line drops at the Moshannon 230 kV substation	PENELEC	30.7652	12/31/2019
n4927	Rebuilding the line with 1590 ACSS, replacing the disconnect switch at the Canyon 230 kV substation, and replacing the wave trap at the N. Meshhoppen 230 kV	PENELEC	21.1533	12/31/2019
n4928	Reconductoring 0.1 miles of existing 1033 ACSR conductor with new 1033 ACSS conductor from Chapman Sub to new AA1-111. adjusting remote settings at the Moshannon	PENELEC	0.4674	12/31/2019
n4929	Building a new 345kV string on the east side of the substation, remove existing North Transformer breaker, and re-terminating Transformer connection on new 345kV string are required.	PENELEC	6.67	10/31/2019
n4930	Replacing the existing wave trap and line drops at East Towanda is required	PENELEC	0.1201	12/31/2019
n4931	Reconductoring 230 kV line from Four Mile Junction to the W3-099 Tap point with 1033 ACSS high temperature conductor, and replacing the line drops at the Four Mile Junction substation	PENELEC	10.4584	12/31/2019

n4932	Removing South Transformer low side breaker, installing new breaker in existing 230kV breaker and one half configuration, and re-terminating transformer connection in newly created position are required	PENELEC	1.38	12/29/2017
n4933	Rebuilding 10.6 miles of single circuit 230kV between Oxbow and North Meshoppen Substations using 1590 ACSS, and replacing the existing wave trap, breaker disconnect switches at the North Meshoppen substation	PENELEC	13.0121	6/30/2020
n4934	Rebuilding 16.3 miles of single circuit 230kV between PPL's Lackawanna Substation and Oxbow Substations using 1590 ACSS, and adjusting relay settings at the North Meshoppen substation are required	PENELEC	16.4706	6/30/2020
n4937	Rebuilding the Mansfield – Mainesburg 115 kV line with 795 ACSS, replacing the existing line drops at the Mainesburg substation, and replacing the substation conductor and adjusting CT ratio at the Mansfield	PENELEC	10.1479	6/30/2020
n4939	Adjust remote relay settings at Atlantic Substation	JCPL	0.02	6/30/2017
n4940	Reconductor the 2.1 mile Lake Nelson-Kilmer (I1023) 230kV line w/ single 1590 kcmil ACSS conductor, replacing the existing 1590 kcmil ACSR conductor	JCPL	8	6/30/2017
n4941	Reconductor South River Junction 230kV line drops due to overloading, and Replace limiting components at the Atlantic substation	JCPL	2	6/30/2017
n4944	Build a new double circuit 69kV Tap off East Palmerton-Acahela #1 & #2 69 kV lines	PPL	2.749	12/1/2018
n4945	New 500 kV GIL(Gas Insulated Line) will be required along with a tie into 500kV GIS yard. Option is to tie into the existing 500kV bay 2 requiring one new circuit breaker and associated motor-operated disconnect switched to complete the breaker and a ha	PPL	4.1	9/1/2019
n4956	Install New 230kV three breaker ring bus substation	PENELEC	7.8285	10/1/2019
n4957	Marshall-Moshannon 230kV, Loop to Proposed 3-Breaker Ring Bus	PENELEC	0.5239	10/1/2019
n4958	Marshall 230 kV Sub. Adjust Relay Settings	PENELEC	0.1186	10/1/2019
n4959	Moshannon 230 kV Sub. Adjust Relay Settings	PENELEC	0.053	10/1/2019
n4967	AA1-144 Interconnect SS. Revise anti-islanding scheme for AA1-111 Interconnect	PENELEC	0.0823	10/1/2019

