



Transmission Expansion Advisory Committee (TEAC)

Recommendations to the PJM Board

PJM Staff Whitepaper
October 2017



EXECUTIVE SUMMARY

On July 25, 2017 the PJM Board of Managers approved changes to the Regional Transmission Expansion Plan (RTEP), totaling \$416.80 million, primarily to resolve baseline reliability criteria violations.

Since that time PJM has identified additional baseline reliability criteria violations within the planning horizon as part of the 2017 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 \$1,000.86 million. PJM has also identified several market efficiency upgrades to address capacity market congestion. The increase in the RTEP to include these market efficiency upgrades is \$6.46 million. In addition, a number of previously approved baseline projects have been cancelled or the cost and scope has changed resulting in a net increase of \$12.09 million. The net impact due to baseline reliability changes is an increase of \$1,019.41 million.

With these changes, the RTEP includes over \$32,278.74 million of transmission additions and upgrades since the first plan was approved by the Board in 2000.

The additional baseline projects are summarized in the following paper and were presented for the Board Reliability Committee's consideration and for recommendation to the full Board for approval. At the October 2017 meeting, the PJM Board approved the updated RTEP as requested.

2016/17 RTEP Long Term Proposal Window

PJM opened the second Long Term Market Efficiency proposal window from November 1, 2016 through February 28, 2017 to solicit proposals addressing future simulated congestion.

Market Efficiency Analysis is a part of the overall Regional Transmission Expansion Plan (RTEP) process that accomplishes the following objectives:

1. Determine which reliability upgrades, if any, have an economic benefit if accelerated or modified.
2. Identify new transmission upgrades that may result in economic benefits.
3. Identify economic benefits associated with “hybrid” transmission upgrades. Hybrid transmission upgrades include proposed solutions which encompass modification to reliability-based enhancements already included in RTEP that when modified would relieve one or more economic constraints. Such hybrid upgrades resolve reliability issues but are intentionally designed in a more robust manner to provide economic benefits in addition to resolving those reliability issues.

Market Efficiency analysis is conducted using market simulation tools which model the commitment and dispatch of generation over a future annual period for both the capacity market and energy market. Economic benefits of transmission upgrades are determined by comparing results of simulations which include the study upgrade to results of simulations which do not include the study upgrade. Projects are measured using two Tariff/Operating Agreement criteria. First, the project must address either an identified congestion driver or a capacity market constraint. Second, the project total energy and capacity benefits must exceed the costs by at least 25 percent. Project energy benefits are measured by comparing the benefits in the form of net load payments and/or production costs with and without the proposed project for a 15-year study period. Projects affecting the capacity market derive additional capacity benefits in the form of net load capacity payments and/or capacity costs.

PJM staff provided participants with a list of target congested facilities, along with their simulated congestion values, in order to solicit proposals during the Long Term Proposal Window. The list of these facilities along with the simulated congestion for study years 2021 and 2024 is shown in Table 1. In the Market Efficiency Proposal Window, PJM received project proposals to address future simulated congestion and capacity market constraints. PJM staff is recommending a number of these projects as further described below.

Table 1. Facilities Recommended for Project Proposals and Simulated Congestion

Constraint	Area	Type	2021	2021 Market	2024	2024 Market
			Congestion Frequency (hours)	Congestion (\$ mil)	Congestion Frequency (hours)	Congestion (\$ mil)
Graceton to Conastone 230kV	BGE	Line	972	\$58.3	1,044	\$72.1
Bagley to Graceton 230kV	BGE	Line	1,265	\$33.0	1,518	\$49.6
Susquehanna to Harwood 230kV	PPL	Line	166	\$4.0	201	\$5.6
Bosserman to Olive 138kV	AEP	Line	17	\$0.4	71	\$2.0

There were 96 proposals submitted during the Long Term window that closed in February of 2017. Proposals submitted ranged in costs from \$0 to \$371.3 million and included Transmission Owner upgrades

and Greenfield projects from incumbent transmission owners and non-incumbent entities. The breakdown of project proposals by area is shown in Table 2.

Table 2. Proposals by Area

Area of Proposal	Number of Proposals	Greenfield Proposals	TO Upgrade Proposals
AEP	11	5	6
APS	4	3	1
ATSI	1	0	1
BGE	47	33	14
ComEd	5	3	2
Dayton	3	3	0
DEOK	1	1	0
Dominion	20	3	17
EKPC	1	1	0
ME	2	2	0
PECO	12	6	6
PEPCO	3	2	1
PPL	7	4	3
AMIL (External)	1	1	0
LGEE (External)	1	1	0
NISP (External)	3	2	1
OVEC (External)	1	1	0
GRAND TOTAL	96	52	44

Five proposals were submitted to address COMED LDA capacity market constraints. The five proposals were received from three entities and their cost ranged from \$0 million to \$5.62 million. Two proposals were zero cost accelerations of previously approved baseline reliability upgrades. Following the 2020/21 RPM Base Residual Auction (BRA) in May of 2017, imports into the COMED LDA were limited by the Eugene - Dequine 345kV line.

PJM staff conducted an extensive analysis on the proposals to determine which projects satisfy the Market Efficiency criteria of having a Benefit/Cost ratio >1.25, and are economically justified.

The capacity benefits associated with the proposed projects were determined using the methodologies specified in Schedule 6 of the PJM Operating Agreement. PJM's annual capacity benefits calculation for lower voltage facilities is weighted 100 percent to zones with a decrease in net load capacity payments as a result of the proposed project. Change in net load capacity payments comprises the change in gross capacity payments offset by the change in capacity transfer rights.

PJM determined the impact of each of the five proposed projects on the COMED LDA Capacity Emergency Transfer Limit (CETL). By increasing the capability of the LDA's limiting element the COMED zone and other LDAs may be able to satisfy capacity requirements at a lower overall cost. PJM simulated the RPM process for multiple study years with the updated CETL values and measured each projects capacity benefits over a 15 year period.

The total Market Efficiency benefit of a project is the summation of the energy market benefits and the capacity market benefits. The energy market benefits were derived from production cost simulations and the capacity benefits were derived from capacity market simulations.

The projects shown in Table 3 provide the highest total benefits, satisfy the B/C ratio of 1.25 and are being recommended to the Board for approval for inclusion into the RTEP. These projects are all upgrades to existing equipment and will be designated to the incumbent transmission owners.

Table 3. Recommended Market Efficiency RPM Projects

PJM Baseline ID	PJM Window Project ID	Project Description	Transmission Zone	Constraint Project Addresses	Project Cost (\$M)	In Service Date	B/C Ratio
b2776	201617_1-11C	Accelerate previously approved upgrade	AEP	Dequin-Meadow 345kV, RPM Benefits	\$0.00	2019	
b2777	201617_1-11B	Accelerate previously approved upgrade	AEP	Eugene-Dequin 345kV, RPM Benefits	\$0.00	2019	
b2930	201617_1-3A	Upgrade capacity on E. Frankfort - University Park 345 kV line.	ComEd	East Frankfort-University Park 345kV, RPM Benefits	\$0.84	2021	147.69
b2931	201617_1-3B	Upgrade substation equipment at Pontiac Midpoint station to increase capacity on Pontiac-Brokaw 345 kV line.	ComEd	Pontiac-Brokaw 345kV, RPM Benefits	\$5.62	2021	13.45

The recommended projects will provide estimated average annual savings of \$18 million in load energy and capacity payments. Additionally, the acceleration of the two baseline projects will provide increased confidence to PJM load customers that their anticipated energy and capacity benefits would be realized by 2021.

The maps in Figure 1 through Figure 4 show the location of the recommended projects.

Figure 1. Recommended acceleration of Dequine - Meadow Lake 345 kV

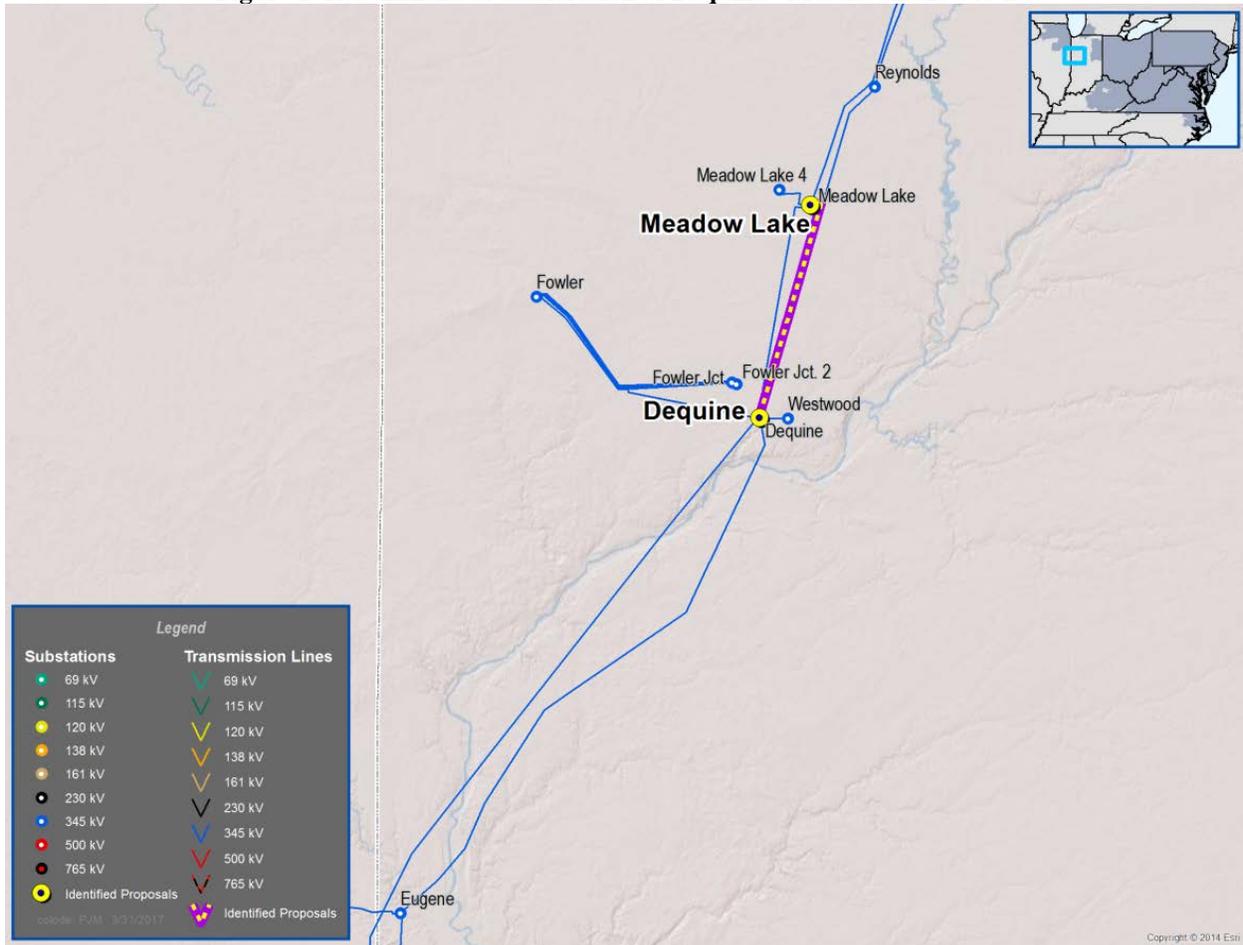


Figure 2. Recommended acceleration of Dequine - Eugene 345 kV

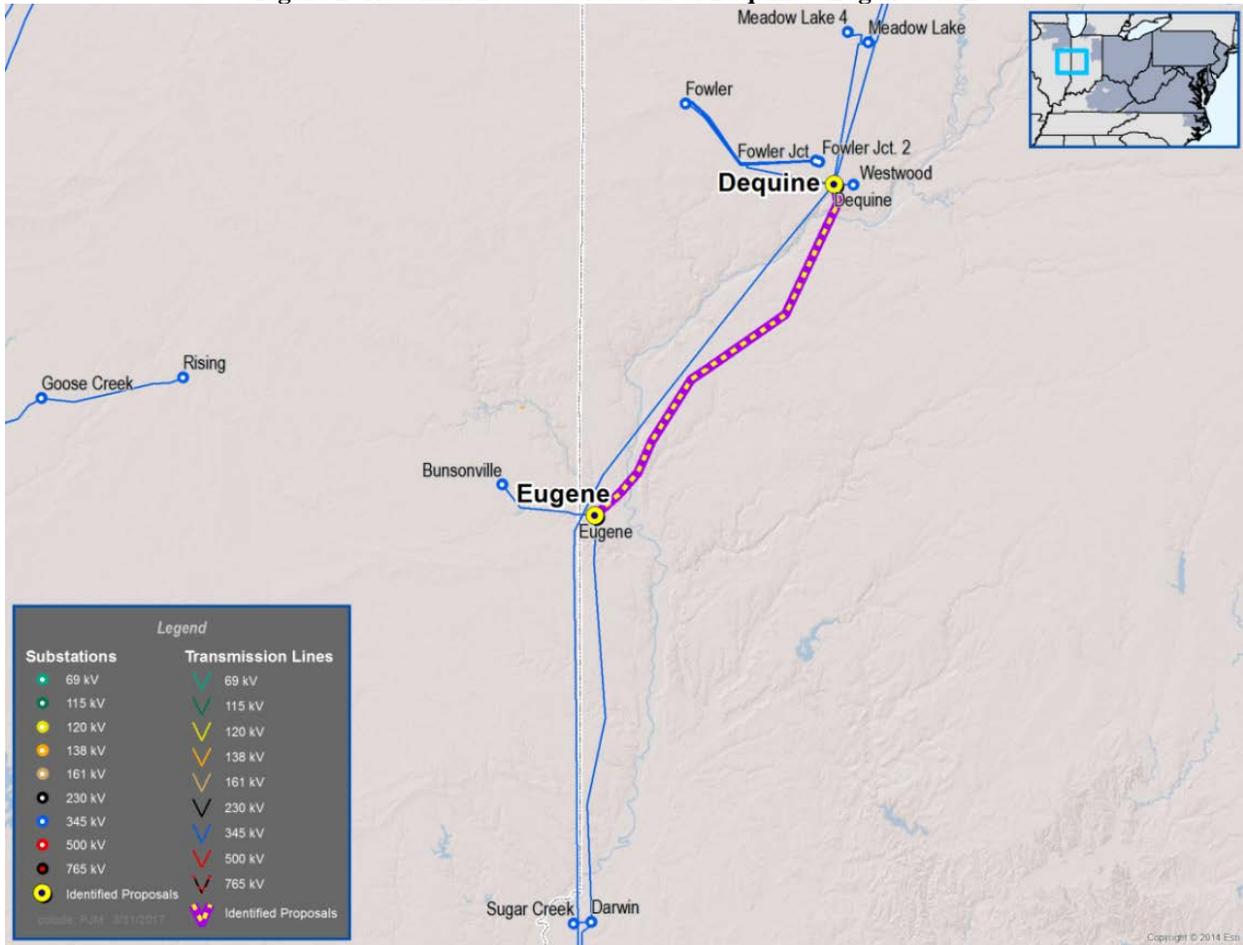


Figure 3. Location of Proposal 201717_1-3A (PJM Baseline B2930)

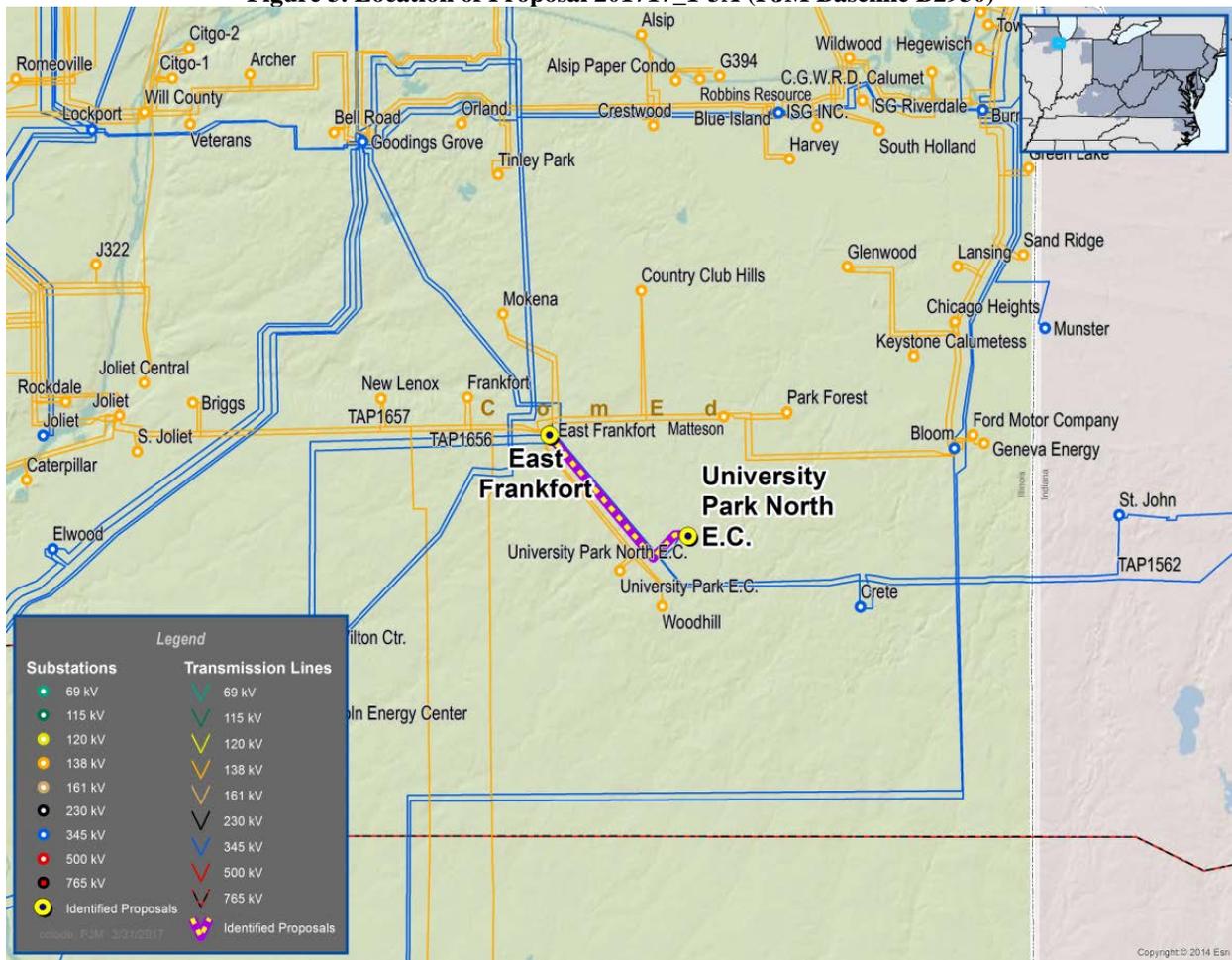
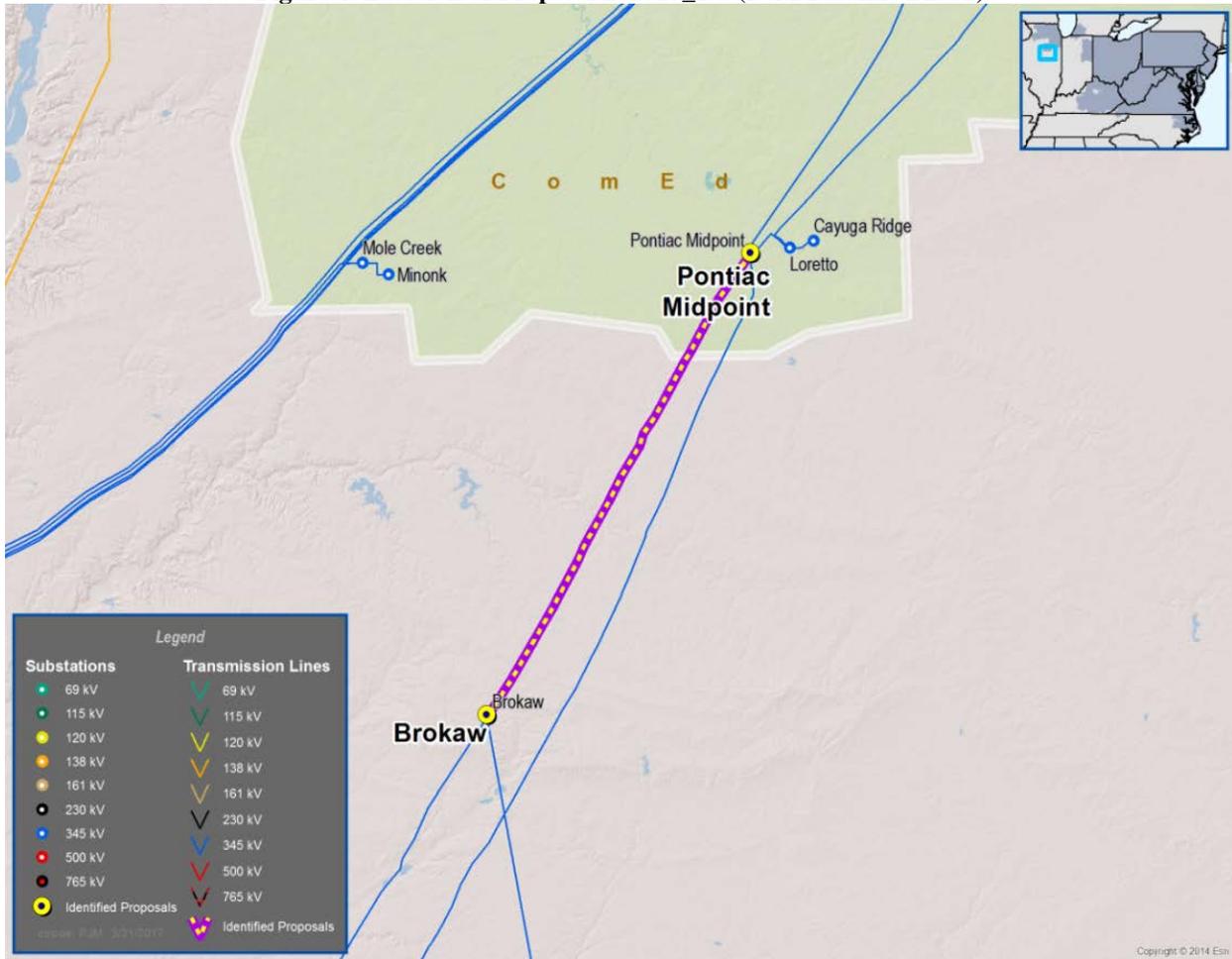


Figure 4. Location of Proposal 201717_1-3 (PJM Baseline B2931)



2017 Baseline Reliability 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 stakeholders through the Transmission Expansion Advisory Committee (TEAC) and Subregional RTEP Committees. The cost of transmission upgrades to mitigate such baseline reliability criteria violations are the responsibility of the PJM load customers.

Reliability Project Summary

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 to this white paper. The projects with estimated costs less than \$5 million include transmission line upgrade / reconductor projects and, modifications to existing substations such as modifications to existing capacitor banks or new capacitor banks, modification to existing protection systems, new transmission switches, circuit breaker replacements or installations, and new transformers.

Mid-Atlantic Region System Upgrades

- Penelec Transmission Zone
 - Install two 345kV, 80 MVAR shunt reactors at Mainsburg station - \$11.5M
- PSE&G Transmission Zone
 - Build a new 230/69kV station at Springfield Rd., a new 230/69kV station at Stanley Terrace and a new 69kV network between Front Street, Springfield and Stanley Terrace stations. - \$197.0M
 - Build a new 230/69kV station at Hilltop, build a new 69kV line between Hilltop and Woodbury, convert Runnymede 69kV to a ring bus and construct a new 69kV line between Hilltop and Runnymede - \$98.0M
 - Build a new 69kV line between Hasbrouck Heights and Carlstadt - \$21.0M

Western Regional System Upgrades

- AEP Transmission Zone
 - Rebuild the Valley-Almena, Almema-Hartford, and Riverside-South Haven 69kV lines and install new 138/69kV transformers at Almema and Hartford - \$53.0M
 - Rebuild the East Cambridge-Smyrna 34.5kV line - \$36.3M
 - Expand the Cliffview station and retire existing Byllsby-Wythe and Galax-Wythe 69kV lines - \$30.0M
 - Install a new 138/12kV transformer at Leon station and new 138/69kV transformer at Ripley station - \$27.1M
 - Retire and remove the existing Poston station and build a new Lemaster 138kV station - \$27.0M
 - Rebuild the Ohio Central-Conesville 69kV line, replace 138/69kV transformer at Ohio Central - \$20.6M
 - Rebuild the East Tiffin-Howard 69kV line, rebuild the Tiffin-Howard 69kV line and install a new 138/69kV transformer at Chatfield station - \$20.4M
 - Rebuild the Brues-Glendale Heights 69kV line - \$16.7M
 - Rebuild Mottville-Pigeon 69kV line - \$13.5M
 - Install new 500/138kV transformer at Nagel station - \$13.0M
 - Install new City of Jackson customer delivery point including a new 138/69kV station - \$13.0M

- Construct a new 138/69/34kV station between Wildcreek and North Waldo - \$12.7M
- Rebuild the Cannonsburg-South Neal 69kV line - \$12.5M
- Rebuild the Craneco-Pardee-Three Forks-Skin Fork 46kV line - \$12.2M
- Replace the transformer at Elliott station, reconductor the Elliott-Ohio University 69kV line and rebuild the Clark Street-Strouds Run-Crooksville 138kV line - \$5.8M

- ATSI Transmission Zone
 - Install 345kV shunt reactors at Hayes and Bayshore - \$10.7 M

- ComEd Transmission Zone
 - Build new 138kV gas insulated substation at Elk Grove - \$90.0M

- EKPC Transmission Zone
 - Add new 161kV interconnection with TVA, new 161/69kV transformer at Fox Hollow and new Fox Hollow-Fox Hollow Jct 161kV line - \$18.1M

Southern Region System Upgrades

- Dominion Transmission Zone
 - Rebuild the Chickahominy-Surry 500kV line - \$41.0M
 - Rebuild the Mackeys-Creswell 115kV line - \$40.0M
 - Rebuild the 230kV lines #211 and #228 between Chesterfield and Hopewell - \$28.1M
 - Rebuild the 115kV lines #76 and #79 between Yorktown and Peninsula - \$22.0M
 - Rebuild the 230kV line #231 between Landstown and Thrasher - \$22.0M
 - Build a new 230/115kV station connecting Earleys and Everetts - \$11.5M
 - Rebuild the Fudge Hollow-Lowmoor 138kV line - \$8.0M
 - Rebuild the Dozier-Thompsons Corner 115kV line - \$6.5M
 - Rebuild the Winfall-Swamp 230kV line - \$6.0M

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 b2791 – Rebuild the East Tiffin-Howard 69kV line, rebuild the Tiffin-Howard 69kV line and install a new 138/69kV transformer at Chatfield station

Baseline Reliability Violations

Several 69 kV lines in the AEP transmission zone are overloaded for the loss of the Chatfield 138-69 kV XFMR or similar bus contingencies near Chatfield and for multiple N-1-1 contingency pairs in the 2021 RTEP case.

In addition, voltage drop and voltage magnitude violations at West Shelby, Hinesville and other surrounding 69KV buses occur for multiple contingencies.

Aging Infrastructure Considerations

In addition to the thermal and voltage violations noted above, there are also aging infrastructure issues in the area. The East Tiffin-Howard 69 kV path was originally constructed in 1918 with wood pole structures utilizing #1 Copper conductor. There are 285 open maintenance conditions on the 57-mile long line associated with structures, hardware, and shielding.

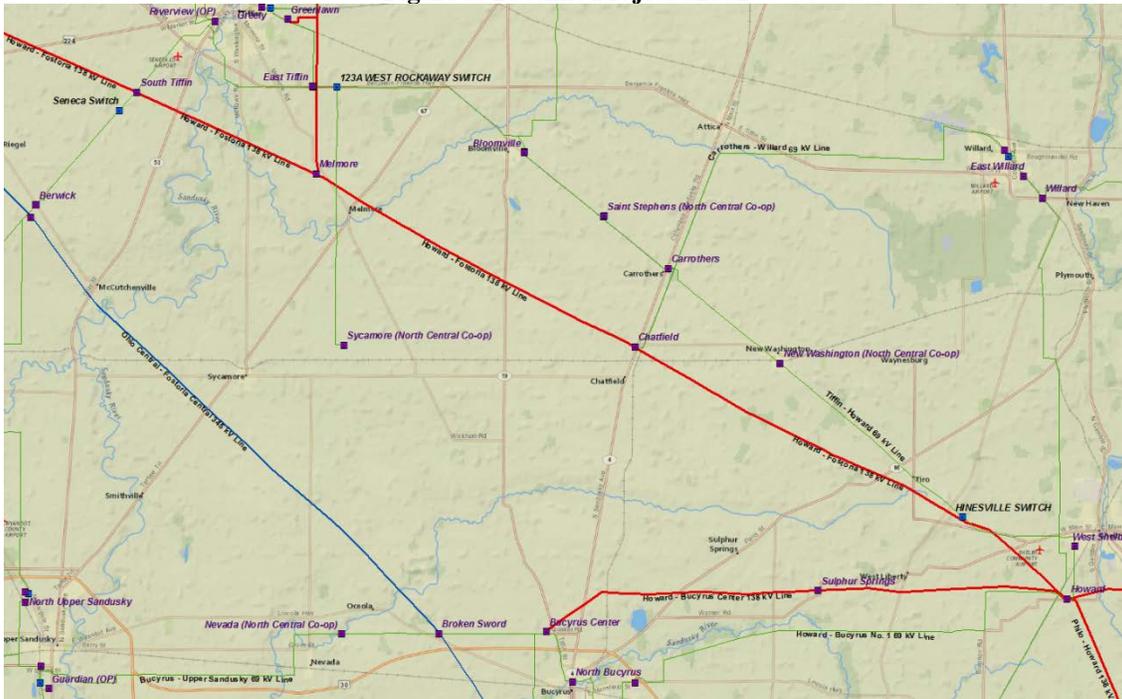
Recommended Solution

The recommended solution to address the reliability criteria violations as well as the aging infrastructure concerns are described below.