	line.			
n4967	AA1-144 Interconnect SS. Revise anti-islanding scheme for AA1-111 Interconnect line.	PENELEC	0.0823	10/1/2019
n4970	Install tap from Thompson 34.5 kV line	PENELEC	0.133	6/1/2017
n4970	Incorrect NUN. Remove from DB	PENELEC	0.133	6/1/2017
n4975	New Tap on Wellsboro 2 34.5 kV line	PENELEC	0.1044	6/1/2017
n4976	Niles Valley SS. Install sync check and anti-islanding scheme on the Wellsboro line exit to developer site AA2-081	PENELEC	0.4667	6/1/2017
n4977	Wellsboro SS. Install sync check and antiislanding scheme on the Niles Valley line exit to developer site AA2-081	PENELEC	0.5181	6/1/2017
n4981	Replace the existing circuit breaker and waver trap at East Towanda 115 kV substation, and replacing the wave trap at the North Meshoppen 115kV substation	PENELEC	0.2428	6/1/2017
n4982	Rebuild 12.3 miles of single circuit 230kV between East Towanda and Canyon Substations using 1590 ACSS and upgrade the associated terminal equipment.	PENELEC	30.4768	6/1/2017
n4983	Rebuild the North Meshoppen- Canyon 230 kV Line line with 1590 ACSS, replace the disconnect switch at the Canyon 230 kV substation, and the wave trap at the N. Meshhoppen 230 kV substation.	PENELEC	24.1533	6/1/2017
n4984	Raritan River – Werner 115 kV Line: Loop the existing Raritan River-Werner 115kV circuit into the new Horseshoe Road Substation.	JCPL	1.1972	6/17/2016
n4985	Horseshoe Road Substation: Construct a 115 kV three breaker ring bus interconnect substation between Raritan River and Werner substations for AA2-128 Interconnection.	JCPL	5.9208	6/17/2016
n4986	Region Line Tap on Wyalusing 34.5 kV line AA2-133 Point of Interconnection including costs associated with 34.5 kV Metering Package.	PENELEC	0	6/1/2017
n4987	New Albany SS. 34.5kV Relaying Upgrade for AA2-133 Generation Interconnection.	PENELEC	0	6/1/2017
n4988	Wyalusing SS. 34.5kV Relaying Upgrade for AA2-133 Generation Interconnection.	PENELEC	0	6/1/2017
n4989	East Towanda SS. Relaying Upgrade for AA2-133 Generation Interconnection.	PENELEC	0	6/1/2017
n4990	34.5 kV Pole Recloser Work Wyalusing-New Albany 34.5 kV.	PENELEC	0	6/1/2017

n4997	Replace the disconnect switch at the Sabinsville 115 kV substation.	PENELEC	0.0856	6/1/2017
n4997	Replace the disconnect switch at the Sabinsville 115 kV substation.	PENELEC	0.0856	6/1/2017
n5000	New 34kV tap connection to the Atlantic – Ocean View 34kV line	JCPL	0	7/1/2017
n5000	Incorrect NUN. Remove from DB	JCPL	0	7/1/2017
n5001	Distribution protection system settings changes at Atlantic 34kV Sub	JCPL	0.0392	7/1/2017
n5001	Incorrect NUN. Remove from DB	JCPL	0.0392	7/1/2017
n5002	Distribution protection system settings changes at Ocean View 34kV Sub	JCPL	0.0392	7/1/2017
n5002	Incorrect NUN. Remove from DB	JCPL	0.0392	7/1/2017
n5021	Construct a new six (6) breaker 345 kV switching station laid out in a breaker and half arrangement including installation of associated disconnect switches, bus work, SCADA and 345 kV revenue metering.	AEP	14	4/1/2020
n5022	Line protection and controls will need to be installed at the new 345 kV switching station between Cook and East Elekhart Substations	AEP	1	4/1/2020
n5023	Line protection and controls settings at Cook Circuit # 1 and #2 at Cook 345 kV substation will need to be changed to coordinate with the new 345 kV switching station due to the new generation added	AEP	0.05	4/1/2020
n5024	Line protection and controls at the Kenzie Creek 345/138 kV Substation will need to be upgraded to coordinate with the new 345 kV switching station due to the new generation added.	AEP	0.6	4/1/2020
n5025	Line protection and controls settings at the East Elkhart 345/138 kV Substation will need to be changed to coordinate with the new 345 kV switching station between East Elkhart and Cook due to the new generation added.	AEP	0.05	4/1/2020
n5026.1	Replace nameplate for H2t539 breaker from 40 kA to 50 kA. Cost estimate of about $2000 each with 3 months to receive and replace.	Dominion	0	7/1/2018
n5026.2	Replace nameplate for H1T539 breaker from 40 kA to 50 kA. Cost estimate of about $2000 each with 3 months to receive and replace.	Dominion	0	7/1/2018
n5026.3	Replace nameplate for H1T561 breaker from 40 kA to 50 kA. Cost estimate of about $2000 each with 3 months to receive and replace.	Dominion	0	7/1/2018