- Rebuild portions of the East Tiffin-Howard 69kV line from East Tiffin to West Rockaway Switch (0.8 miles) using 795 ACSR Drake conductor which will increase the rating to 129 MVA rating.
- Rebuild Tiffin-Howard 69kV line from St. Stephen's Switch to Hinesville (14.7 miles) using 795 ACSR Drake conductor increasing the rating to 90 MVA.
- Install a new 138/69kV transformer at Chatfield station
- Install a new 138kV & 69kV protection at existing Chatfield transformer

The estimated cost for this work is \$20.4 million and the required in service date is June 1, 2021. The local Transmission Owner, AEP, will be the Designated Entity to complete this work.

Figure 5. Baseline Project b2791



Baseline Project b2799 – Rebuild the Valley-Almena, Almena-Hartford, and Riverside-South Haven 69kV lines and install new transformers at Almena and Hartford

Baseline Reliability Violations

Low voltage violations at 19 different stations, along with thermal violations on several facilities were identified for multiple N-1-1 contingencies involving the 138/69 kV sources and lines in the Valley, Almena, Hartford, Riverside, and South Haven area of the AEP system.

Aging Infrastructure Considerations

In addition to the thermal and voltage violations noted above, there are also aging infrastructure issues in the area. Several of the lines were built between 1960 and 1971 with wood poles. These lines have many open maintenance conditions associated with structures, hardware and shielding. The circuit breakers at the substations have operated for fault conditions in excess of the manufacturer's recommendation. Finally, two of the transformers are showing signs of deterioration including breakdown of the dielectric and damage to the bushings.

Recommended Solution:

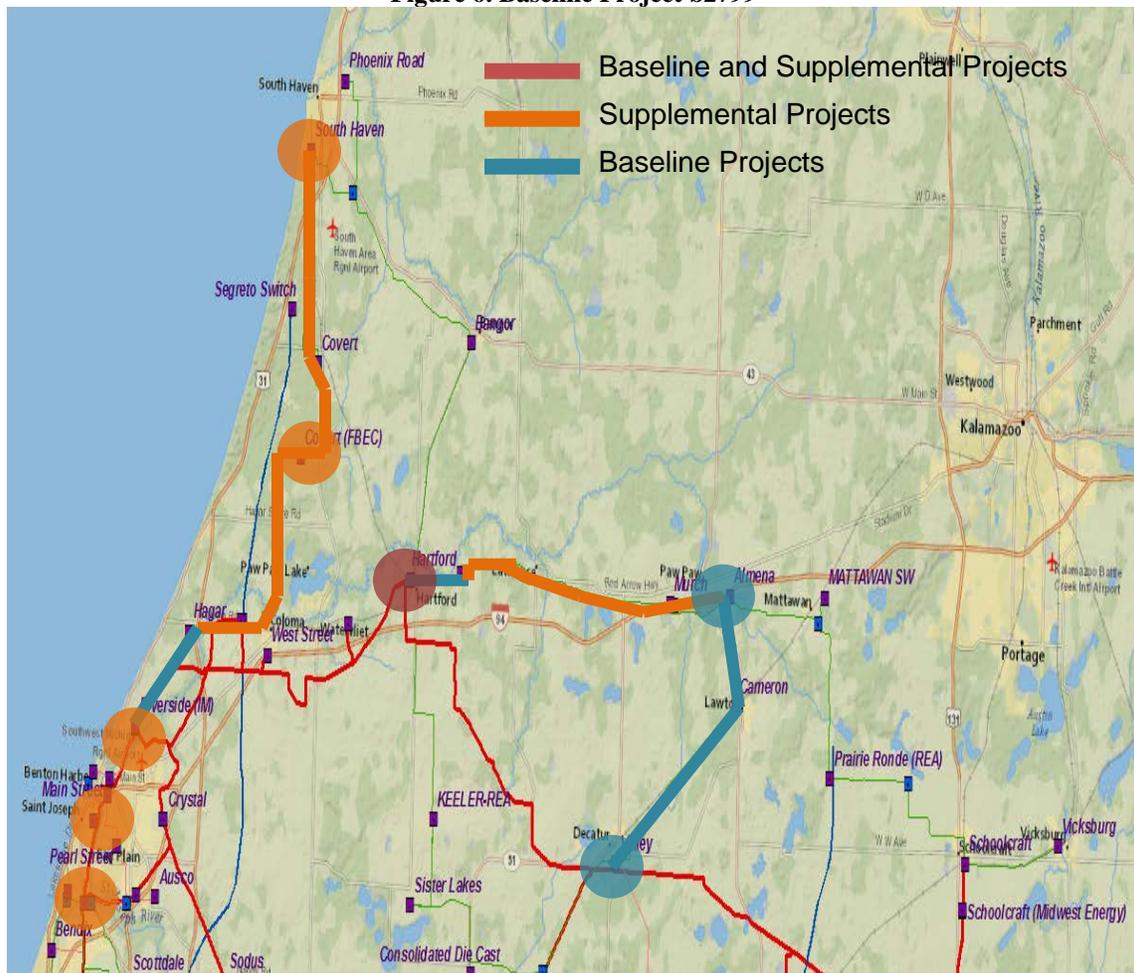
The following recommended solution addresses the reliability criteria violations noted above as well as the aging infrastructure concerns.

- Rebuild 12 miles of Valley – Almena 69kV line as a double circuit 138kV/69kV line using 795 ACSR conductor increasing the rating to 360 MVA and introduce a new 138 kV source into the 69 kV load pocket around Almena station.

- Rebuild 3.2 miles of Alma to Hartford 69kV line using 795 ACSR conductor increasing the rating to 90 MVA.
- Rebuild 3.8 miles of Riverside – South Haven 69V line using 795 ACSR conductor increasing the rating to 90 MVA.
- At Valley station, add new 138kV line exit with a 3000 A 40 kA breaker for the new 138 kV line to Alma and replace CB D with a 3000 A, 40 kA breaker.
- At Alma station, install a 90MVA 138kV/69kV transformer with low side 3000 A, 40 kA breaker and establish a new 138kV line exit towards Valley.
- At Hartford station, install a second 90MVA 138/69kV transformer with a circuit switcher and 3000 A 40 kA low side breaker.

The estimated cost is \$53.0 million and the required in service date is June 1, 2021. The local Transmission Owner, AEP, will be the Designated Entity to complete this work.

Figure 6. Baseline Project b2799



Baseline Project b2888 – Retire Poston station and build new 138kV station

Baseline Reliability Violations

PJM identified an overload on the Elliot – Rosewood 138kV line for multiple common mode contingencies associated with the Poston 138kV substation. AEP and PJM also identified overloads on the Elliot – Ohio U 69kV line and Elliot transformer for multiple common mode contingencies associated with the Poston 138kV substation. In addition PJM identified low voltage and voltage drop violations at Elliot 138kV bus for multiple common mode contingencies associated with the Poston 138kV substation

Aging Infrastructure Considerations

AEP has also identified aging infrastructure concerns with some of the equipment in this area. The equipment at Poston is mostly over 60 years in age and is deteriorated. The bus consists of cap and pin insulators which have mechanically weakened over time and are at risk of failing. All of the circuit breakers except one breaker (138kV & 69kV) at Poston are oil breakers (1200 A 20 kA FK-439's and 600 A 13 kA GO-4Bs types) that were originally installed in the 1940's and 50's and are at or approaching their end of life. The Poston 138/69 kV 47 MVA transformer 2 also needs to be replaced. The drivers for replacement are age, dielectric strength breakdown (winding insulation), short circuit strength breakdown (due to the amount of through fault events), and accessory damage (bushings)

Additionally, this station has been subject to flooding in the past, which has had an adverse impact on reliability in the area.

In addition to the aging infrastructure issues with equipment in the Poston station, the Poston – Trimble 69 kV line was originally built in 1924 utilizing 336 ACSR conductor (75 MVA rating) and currently has 30 open maintenance conditions along the 9.7 mile long line. In coordination with AEP Ohio and transmission operations and transmission field services, a plan to replace the existing 69 kV radial line with a new 138 kV tap to serve customers at Trimble station was developed.

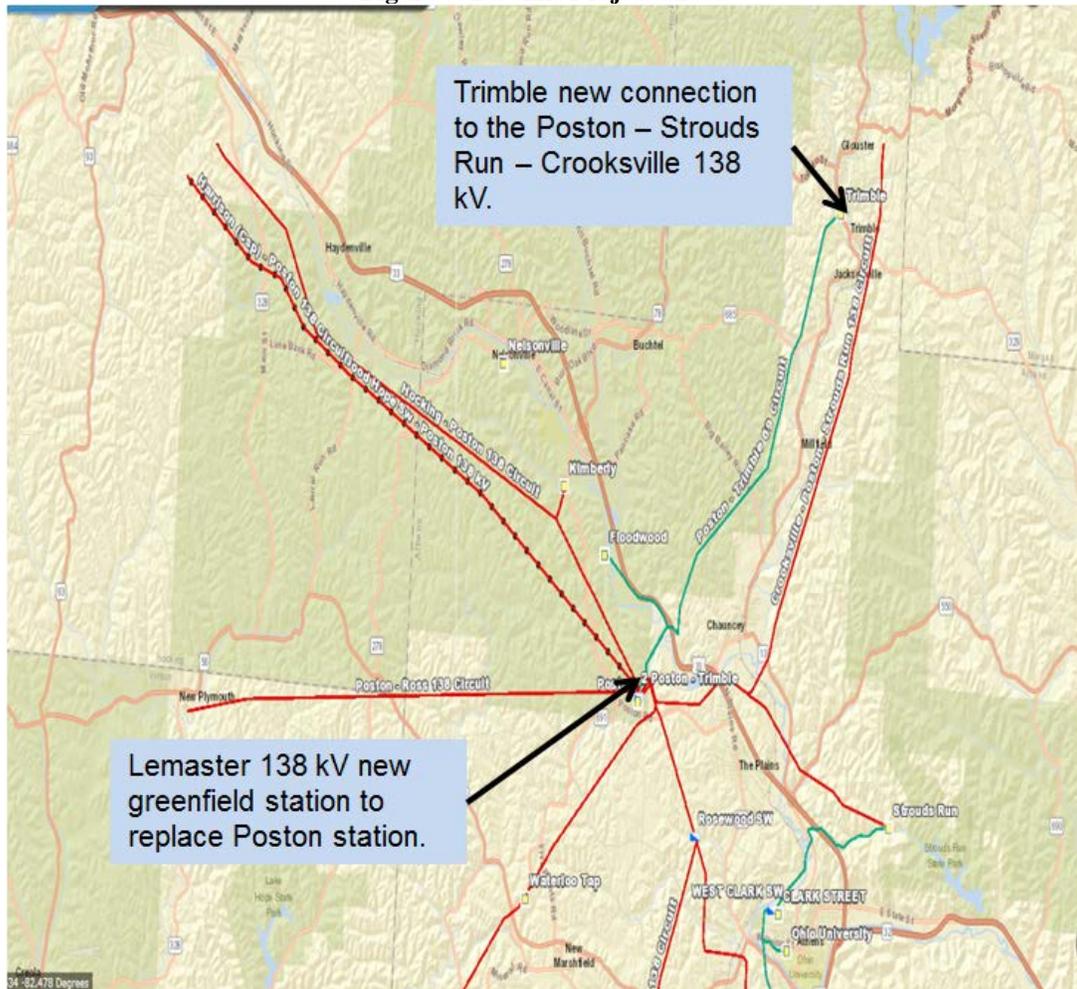
Recommended Solution

The recommended solution to address the reliability criteria violations as well as the aging infrastructure concerns are described below.

- Remove and retire the Poston 138kV station
- Install a new greenfield station, Lemaster 138kV Station, in the clear as a 138 kV switching station utilizing 3000 A 40 kA breakers.
- Relocate the Trimble 69 kV AEP Ohio radial delivery point to 138 kV, to be served off of the Poston – Strouds Run – Crooksville 138 kV circuit via a new three-way switch. Retire the Poston-Trimble 69kV line.

The estimated cost for all of this work is \$27.0 million and the required in service date is June 1, 2018. The local Transmission Owner, AEP, will be the Designated Entity to complete this work.

Figure 7. Baseline Project b2888



Baseline Project b2889 – Expand the Cliffview station and retire existing Byllesby-Wythe, Galax-Wythe 69kV lines

Baseline Reliability Violations

The Cliffview – Lee Highway 69 kV line in the AEP transmission zone is overloaded for the loss of the Jubal Early 138/69 kV transformer in the 2021 RTEP case.

There are also aging infrastructure concerns in the area. The 13 mile double circuit line section north of Byllesby (Wythe – Cliffview and Wythe – Byllesby) is approximately 93 years old and has small 1/0 CU conductor. Approximately 4 miles of this double circuit line is also in the national forest near Byllesby.

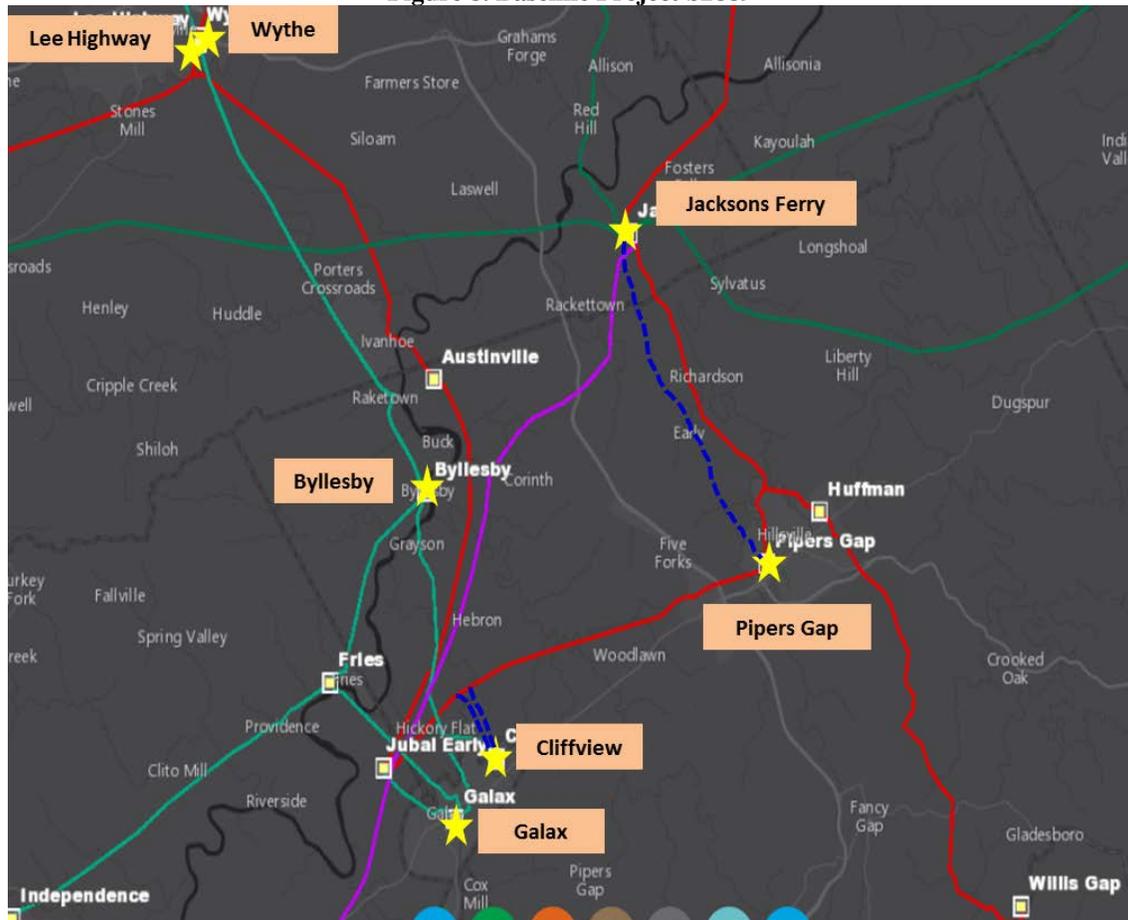
In addition to the thermal overload violation of the Jubal Early transformer, an additional consideration is the approximately 120 MW of load being served directly off the 138kV system in this area. Under N-1-1 conditions on the 138kV system, this entire load would be dropped. There is no opportunity to sectionalize the 138kV system as this would force the 69kV system to support the existing 90 MW of load plus the 120 MW of load on the 138kV, resulting in the overload of the entire local 69kV system.

Recommended Solution

- Cliffview Station: Establish 138kV bus. Install two 138/69kV XFRs (130 MVA), six 138kV CBs (40kA 3000A) and four 69kV CBs (40kA 3000A)
- Cliffview Line: Tap the existing Pipers Gap – Jubal Early 138kV line section. Construct double circuit in/out (~2 miles) to newly established 138kV bus, utilizing 795 26/7 ACSR conductor.
- Byllesby – Wythe 69kV: Retire all 13.77 miles (1/0 CU) of this circuit (approximately 4 miles currently in national forest).
- Galax – Wythe 69kV: Retire 13.53 miles (1/0 CU section) of line from Lee Highway down to Byllesby. This section is currently double circuited with Byllesby – Wythe 69kV. Terminate the southern 3/0 ACSR section into the newly opened position at Byllesby 69kV, creating a new Galax – Byllesby 69kV circuit.

The estimated cost to resolve the reliability criteria, aging infrastructure concerns and operational concerns is \$30.0 million and the required in service date is June 1, 2021. The local Transmission Owner, AEP, will be the Designated Entity to complete this work.

Figure 8. Baseline Project b2889



Baseline Project b2890 – Rebuild and Convert the East Cambridge-Smyrna 34.5kV line to 69kV

Baseline Reliability Violations

The Fairdale-Cambridge 69 kV line (266 ACSR, 64 MVA rating), the Summerfield-Derwent 69 kV line (336 ACSR, 75 MVA rating), and the Cambridge-West Cambridge 34.5kV line (4/0 Copper, 27 MVA rating) are overloaded for several combinations of N-1-1 contingencies in the Cambridge area of the AEP transmission zone.

Aging Infrastructure Considerations

In addition to the reliability violations described above, there are also aging infrastructure issues that need to be addressed.

The East Cambridge – Smyrna 34.5 kV circuit was built originally in 1954 and is comprised of mostly 1/0 and 4/0 Copper conductor (17 MVA rating). It presently has 135 open high priority maintenance conditions on the 23.5 mile long line associated with conductor and structure concerns and has resulted in over 3.1M customer minutes of interruption between 2013 and 2016

Recommended Solution

- Rebuild 23.55 miles of the East Cambridge – Smyrna 34.5 kV circuit with 795 ACSR conductor increasing the rating to 128 MVA and convert to 69 kV.
- East Cambridge: Install a 2000 A 69 kV, 40 kA circuit breaker for the East Cambridge – Smyrna 69 kV circuit.
- Old Washington: Install 69 kV 2000 A disconnect switch.
- Antrim Switch: Install 69 kV 2000 A disconnect switch.

The estimated cost is \$36.3 million and the required in service date is June 1, 2021. The local Transmission Owner, AEP, will be the Designated Entity to complete this work.

Figure 9. Baseline Project b2890



Baseline Project b2892 – Install new 138/12kV transformer at Leon station and new 138/69kV transformer at Ripley station

Baseline Reliability Violations

The Leon-Ripley 69kV line and 138/69kV transformers #3 at Leon are overload for the N-1-1 loss of the Gavin – Meigs 69kV line in conjunction with the Lakin – Racine 69 kV line in the AEP transmission zone. In addition there are voltage violations at the Ripley bus for the loss of the Leon-Ripley 69 kV line.

Aging Infrastructure Considerations

In addition to the reliability criteria violations there are also aging infrastructure concerns in the area. The Leon-Ripley 69 kV line was constructed in 1957 utilizing 4/0 ACSR conductor on wood H-frame structures. Most of the structures on this line (77%) are still original from 1957. Major equipment at the Leon 69 kV station and nearby Ravenswood 69 kV station including circuit breakers and transformer are also at or approaching their end of life.

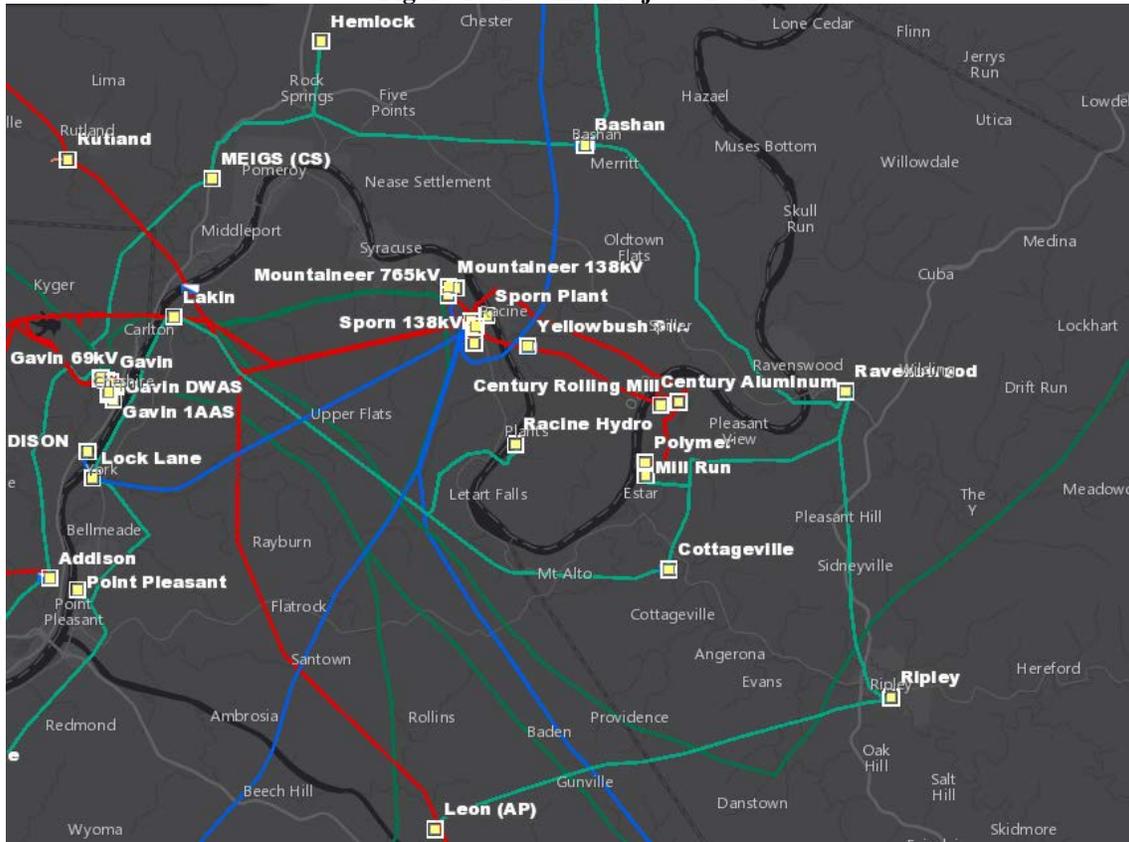
Recommended Solution

The recommended solution to address the reliability issues as well as the aging infrastructure issues follows:

- Install new 138/12kV transformer with high side circuit switcher at Leon and a new 138 kV line exit towards Ripley.
- Establish 138kV at Ripley station with a new 138/69 kV 130MVA transformer and move the distribution load to 138 kV service.
- Rebuild the existing 69kV Leon – Ripley branch with 1033 ACSR and operate at 138kV.
- Rebuild the Ripley 69 kV bus.

The estimated cost is \$27.1 million and the required in service date is June 1, 2021. The local Transmission Owner, AEP, will be the Designated Entity to complete this work.

Figure 10. Baseline Project b2892



AEP Reliability Criteria Violations

Baseline Project b2797 – Rebuild the Ohio Central-Conesville 69kV line, replace 138/69kV transformer at Ohio Central

Baseline Reliability Violations

The Ohio Central - Conesville 69kV line section and the Ohio Central 138/69 kV transformer (50 MVA rating) are overloaded for multiple N-1 and N-1-1 contingencies in the 2021 RTEP case.

Recommended Solution

- Rebuild the Ohio Central-Conesville 69kV line section (11.8 miles) with 795 ACSR conductor increasing the rating to 128 MVA.
- Replace the 50 MVA Ohio Central 138-69kV XFMR with a 90 MVA unit.

The estimated cost is \$20.6 million and the required in service date is June 1, 2021. The local Transmission Owner, AEP, will be the Designated Entity to complete this work.

Figure 11. Baseline Project b2797



Dominion End of Life Violations

Baseline Project b2801 – Rebuild the 115kV lines #76 and #79 between Yorktown and Peninsula

Baseline Reliability Violations

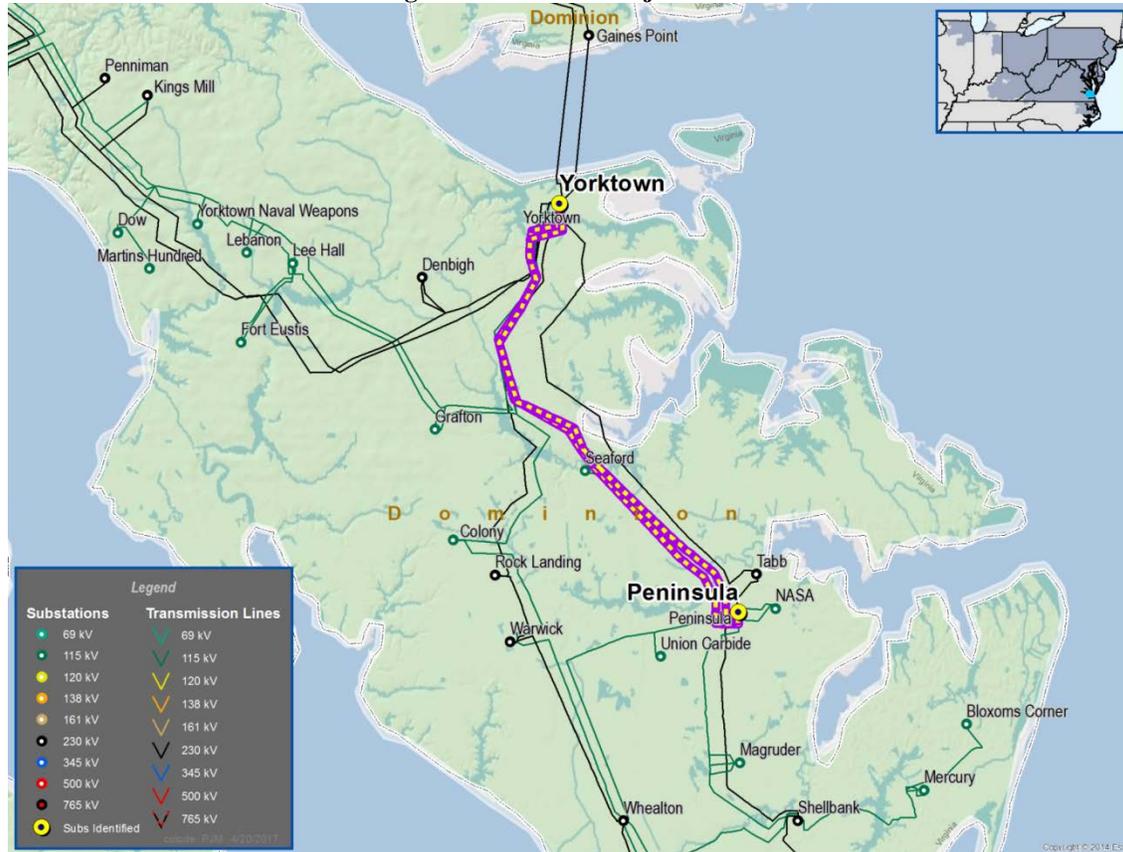
The 115kV Lines #76 and #79 from Yorktown to Peninsula are 11 miles long and were constructed on double circuit 3 pole wood H-frame structures in 1957. The structures and much of the associated hardware has reached their end of life. The existing summer emergency ratings of these lines are 193 MVA. These lines serve approximately 30 MW of load that cannot be picked up by adjacent lines.

Recommended Solution

Lines #76 and #79 will be rebuilt to current standard using 768.2 ACSS conductor with a summer emergency rating of 346 MVA at 115kV. Proposed structure for rebuild is double circuit steel monopole structure.

The estimated cost is \$22.0 million and the estimated in service date is December 30, 2020. The local Transmission Owner, Dominion, will be the Designated Entity to complete this work.

Figure 12. Baseline Project b2801



Baseline Project b2876 – Rebuild the Mackeys-Creswell 115kV line

Baseline Reliability Violations

The 115kV Line #101 from Mackeys to Creswell (14 miles) was constructed on wood H-frames in the 1970-1975 timeframe and are at or approaching their end of life. In addition, the conductor has broken stranding at many locations across the entire line. The existing summer emergency rating of this line is 152 MVA. Current conductor used is 545.6 ACAR (15/7). The loss of this line results in a load loss of 21 MW.

The MW-mile for line #101 is 518 MW-mile based on the Winter 2025/26 projection. Dominion's 700 MW-mile radial line criteria would be violated if 8 MW or more of new load were added in the future.