n5027	Buena Vista SS – Construct 6-breaker ring bus substation	APS	7.1	6/1/2020
n5028	Huntingdon-Yukon 138kV, Install a loop to the proposed 6-breaker ring bus	APS	0.4154	6/1/2020
n5029	Springdale-Yukon 138kV, Install a loop to the proposed 6-breaker ring bus	APS	0.3575	6/1/2020
n5030	Yukon SS – Install new relay panels and carrier equipment on the Huntingdon and Springdale 138kV	AEC	0.36	6/1/2020
n5031	Springdale SS – Install new relay panels and carrier equipment on the Yukon 138kV line	APS	0.1801	6/1/2020
n5032	Huntingdon SS – Install new relay panels and carrier equipment on the Yukon 138kV line	APS	0.1801	6/1/2020
n5033	All Dam 6 Tap-Kittanning 138kV, Reconductor ~6.4 miles with 795 kcmil ACSR conductor	APS	6.6223	6/1/2020
n5038	Install new fiber optic communication cable between the Hartle and Raritan River terminals 230kV.	JCPL	0.1666	5/30/2018
n5039	Protection system modifications at Raritan River, Red Oak 230kV	JCPL	0.2351	5/30/2018
n5040	Protection system modifications at Raritan River, Red Oak 230kV	JCPL	0.012	5/30/2018
n5041	Protection system modifications at Raritan River, Red Oak 230kV	JCPL	0.012	5/30/2018
n5042	Protection system modifications at Raritan River, Red Oak 230kV	JCPL	0.012	5/30/2018
n5043	Protection system modifications at Raritan River, Red Oak 230kV	JCPL	0.012	5/30/2018
n5044	Protection system modifications to support reconductoring of the Freneau-Parlin 230kV line	JCPL	0.012	5/30/2018
n5056	Install dual fiber optic cables from the new AA1-123 Interconnection SS to the Sammis SS approximately 11 miles.	ATSI	1.39	12/31/2019
n5057	Adjust Remote Relay Settings at Bluebell, Bruce Mansfield, Evergreen, Glenwillow, GM Lordstown, Hanna, Highland, Hoytdale, Mahoningside, Newton Falls, Niles, Salt Springs, Shenango, Star, Toronto, and Z2-028 substations.	ATSI	0.15	12/31/2019
n5058	Westfall & Summit Substations- Adjust remote relay settings.	PENELEC	0.03	6/1/2016
n5059	Construction Oversight for AA1-046 Interconnection Substation.	PENELEC	1.02	11/1/2017
n5060	Hooversville, Rockwood, and Bedford North	PENELEC	0.04	11/1/2017