Additional Information

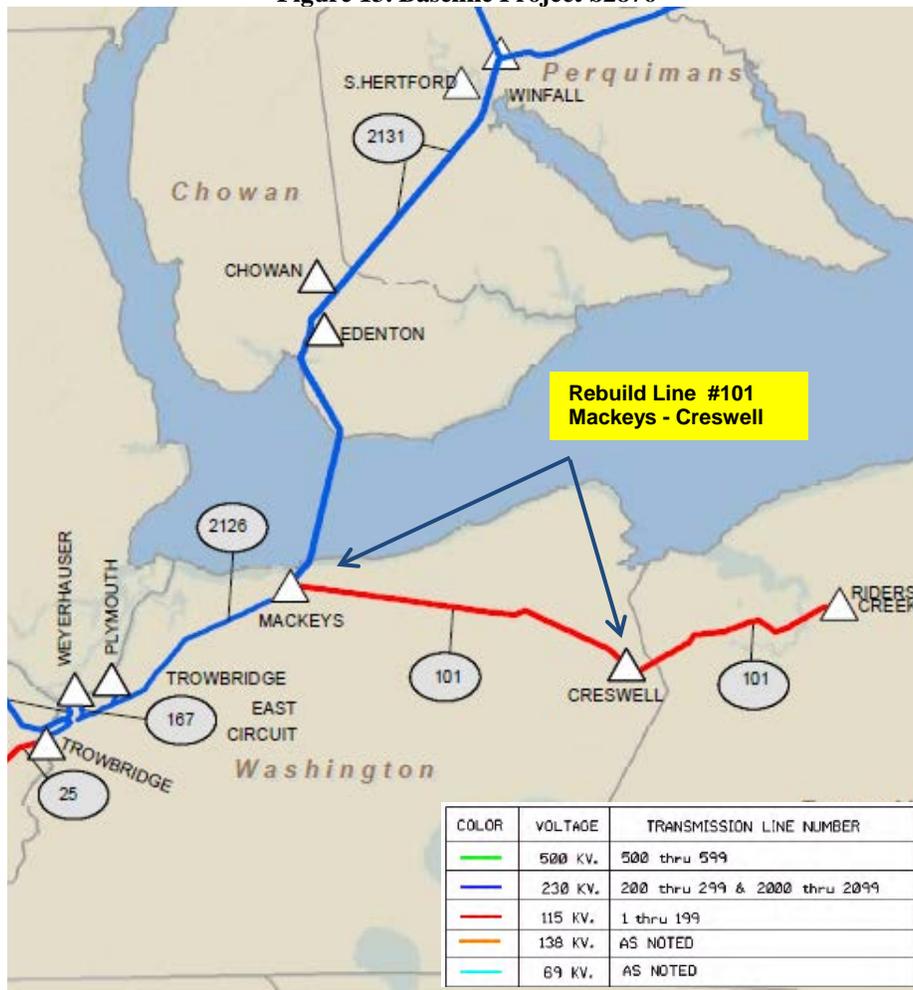
- Radial Line #101 is located in an isolated area with no distribution ties
- Obtaining right-of-way to network Line #101 to a different source is restricted by wetlands and significant natural heritage areas to the south as well as very long water crossings to the north and to the east.
- Any option to introduce a different source, assuming right-of-way could be obtained, would be much greater than the preferred option cost

Recommended Solution

Rebuild Line #101 from Mackeys to Creswell, 14 miles, with double circuit steel structures. Install one circuit with provisions for a second circuit. The line is being recommended to be rebuilt with double circuit structures to provide for a future second circuit which would allow networking of the line (Mackeys – Creswell) if the 700 MW-mile level was exceeded. The conductor used will be at current standards (636 ACSR) with a summer emergency rating of 262 MVA at 115kV. Additional right-of-way is required for the temporary line.

The estimated cost is \$40.0 million and the estimated in service date is December 30, 2022. The local Transmission Owner, Dominion, will be the Designated Entity to complete this work.

Figure 13. Baseline Project b2876



Baseline Project b2899 – Rebuild the 230kV line #231 between Landstown and Thrasher

Baseline Reliability Violations

230kV Line #231 from Landstown to Thrasher is 8.5 miles long and was built mostly on double circuit weathering steel (Corten) towers in 1965. The structures are similar to other Corten steel lattice structures on the Dominion system and have reached their end of life. The existing summer emergency rating of this line is 955 MVA. The loss of this line results in a load loss of 89 MW.

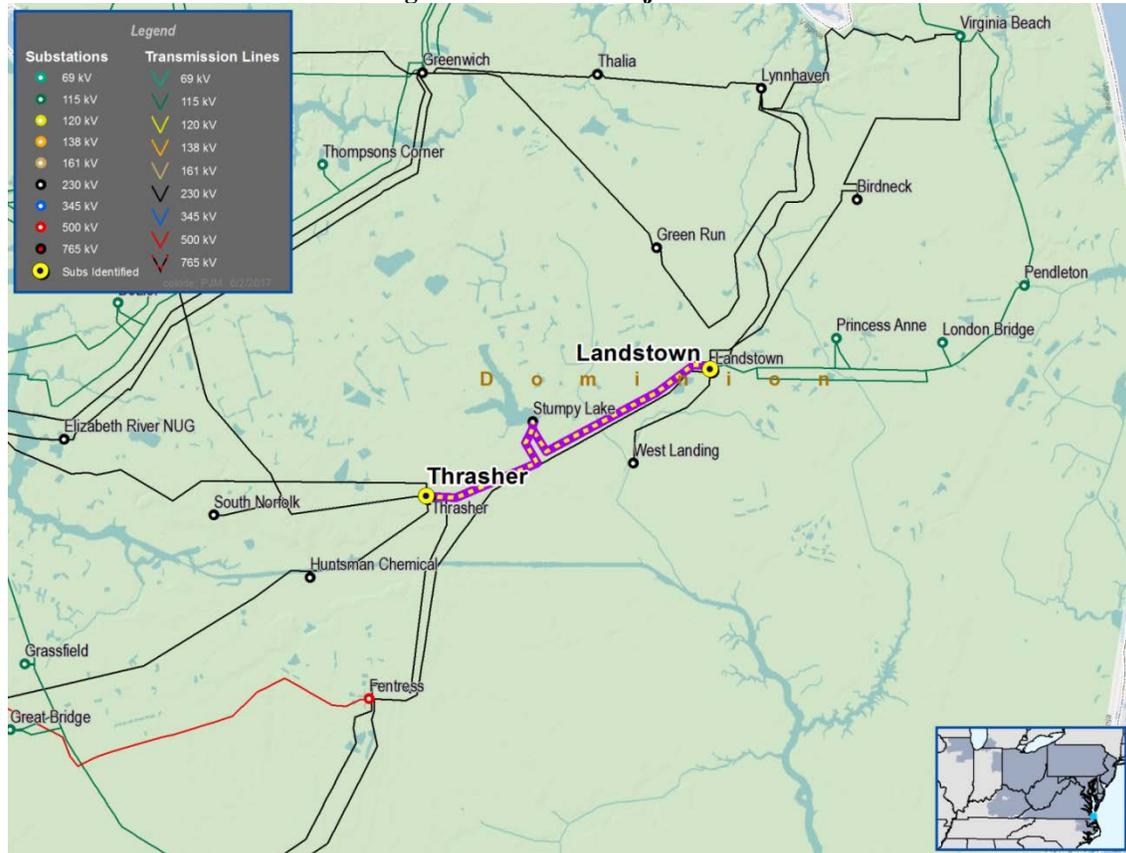
Recommended Solution

Line #231 will be rebuilt to current standard with a summer emergency rating of 1046 MVA at 230kV. Proposed conductor is 2-636 ACSR. Structures being considered include double circuit steel pole and double circuit galvanized steel tower.

Proposed conductor has a summer load dump rating of 1203 MVA. An N-1-1 study using the 2022 RTEP summer case indicates with the proposed conductor, 48% is the highest loading on the line. Therefore, there is no justification to consider a higher capacity conductor.

The estimated cost is \$22.0 million and the expected in service date is December 30, 2020. The local Transmission Owner, Dominion, will be the Designated Entity to complete this work.

Figure 14. Baseline Project b2899



Baseline Project b2922 – Rebuild the 230kV lines #211 and #228 between Chesterfield and Hopewell

Baseline Reliability Violations

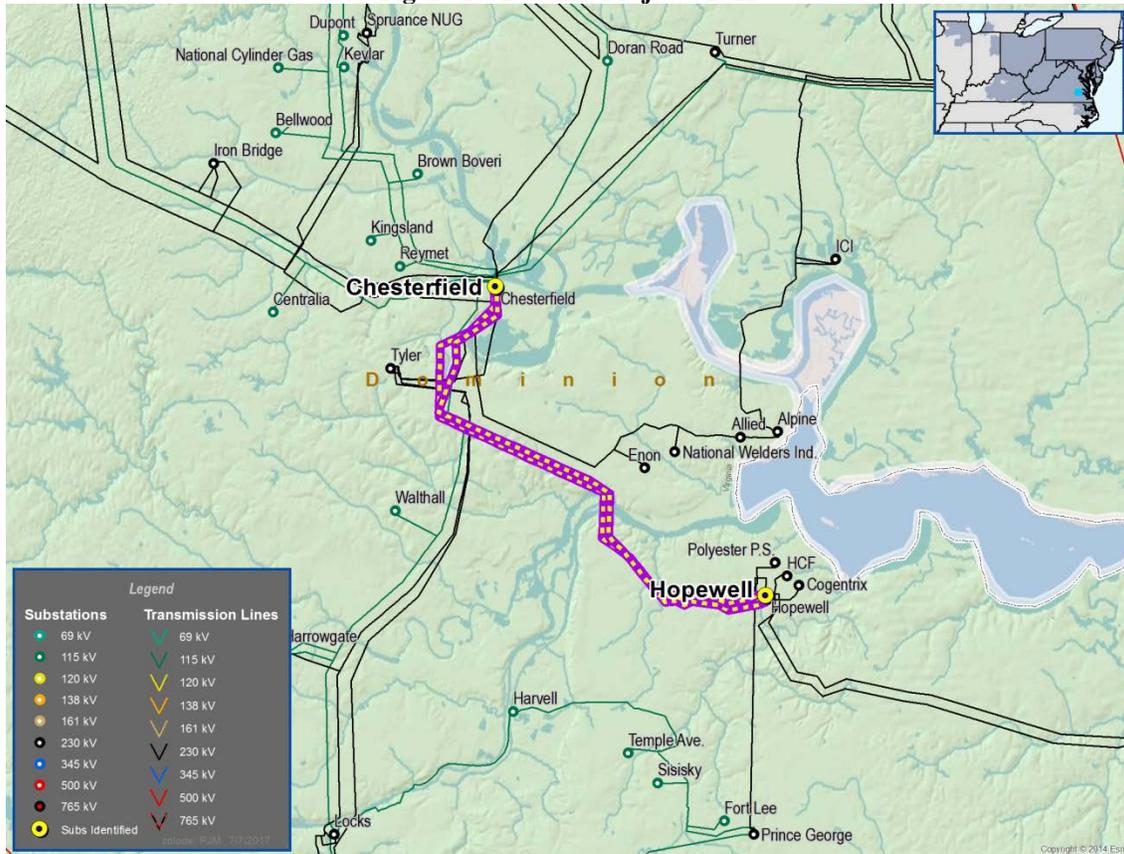
The 230kV Lines #211 and #228 from Chesterfield to Hopewell are double circuit lines. Approximately 8 of the 11 mile long lines were built on double circuit weathering steel (Corten) towers in 1969. Field reports and condition assessment indicate the Corten structures have reached their end of life. The static wire is also at end of life. These lines provide critical outlet for Chesterfield Power station along with HCF and Polyester

Recommended Solution

Rebuild 8 miles of Line #211 and #228 to current standard. Proposed conductor is 2-636 ACSR. Summer emergency rating of the rebuilt section is 1046 MVA. Summer emergency rating of the entire lines after rebuild is 477 MVA with the remaining 3 mile section being the most limiting conductor. Structures being considered for the rebuilt lines include double circuit steel pole and double circuit galvanized steel tower.

The estimated cost is \$28.1 million and the expected in service date is December 30, 2022. The local Transmission Owner, Dominion, will be the Designated Entity to complete this work.

Figure 15. Baseline Project b2922



Baseline Project b2928 – Rebuild the Chickahominy-Surry 500kV line River Crossing

Baseline Reliability Violations

The Surry to Chickahominy 500 kV line includes a river crossing of the James River. Dominion filed an application with the Virginia SCC in December of 2016 to replace four structures of 500kV Line #567 (Chickahominy – Surry PS) associated with the river crossing. Two of these structures are located in the James River and are approximately 400 feet tall and the other two structures are located on the river's edge. These structures have deteriorated to a point that they need to be replaced. A specialized conductor was used in the original construction of the river crossing which limits the line to 1954 MVA. This is the only location on Dominion's system where this conductor is used.

Loss of Line #567 results in multiple Generation Deliverability violations:

- 230kV Line #259 Chesterfield – Basin is overloaded for the loss of Line #563 Carson – Midlothian or the loss of 230kV Line #217 Chesterfield – Lakeside
- 230 kV Line #2154 Skiffes Creek – Kings Mill is overloaded for the loss of Line # 563 Carson – Midlothian
- 230kV Line #2154 Skiffes Creek – Kings Mill – Penniman – Waller is overloaded for stuck breaker 56372 at Carson
- 500kV – 230 kV Transformer at Carson is overloaded for stuck breaker 562T563 at Carson

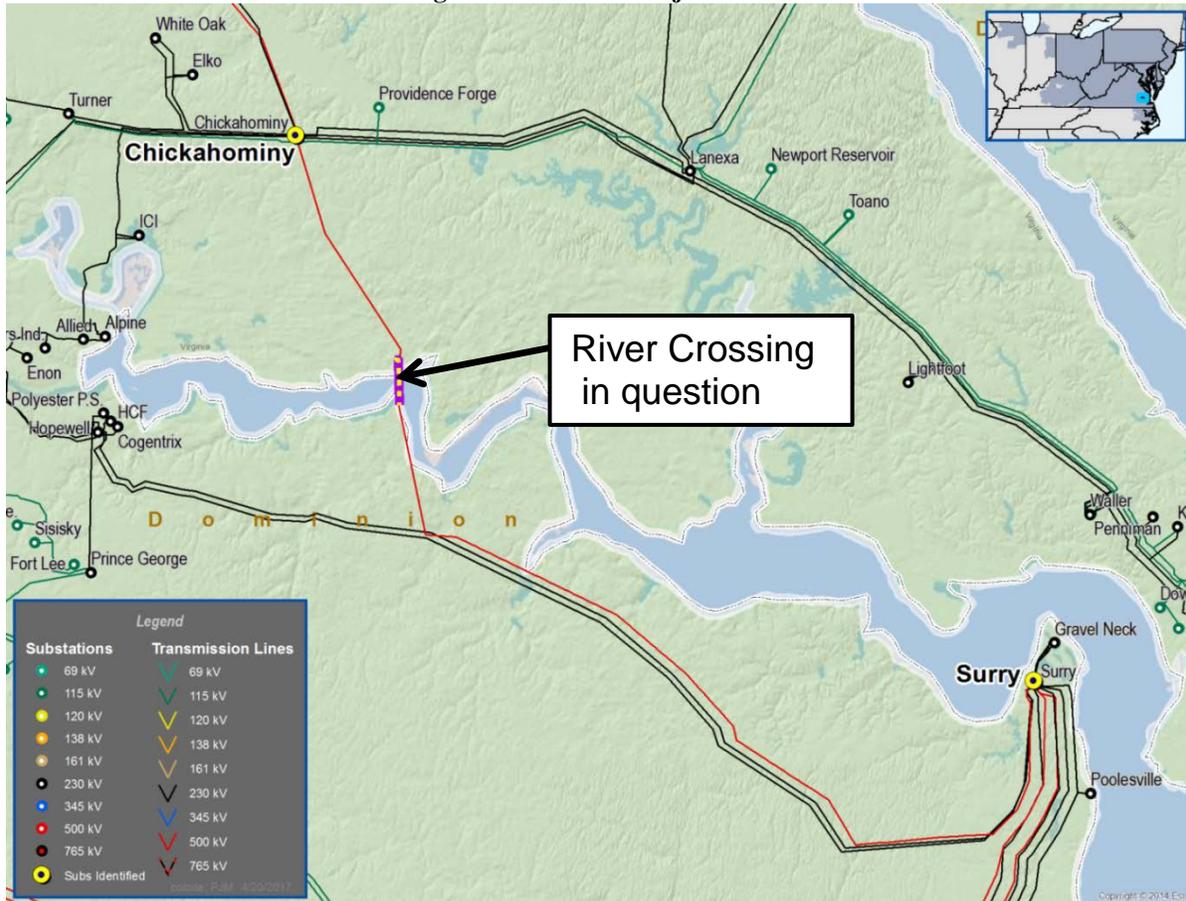
- 230kV Line #259 Chesterfield – Basin is overloaded for stuck breaker 205T217 at Chesterfield

Recommended Solution

Rebuild the four structures using galvanized steel and replace the river crossing conductor with 3-1534 ACSR. This will increase the 500kV Line #567 line rating from 1954 MVA to 2600 MVA

This is an immediate need project given the condition of the facilities. The estimated cost is \$41.0 million and the projected in service date is December 30, 2017. This project is an immediate need solution where the timing required to include the violation in an RTEP proposal window was infeasible. The local Transmission Owner, Dominion, will be the Designated Entity to complete this work.

Figure 16. Baseline Project b2928



PSE&G Transmission Owner Criteria for Acceptable Load Drop Levels and Durations

Baseline Project b2933 – New Springfield and Stanley Terrace stations

Baseline Reliability Violations

The Springfield Substation in the PSEG transmission zone is supplied by two 230kV underground lines. The station supplies more than 10,000 customers with load in excess of 80MVA. An N-1-1 event would result in a complete loss of electric supply to the station for more than 24 hours. Stanley Terrace is supplied by two 230kV underground lines. Stanley Terrace will supply more than 5,000 customers with an anticipated load in excess of 37MVA. An N-1-1 event would result in a complete loss of electric supply to the station.

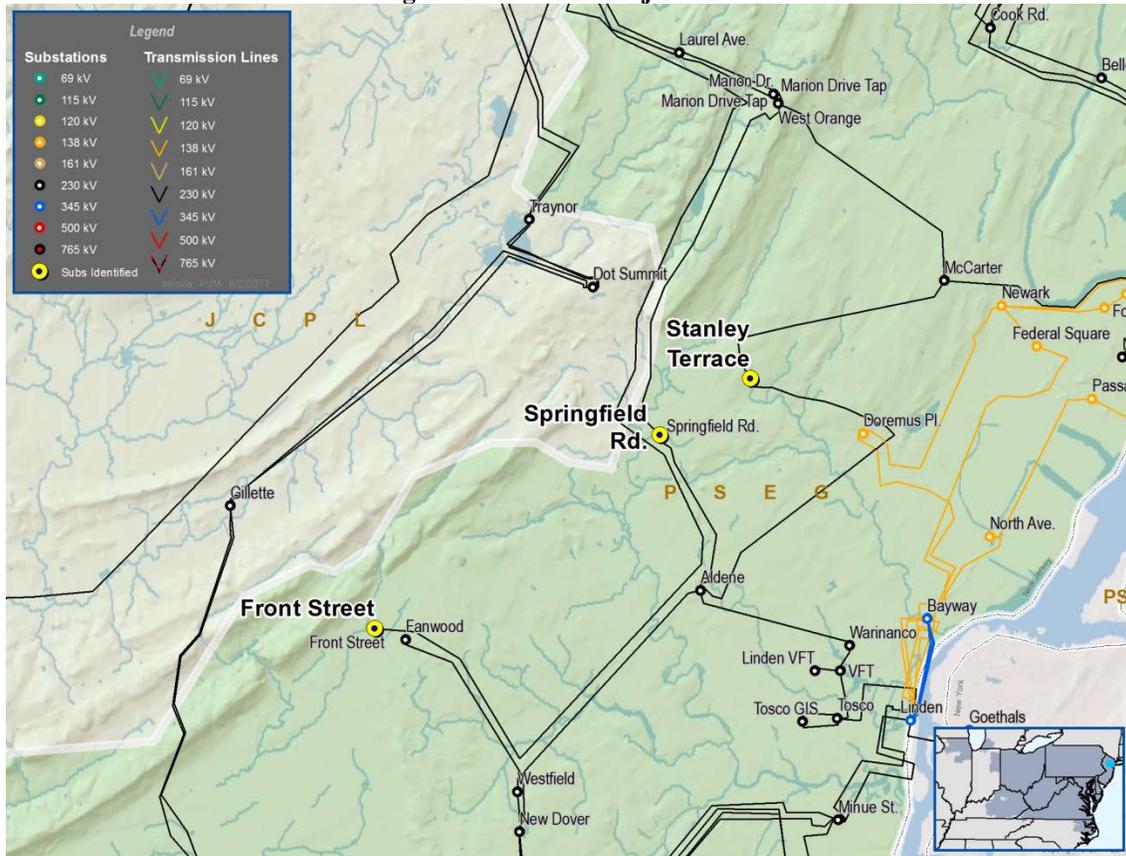
Both of these designs violate PSE&G's local FERC 715 planning criteria related to acceptable load drop levels and durations.

Recommended Solution

- Construct a 230/69 kV station at Springfield.
- Construct a 230/69 kV station at Stanley Terrace.
- Construct a 69 kV network between Front Street, Springfield and Stanley Terrace.

The estimated cost is \$197.0 million and the projected in service date is June 1, 2018. The local Transmission Owner, PSE&G, will be the Designated Entity to complete this work.

Figure 17. Baseline Project b2933



Baseline Project b2934 – New 69kV line between Hasbrouck Heights and Carlstadt stations

Baseline Reliability Violations

The Carlstadt 69kV Substation in the PSEG transmission zone is supplied by two partially underground 69kV circuits. Carlstadt supplies more than 1,400 customers with load in excess of 30 MVA. An N-1-1 event would result in a complete loss of electric supply to the station for more than 24 hrs.

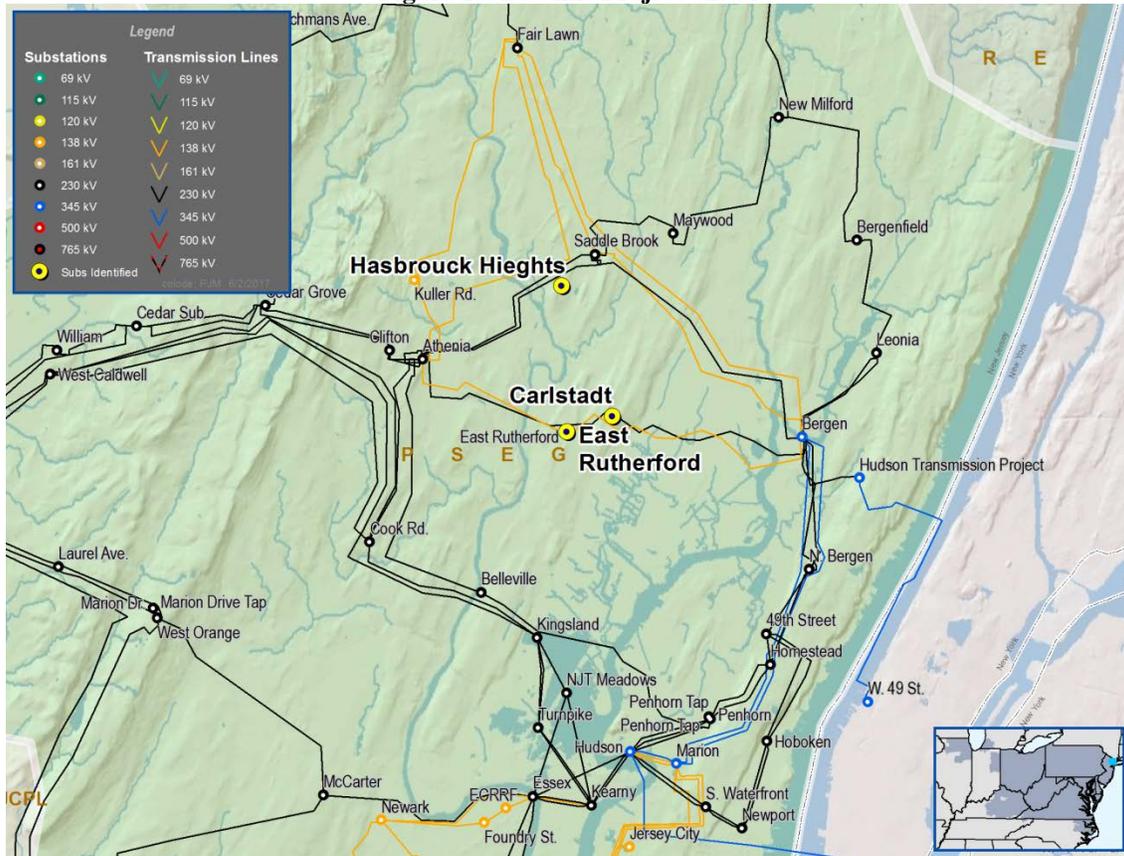
This violates PSE&G’s local FERC 715 planning criteria related to acceptable load drop levels and durations.

Recommended Solution

Build a new 69kV line between Hasbrouck Heights and Carlstadt.

The estimated cost is \$21.0 million and the projected in service date is June 1, 2018. The local Transmission Owner, PSE&G, will be the Designated Entity to complete this work.

Figure 18. Baseline Project b2934



Baseline Project b2935 – New Hilltop station and expansion of 69kV network

Baseline Reliability Violations

The Runnemede 69kV Substation in the PSEG transmission zone is supplied by two 69kV lines with a connected load in excess of 46MW. One of the lines has portions of the circuit fed by underground cable that would take longer than 24 hours to restore during an outage. In addition, a breaker failure on the Runnemede 69kV bus would result in the loss of both 69kV supply lines and a complete substation shutdown, interrupting more than 11,000 customers. This is a violation of PSE&G’s local FERC 715 planning criteria related to acceptable load drop levels and durations.

A significant amount of the PSE&G load in Gloucester and Camden Counties is served from an aging 26 kV network system that PSE&G has been replacing with a 69 kV network system. The Woodbury station will be converted from 26kV up to 69kV through a Supplemental project required by PSEG. After conversion to 69kV, the Woodbury station will be supplied by two 69kV lines from Gloucester 69kV station with no other 69kV source. A third supply is required to satisfy PSE&G’s FERC Form 715 requirements.

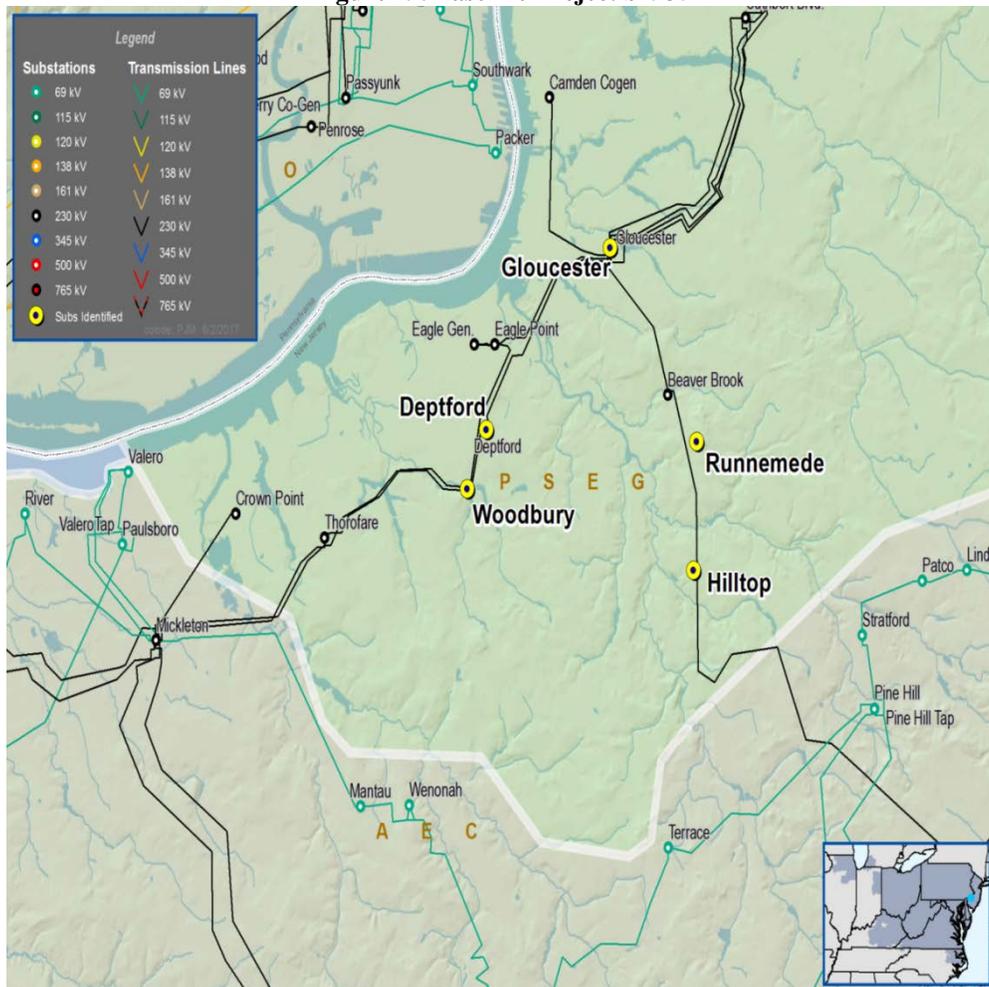
Recommended Solution

The recommended solution to address these issues is to introduce an additional 69 kV source into the area and reconfigure the existing 69 kV stations as follows:

- Build a new 230/69 kV switching substation at Hilltop utilizing the PSE&G property and the K-2237 230 kV line.
- Build a new 69 kV line between Hilltop and Woodbury 69 kV providing the 3rd supply
- Convert Runnemedede's straight bus to a ring bus (eliminating the bus fault violation) and construct a 69 kV line from Hilltop to Runnemedede 69 kV.