	SS 115 kV substation – Adjust Remote Relay Settings.			
n5061	Construction Oversight for AA1-044 Interconnection Substation.	PENELEC	1.07	6/1/2018
n5062	Bruce Mansfield, Cedar Street, Cranberry, Crossland, Maple, Measury, McDowell, New Castle, Niles, and Sharon SS – Adjust Remote Relay Settings.	PENELEC	0.05	6/1/2018
n5063	Install new 138 kV terminal and all necessary terminal end equipment to interconnect AA1-062 on the William bus, including: Test 138 kV breaker & switch, Install control panel & revise relay settings, Terminate Developer's 138 kV line on William Substati	APS	0.24	11/2/2017
n5070	Build a new three breaker ring bus at Haslett substation	Dominion	5.66	10/31/2015
n5071	Modify transmission line #246 (Suffolk - Earleys 230kV) to loop into Haslett substation	Dominion	1.1	10/31/2015
n5072	Upgrade Earleys - Suffolk relay to accommodate queue AA1-138	Dominion	0.37	10/31/2015
n5073	Build a new three breaker ring bus at Boykins - Handsom DP	Dominion	4.5	9/5/2016
n5074	Modify transmission line #140 and loop into AA2-088 substation	Dominion	0.7	9/5/2016
n5075	Upgrade relay at substation AA2-088 to accommodate queue AA2-088	Dominion	0.15	9/5/2016
n5077	Build new three breaker ring bus at AA2-057 substation	Dominion	4.5	6/1/2016
n5078	Tap 115kV between Homertown Substation and Roanoke Rapids Substation to Build Switching Station for the generator	Dominion	0.7	6/1/2016
n5079	Upgrade Relay at remote ends connecting AB2-057 switching station	Dominion	0.15	6/1/2016
n5080	Expedite project b2672 from the 2020 required in-service date. Change CT ratio and relay settings on the Seneca - William 138 kV line at the Seneca substation to facilitate a 150 MVA line rating	APS	0.05	11/2/2017
n5081	Test the Williams substation 138 kV breaker & switch. Install control panel & revise relay settings. Install SCADA RTU and its associated fiber circuit. Terminate Developer's 138 kV line on William Substation dead-end and connect to Developer's fiber.	APS	0.56	11/2/2017
n5082	Finzel-Hazelton 138kV, Loop to 3-Breaker Ring	APS	0.4687	12/1/2017

	Bus for PJM AA1-047 - Install a loop, approx. 200' in length, from the Hazelton-Jennings section of the Finzel-Hazelton 138kV line to the proposed 3-breaker ring bus substation for PJM AA1-047. Note that the			
n5083	Finzel SS. Install a transmitter for anti-islanding signal to the AA1-047 switchyard. Change power line carrier frequencies for the blocking scheme pilot channel.	APS	0.0289	12/1/2017
n5084	Albright, Hazelton, Frostburg, Ridgeley, & Cumberland SS. Adjust remote-relaying settings for Albright, Hazelton, Frostburg, Ridgeley, and Cumberland substations. Adjust Frequency-settings at Hazelton substation.	APS	0.0372	12/1/2017
n5085	Lake Lynn SS. Install new 138 kV relay panel on the Hazelton Line. Install new communication equipment.	APS	0.1296	12/1/2017
n5088	Milesburg-Moshannon 230 kV line, Loop to Interconnection Substation for PJM AA1-085.	APS	0.642	2/2/2018
n5089	Moshannon SS - Install anti-islanding facilities on the Milesburg 230kV line terminal including RFL-9780 FSK transmitter and hybrid.	APS	0.038	2/2/2018
n5090	Milesburg SS - Install anti-islanding facilities on the Shingletown 230 kV line terminal including tuner, transmitter and hybrid. On the new AA1-085 terminal (Moshannon 230 kV) Install trap, turner, transmitter and hybrid.	APS	0.135	2/2/2018
n5091	Shingletown SS - Install anti-islanding facilities on the Milesburg 230kV line terminal including tuner, transmitter and hybrid.	APS	0.04	2/2/2018
n5092	Adjust Remote Relay and Metering Settings at 4 Additional Substations connecting the tapped substation between Milesburg and Moshannon 230kV substation	APS	0.049	2/2/2018
n5098.1	Replace Breaker WK-1 at Wylie Ridge 345 kV from 50 kA to 63 kA	APS	0.798	6/1/2020
n5098.2	Replace Breaker WK-2 at Wylie Ridge 345 kV from 50 kA to 63 kA	APS	0.798	6/1/2020
n5098.3	Replace Breaker WK-3 at Wylie Ridge 345 kV from 50 kA to 63 kA	APS	0.798	6/1/2020
n5098.4	Replace Breaker WK-4 at Wylie Ridge 345 kV from 50 kA to 63 kA	APS	0.798	6/1/2020
n5098.5	Replace Breaker WK-5 at Wylie Ridge 345 kV	APS	0.798	6/1/2020

	from 50 kA to 63 kA			
n5098.6	Replace Breaker WK-6 at Wylie Ridge 345 kV from 50 kA to 63 kA	APS	0.798	6/1/2020