The estimated cost is \$98.0 million and the projected in service date is June 1, 2018. The local Transmission Owner, PSE&G, will be the Designated Entity to complete this work.

Figure 19. Baseline Project b2935



Other Upgrades Greater than \$20 million

Baseline Project b2941 - Build new 138kV gas insulated substation in the ComEd zone

Baseline Reliability Violations

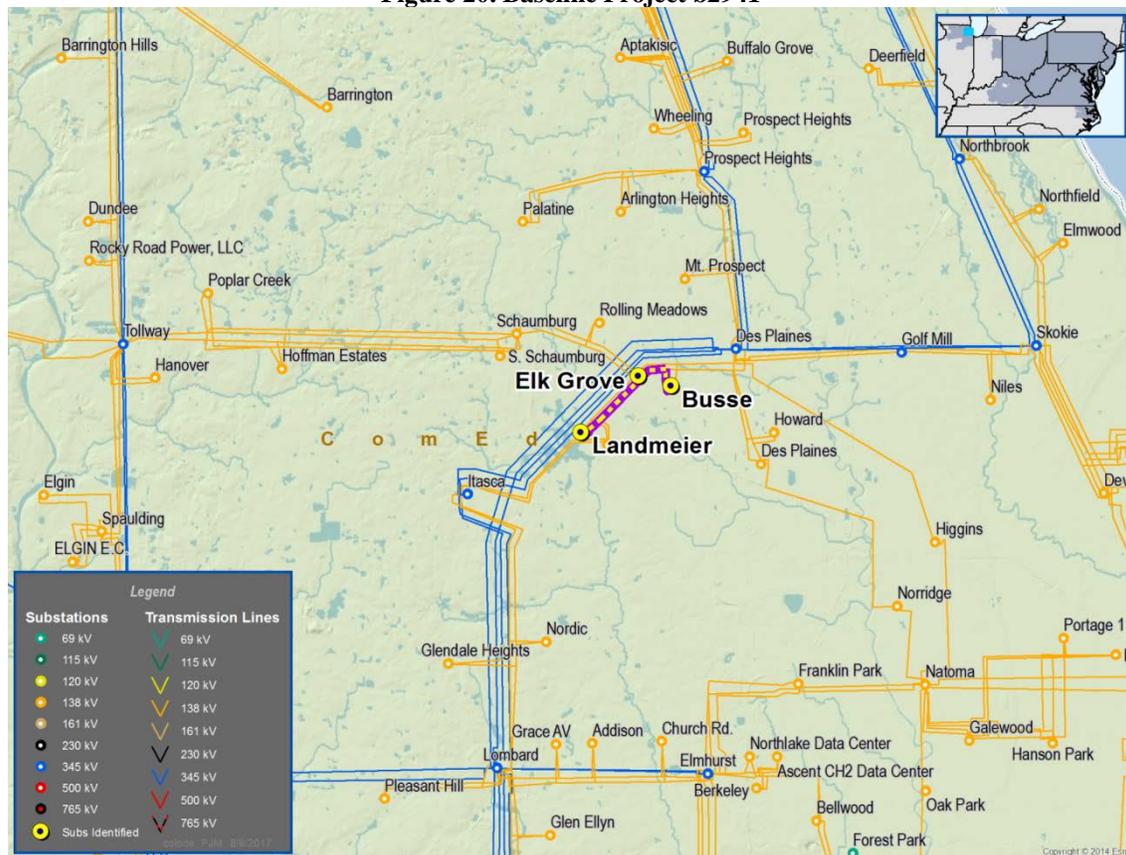
The loss of the 138kV tower lines L4605 (Des Plaines – Busse – Schaumburg – Landmeier – Tonne 138kV “Red” line) and L4606 (Des Plaines – Busse – Schaumburg – Landmeier –Tonne 138kV “Blue” line) in the ComEd transmission zone would result in a load loss exceeding 300 MW. This is in violation of the PJM load loss reliability criteria.

Recommended Solution

Build a new Elk Grove 138kV GIS substation at the point where Rolling Meadows & Schaumburg tap off from the main lines, between Landmeier and Busse. The new station will be located in a building adjacent to the ROW. The four 345 kV circuits in the ROW will be diverted into Gas Insulated Bus (GIB) and go through the basement of the building to provide clearance for the above ground portion of the building.

The estimated cost is \$90.0 million and the projected in service date is June 1, 2021. This project is an immediate need solution where the timing required to include the violation in an RTEP proposal window was infeasible. The local Transmission Owner, ComEd, will be the Designated Entity to complete this work.

Figure 20. Baseline Project b2941



Changes to Previously Approved Projects

Cost and scope of a number of previously approved RTEP baseline projects have changed, resulting in an increase of \$34.71M. Seven projects, totaling \$22.62M, are being cancelled as they are no longer needed to satisfy reliability criteria. The net increase to the RTEP to incorporate these changes is \$12.09M

Review by the Transmission Expansion Advisory Committee (TEAC)

The need for the projects was reviewed with stakeholders at several meetings throughout 2017, most recently at the September 2017 TEAC and Sub Regional RTEP Committee meetings. Written comments were requested to be submitted to PJM to communicate any concerns with the recommendations and any alternative transmission solutions for consideration. As of the writing of this report there have been no comments received on the projects presented to the TEAC.

Cost Allocation

Preliminary cost allocations for the projects being recommended are shown in Attachment A.

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. Baseline projects required exclusively to address local transmission owner FERC Form 715 planning criteria are allocated to the local transmission owner zone. Market efficiency projects are allocated to the load zones that benefit from the upgrade. 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 Board, approval of the baseline upgrades to the 2017 RTEP. The PJM Board of Managers 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
b2649.1	Rebuild of 1.7 mile tap to Metcalf and Belfield DP (MEC) due to poor condition. The existing summer rating of the tap is 48 MVA and existing conductor is 4/0 ACSR on wood H-frames. The proposed new rating is 176 MVA using 636 ACSR conductor.	\$3.57	Dominion	Dominion	12/31/2019
b2649.2	Rebuild of 4.1 mile tap to Brinks DP (MEC) due to wood poles built in 1962. The existing summer rating of the tap is 48 MVA and existing conductor is 4/0 ACSR and 393.6 ACSR on wood H-frames. The proposed new rating is 176 MVA using 636 ACSR conductor.	\$8.21	Dominion	Dominion	12/31/2019
b2689.3	Upgrade terminal equipment at structure 27A	\$0.05	APS	APS	6/1/2018
b2781	Increase Maximum Operating Temperature of Davis - Nicholasville 69kv line section 266.8 MCM conductor to 284°F (LTE of 266°F).	\$0.00	EKPC	EKPC	6/1/2021
b2782	Increase the maximum operating temperature of Plumville - Rectorville 69kV line section 266.8 MCM conductor to 212°F (LTE of 185°F).	\$0.00	EKPC	EKPC	6/1/2021
b2783	Rebuild the Davis - Fayette 69kv line section to 556.5 MCM (3.15 miles)	\$0.00	EKPC	EKPC	12/1/2021
b2784	Increase overcurrent relay at West Berea 138/69kV to at least 139 MVA Winter LTE	\$0.00	EKPC	EKPC	12/1/2021
b2786	Increase Williamstown cap bank to 11.225 MVAR	\$0.02	EKPC	EKPC	12/1/2021
b2787	Reconductor 0.53 miles (14 spans) of the Kaiser Jct-Air Force Jct Sw section of the Kaiser-Heath 69 kV circuit/line with 336 ACSR to match the rest of the circuit (73 MVA rating, 78% loading).	\$1.10	AEP	AEP	6/1/2021
b2788	Install a new 3-way 69kV line switch to provide service to AEP's Barnesville distribution station. Remove a portion of the #1 copper T-Line from the 69kV through-path.	\$0.35	AEP	AEP	6/1/2021
b2789	Rebuild the Brues-Glendale Heights 69kV line section (5 miles) with 795 ACSR (128 MVA rating, 43% loading)	\$16.70	AEP	AEP	6/1/2021
b2790	Install a 3 MVAR, 34.5kV cap bank at Caldwell substation.	\$0.43	AEP	AEP	6/1/2021
b2791	Rebuild Tiffin-Howard, new transformer at Chatfield	\$20.39	AEP	AEP	6/1/2021
b2791.1	Rebuild portions of the East Tiffin-Howard 69kV line from East Tiffin to West Rockaway Switch (0.8 miles) using 795 ACSR Drake conductor (129 MVA rating, 50% loading).	\$0.00	AEP	AEP	6/1/2021
b2791.2	Rebuild Tiffin-Howard 69kV line from St. Stephen's Switch to Hinesville (14.7 miles) using 795 ACSR Drake conductor (90 MVA rating, non-conductor limited, 38% loading).	\$0.00	AEP	AEP	6/1/2021
b2791.3	New 138/69kV transformer with 138kV & 69kV	\$0.00	AEP	AEP	6/1/2021

Upgrade ID	Description	Cost Estimate (\$M)	Trans Owner	Cost Responsibility	Required IS Date
	protection at Chatfield station.				
b2791.4	New 138kV & 69kV protection at existing Chatfield transformer.	\$0.00	AEP	AEP	6/1/2021
b2792	Replace the Elliott transformer with a 130 MVA unit, Reconductor 0.42 miles of the Elliott – Ohio University 69 kV line with 556 ACSR to match the rest of the line conductor (102 MVA rating, 73% loading) and rebuild 4 miles of the Clark Street – Strouds R	\$5.76	AEP	AEP	6/1/2021
b2793	Energize the spare Fremont Center 138/69 kV 130 MVA transformer #3. Reduces overloaded facilities to 46% loading.	\$0.08	AEP	AEP	6/1/2021
b2794	Construct new 138/69/34kV station and 1-34kV circuit (designed for 69kV) from new station to Decliff station, approximately 4 miles, with 556 ACSR conductor (51 MVA rating).	\$12.65	AEP	AEP	6/1/2021
b2795	Install a 34.5 kV 4.8 MVAR capacitor bank at Killbuck 34.5kV station.	\$0.48	AEP	AEP	6/1/2021
b2796	Rebuild the Malvern-Oneida Switch 69kV line section with 795 ACSR (1.8 miles, 125 MVA rating, 55% loading).	\$4.10	AEP	AEP	6/1/2021
b2797	Rebuild the Ohio Central-Conesville 69kV line section (11.8 miles) with 795 ACSR conductor (128 MVA rating, 57% loading). Replace the 50 MVA Ohio Central 138-69kV XFMR with a 90 MVA unit.	\$20.60	AEP	AEP	6/1/2021
b2798	Install a 14.4 MVAR capacitor bank at West Hicksville station. Replace ground switch/MOAB at West Hicksville with a circuit switcher.	\$1.30	AEP	AEP	6/1/2021
b2799	Rebuild Valley-Almena, Almema-Hartford, Riverside-South Haven 69kV lines. New line exit at Valley Station. New transformers at Almema and Hartford	\$53.00	AEP	AEP	6/1/2021
b2799.1	Rebuild 12 miles of Valley – Almema 69kV line as a double circuit 138kV/69kV line using 795 ACSR conductor (360 MVA rating) to introduce a new 138 kV source into the 69 kV load pocket around Almema station.	\$0.00	AEP	AEP	6/1/2021
b2799.2	Rebuild 3.2 miles of Almema to Hartford 69kV line using 795 ACSR conductor (90 MVA rating).	\$0.00	AEP	AEP	6/1/2021
b2799.3	Rebuild 3.8 miles of Riverside – South Haven 69V line using 795 ACSR conductor (90 MVA rating).	\$0.00	AEP	AEP	6/1/2021
b2799.4	At Valley station, add new 138kV line exit with a 3000 A 40 kA breaker for the new 138 kV line to Almema and replace CB D with a 3000 A 40 kA breaker.	\$0.00	AEP	AEP	6/1/2021
b2799.5	At Almema station, install a 90MVA 138kV/69kV transformer with low side 3000 A 40 kA breaker and establish a new 138kV line exit towards Valley.	\$0.00	AEP	AEP	6/1/2021
b2799.6	At Hartford station, install a second 90MVA	\$0.00	AEP	AEP	6/1/2021

Upgrade ID	Description	Cost Estimate (\$M)	Trans Owner	Cost Responsibility	Required IS Date
	138/69kV transformer with a circuit switcher and 3000 A 40 kA low side breaker.				
b2800	The 7 mile section from Dozier to Thompsons Corner of line #120 will be rebuilt to current standards using 768.2 ACSS conductor with a summer emergency rating of 346 MVA at 115kV. Line is proposed to be rebuilt on single circuit steel monopole structure	\$6.50	Dominion	Dominion	12/30/2021
b2801	Line #76 and #79 will be rebuilt to current standard using 768.2 ACSS conductor with a summer emergency rating of 346 MVA at 115kV. Proposed structure for rebuild is double circuit steel monopole structure	\$22.00	Dominion	Dominion	12/30/2020
b2872	Replace the South Canton 138 kV breaker 'K2' with an 80 kA breaker .	\$0.60	AEP	AEP	6/1/2019
b2873	Replace the South Canton 138 kV breaker "M" with a 80 kA breaker	\$0.60	AEP	AEP	6/1/2022
b2874	Replace the South Canton 138 kV breaker "M2" with a 80 kA breaker	\$0.60	AEP	AEP	6/1/2022
b2876	Rebuild Line #101 from Mackeys - Creswell 115 kV, 14 miles, with double circuit structures. Install one circuit with provisions for a second circuit. The conductor used will be at current standards with a summer emergency rating of 262 MVA at 115kV.	\$40.00	Dominion	Dominion	12/30/2022
b2877	Rebuild Line #112 from Fudge Hollow - Lowmoor 138 kV (5.16 miles) to current standards with a summer emergency rating of 314 MVA at 138kV.	\$8.00	Dominion	Dominion	10/31/2020
b2880	Rebuild approximately 4.77 miles of the Cannonsburg – South Neal 69 kV line section utilizing 795 ACSR conductor (90 MVA rating, 83%)	\$12.50	AEP	AEP	6/1/2021
b2881	Rebuild ~1.7 miles of the Dunn Hollow – London 46kV line section utilizing 795 26/7 ACSR conductor (58 MVA rating, non-conductor limited, 55%).	\$4.50	AEP	AEP	6/1/2021
b2882	Rebuild Reusens-Peakland Switch 69kV line. Replace Peakland Switch.	\$2.90	AEP	AEP	6/1/2021
b2882.1	Rebuild the Reusens - Peakland Switch 69 kV line (approximately 0.8 miles) utilizing 795 ACSR conductor (86 MVA rating, non-conductor limited, 67%)	\$0.00	AEP	AEP	6/1/2021
b2882.2	Replace existing Peakland S.S with new 3 way switch phase over phase structure.	\$0.00	AEP	AEP	6/1/2021
b2883	Rebuild the Craneco – Pardee – Three Forks – Skin Fork 46kV line section (approximately 7.2 miles) utilizing 795 26/7 ACSR conductor (108 MVA rating, 43%)	\$12.20	AEP	AEP	6/1/2021
b2884	Install a second transformer at Nagel station, comprised of 3 single phase 250MVA 500/138kV transformers. Presently, TVA	\$13.00	AEP	AEP	6/1/2021

Upgrade ID	Description	Cost Estimate (\$M)	Trans Owner	Cost Responsibility	Required IS Date
	operates their end of the Boone Dam – Holston 138 kV interconnection as normally open preemptively for the loss of the existing Nagel				
b2885	New delivery point for City of Jackson	\$13.00	AEP	AEP	3/1/2018
b2885.1	Install a new Ironman Switch to serve a new delivery point requested by the City of Jackson for a load increase request.	\$0.00	AEP	AEP	3/1/2018
b2885.2	Install a new 138/69 kV station (Rhodes) to serve as a third source to the area to help relieve overloads caused by the customer load increase.	\$0.00	AEP	AEP	3/1/2018
b2885.3	Replace Coalton Switch with a new three breaker ring bus (Heppner).	\$0.00	AEP	AEP	3/1/2018
b2886	Install 90 MVA 138/69 kV transformer, new transformer high and low side 3000 A 40 kA CBs, and a 138 kV 40 kA bus tie breaker at West End Fostoria.	\$3.20	AEP	AEP	6/1/2021
b2887	Add 2-138kV CB's and relocate 2-138kV circuit exits to different bays at Morse Road. Eliminate 3 terminal line by terminating Genoa-Morse circuit at Morse Road.	\$3.00	AEP	AEP	12/31/2019
b2888	Retire Poston substation. Install new Lemaster substation.	\$26.97	AEP	AEP	12/31/2018
b2888.1	Remove and retire the Poston 138kV station.	\$0.00	AEP	AEP	12/31/2018
b2888.2	Install a new greenfield station, Lemaster 138kV Station, in the clear.	\$0.00	AEP	AEP	12/31/2018
b2888.3	Relocate the Trimble 69 kV AEP Ohio radial delivery point to 138 kV, to be served off of the Poston – Strouds Run – Crooksville 138 kV circuit via a new three-way switch. Retire the Poston-Trimble 69kV line.	\$0.00	AEP	AEP	12/31/2018
b2889	Expand Cliffview station	\$30.00	AEP	AEP	6/1/2021
b2889.1	Cliffview Station: Establish 138kV bus. Install two 138/69kV XFRs (130 MVA), six 138kV CBs (40kA 3000A) and four 69kV CBs (40kA 3000A).	\$0.00	AEP	AEP	6/1/2021
b2889.2	Byllesby – Wythe 69kV: Retire all 13.77 miles (1/0 CU) of this circuit (~4 miles currently in national forest)	\$0.00	AEP	AEP	6/1/2021
b2889.3	Galax – Wythe 69kV: Retire 13.53 miles (1/0 CU section) of line from Lee Highway down to Byllesby. This section is currently double circuited with Byllesby – Wythe 69kV. Terminate the southern 3/0 ACSR section into the newly opened position at Byllesby	\$0.00	AEP	AEP	6/1/2021
b2889.4	Cliffview Line: Tap the existing Pipers Gap – Jubal Early 138kV line section. Construct double circuit in/out (~2 miles) to newly established 138kV bus, utilizing 795 26/7 ACSR conductor.	\$0.00	AEP	AEP	6/1/2021
b2890	Rebuild East Cambridge-Smyrna. Install breakers as East Cambridge. Install switches as Old Washington and Antrim.	\$0.00	AEP	AEP	6/1/2021

Upgrade ID	Description	Cost Estimate (\$M)	Trans Owner	Cost Responsibility	Required IS Date
b2890.1	Rebuild 23.55 miles of the East Cambridge – Smyrna 34.5 kV circuit with 795 ACSR conductor (128 MVA rating) and convert to 69 kV.	\$34.00	AEP	AEP	6/1/2021
b2890.2	East Cambridge: Install a 2000 A 69 kV 40 kA circuit breaker for the East Cambridge – Smyrna 69 kV circuit.	\$0.54	AEP	AEP	6/1/2021
b2890.3	Old Washington: Install 69 kV 2000 A two way phase over phase switch.	\$0.51	AEP	AEP	6/1/2021
b2890.4	Antrim Switch: Install 69 kV 2000 A two way phase over phase switch.	\$1.20	AEP	AEP	6/1/2021
b2891	Rebuild the Midland Switch to East Findlay 34.5 kV line (3.31 miles) with 795 ACSR (63 MVA rating) to match other conductor in the area.	\$4.80	AEP	AEP	6/1/2021
b2892	Install new 138/12kV transformer with high side circuit switcher at Leon and a new 138 kV line exit towards Ripley. Establish 138kV at the Ripley station with a new 138/69 kV 130MVA transformer and move the distribution load to 138 kV service. Rebuild the	\$27.10	AEP	AEP	6/1/2021
b2893	Re-build the existing (1.5 mile), 1/0 MCM ACSR South Bardstown – West Bardstown Jct. 69kV line using 556.5 MCM ACTW conductor.	\$1.03	EKPC	EKPC	12/1/2021
b2894	Replace Todhunter 138 kV breakers '931', '919', and '913' with 80 kA breakers	\$1.97	DEOK	DEOK	6/1/2021
b2895	Replace Dicks Creek 138 kV breaker '963' with 63 kA breaker	\$0.30	DEOK	DEOK	6/1/2019
b2899	Rebuild 230kV Line #231 to current standard with a summer emergency rating of 1046 MVA. Proposed conductor is 2-636 ACSR.	\$22.00	Dominion	Dominion	12/1/2020
b2900	Build a new 230-115kV switching station connecting to 230kV network Line #2014 (Earleys – Everetts). Provide a 115kV source from the new station to serve Windsor DP.	\$11.50	Dominion	Dominion	12/30/2022
b2901	Reconductor the Port Union – Mulhauser 138kV line with 954ASCR	\$4.40	DEOK	DEOK	6/30/2017
b2902	Rebuild the Brodhead - Three Links Jct. 69 kV line section (8.2 miles) using 556.5 MCM ACTW wire.	\$4.72	EKPC	EKPC	12/1/2018
b2903	Raise the V-low setting for Summer Shade 69 kV cap bank to 1.01 pu.	\$0.00	EKPC	EKPC	12/1/2027
b2904	Raise the V-low setting for Newby 69 kV cap bank to 0.955 pu	\$0.00	EKPC	EKPC	12/1/2026
b2905	Resize the Albany 69 KV capacitor bank from 8.4 to 13.776 MVAR.	\$0.09	EKPC	EKPC	6/1/2026
b2906	Increase the Zone 3 distance relay setting at Baker Lane associated with the Baker Lane-Holloway Jct. 69 kV line to at least 142 MVA LTE Winter.	\$0.00	EKPC	EKPC	12/1/2018
b2907	Upgrade the metering CT associated with the Clay Village - KU Clay Village 69 kV Tap line	\$0.13	EKPC	EKPC	12/1/2024

Upgrade ID	Description	Cost Estimate (\$M)	Trans Owner	Cost Responsibility	Required IS Date
	section to 600 A; at least 64 MVA Winter LTE; Upgrade the distance relay associated with the Clay Village - KU Clay Village 69 kV Tap line section to at least 64 MVA				
b2908	Upgrade the distance relay associated with Dale-JK Smith 138 kV line section to 362 MVA normal rating.	\$0.00	EKPC	EKPC	12/1/2027
b2909	Increase the MOT of the EKPC Elizabethtown - Tharp Tap 69 kV line section (1.7 miles) to 302°F. (LTE at 284°F)	\$0.20	EKPC	EKPC	12/1/2026
b2910	Upgrade the distance relay at the Hodgenville station associated with the Glendale - Hodgenville 69 kV line section to at least 90 MVA Winter LTE.	\$0.00	EKPC	EKPC	12/1/2026
b2911	Upgrade the overcurrent relay setting associated with Powell County 138-69 kV transformer to at least 139 MVA Winter LTE.	\$0.00	EKPC	EKPC	12/1/2025
b2912	Upgrade the existing S408-605, 600 A KU Russell Springs Tap -Russell County 69 kV disconnect switch to 1200 A.	\$0.15	EKPC	EKPC	12/1/2025
b2913	Upgrade distance relay at the Stephensburg station associated with Stephensburg - Glendale 69kV line section to at least winter LTE 100 MVA.	\$0.00	EKPC	EKPC	12/1/2024
b2914	Rebuild Tharp Tap-KU Elizabethtown 69kV line section to 795 MCM (2.11 miles).	\$1.22	EKPC	EKPC	12/1/2024
b2915	Resize the Sideview 69 kV capacitor bank from 6.12 MVAR to 9.18 MVAR.	\$0.07	EKPC	EKPC	12/1/2023
b2916	Upgrade the existing metering CTs (Quantity of 2) associated with the East Bardstown - KU Bardstown Industrial Tap 69 kV line section to 1200 A, at least 100 MVA Winter LTE; and upgrade the existing East Bardstown bus and jumpers from 4/0 to 500 MCM Coppe	\$0.25	EKPC	EKPC	12/1/2023
b2917	Replace the existing 100 MVA 138-69 kV transformer bank at the West Berea substation with a 150 MVA transformer.	\$1.73	EKPC	EKPC	12/1/2026
b2918	Upgrade the 4/0 bus and jumpers associated with the West Berea Jct. - Three Links Jct 69 kV line to 500 MCM copper or equivalent equipment at the Three Links Jct. substation.	\$0.15	EKPC	EKPC	12/1/2026
b2919	Install a 69 kV, 15.31 MVAR capacitor bank at South Anderson substation.	\$0.37	EKPC	EKPC	12/1/2026
b2920	Rebuild Boone - Big Bone Tap 69 kV line section using 556.5 MCM ACTW conductor (6.3 miles).	\$3.63	EKPC	EKPC	12/1/2025
b2921	New TVA 161kV Interconnection to TVA's East Glasgow Tap-East Glasgow 161 KV line section (~1 mile due West of Fox Hollow). Add Fox Hollow 161/69 KV 150 MVA transformer. Construct new Fox Hollow-Fox Hollow Jct 161 KV line section using 795 MCM ACSR (~1 m	\$18.10	EKPC	EKPC	6/1/2018

Upgrade ID	Description	Cost Estimate (\$M)	Trans Owner	Cost Responsibility	Required IS Date
b2922	Rebuild 8 of 11 miles of 230kV Lines #211 and #228 to current standard with a summer emergency rating of 1046 MVA for rebuilt section. Proposed conductor is 2-636 ACSR.	\$28.10	Dominion	Dominion	12/1/2020
b2923	Replace the China Tap 230kV 'CS 15' breaker with 63kA breaker	\$0.60	PECO	PECO	6/1/2019
b2924	Replace the Emilie 230kV 'CS 15' breaker with 63kA breaker	\$0.60	PECO	PECO	6/1/2019
b2925	Replace the Emilie 230kV 'CS 25' breaker with 63kA breaker	\$0.60	PECO	PECO	6/1/2019
b2926	Replace the Chichester 230kV '215' breaker with 63kA breaker	\$0.34	PECO	PECO	6/1/2019
b2927	Replace the Plymouth Meeting 230kV '125' breaker with 63kA breaker	\$0.34	PECO	PECO	6/1/2019
b2928	Rebuild four structures of 500kV Line #567 from Chickahominy to Surry using galvanized steel and replace the river crossing conductor with 3-1534 ACSR. This will increase the Line #567 Line Rating from 1954 MVA to 2600 MVA.	\$41.00	Dominion	Dominion	12/30/2017
b2929	Rebuild 230kV Line #2144 from Winfall to Swamp (4.3 miles) to current standards with a standard conductor (bundled 636 ACSR) having a summer emergency rating of 1047 MVA at 230kV.	\$6.00	Dominion	Dominion	12/30/2022
b2930	Upgrade capacity on E. Frankford-University Park 345kV	\$0.84	ComEd	ComEd	6/1/2021
b2931	Upgrade substation equipment at Pontiac Midpoint station to increase capacity on Pontiac-Brokaw 345 kV line.	\$5.62	ComEd	ComEd	6/1/2021
b2933	Third Source for Springfield Rd. and Stanley Terrace Stations	\$197.00	PSEG	PSEG	6/1/2018
b2933.1	Construct a 230/69 kV station at Springfield.	\$0.00	PSEG	PSEG	6/1/2018
b2933.2	Construct a 230/69 kV station at Stanley Terrace	\$0.00	PSEG	PSEG	6/1/2018
b2933.3	Construct a 69 kV network between Front Street, Springfield and Stanley Terrace	\$0.00	PSEG	PSEG	6/1/2018
b2934	Build a new 69kV line between Hasbrouck Heights and Carlstadt	\$21.00	PSEG	PSEG	6/1/2018
b2935	Third Supply for Runnemede 69kV and Woodbury 69kV	\$98.00	PSEG	PSEG	6/1/2018
b2935.1	Build a new 230/69 kV switching substation at Hilltop utilizing the PSE&G property and the K-2237 230 kV line.	\$0.00	PSEG	PSEG	6/1/2018
b2935.2	Build a new line between Hilltop and Woodbury 69 kV providing the 3rd supply	\$0.00	PSEG	PSEG	6/1/2018
b2935.3	Convert Runnemede's straight bus to a ring bus and construct a 69 kV line from Hilltop to Runnemede 69 kV.	\$0.00	PSEG	PSEG	6/1/2018
b2936	Rebuild Mottville-Pigeon River. Replace MOAB swith at Pigeon River.	\$0.00	AEP	AEP	6/1/2020
b2936.1	Rebuild approximately 6.7 miles of 69kV line	\$12.00	AEP	AEP	6/1/2020

Upgrade ID	Description	Cost Estimate (\$M)	Trans Owner	Cost Responsibility	Required IS Date
	between Mottville and Pigeon River using 795 ACSR conductor (129 MVA rating). New construction will be designed to 138kV standards but operated at 69kV.				
b2936.2	Pigeon River Station: Replace existing MOAB Sw. 'W' with a new 69kV 3000 A 40 kA breaker, and upgrade existing relays towards HMD station. Replace CB H with a 3000 A 40 kA breaker.	\$1.50	AEP	AEP	6/1/2020
b2937	Replace the existing 636 ACSR 138 kV Bus at Fletchers Ridge with a larger 954 ACSR conductor.	\$0.63	AEP	AEP	6/1/2022
b2938	Perform a sag mitigations on the Broadford – Wolf Hills 138kV circuit to allow the line to operate to a higher maximum temperature.	\$2.60	AEP	AEP	6/1/2022
b2939	Increase the conductor MOT for the Dale – JK Smith 138kV line to 275°F. The new summer ratings would be 229/296.	\$0.40	EKPC	EKPC	6/1/2022
b2940	Upgrade the distance relay on the Wayne Co – Wayne Co KY 161kV line to increase the line winter rating would be 167/167.	\$0.00	EKPC	EKPC	6/1/2022
b2941	Build an indoor new Elk Grove 138kV GIS substation at the point where Rolling Meadows & Schaumburg tap off from the main lines, between Landmeier and Busse. The four 345 kV circuits in the ROW will be diverted into Gas Insulated Bus (GIB) and go through the basement of the building to provide clearance for the above ground portion of the building.	\$90.00	ComEd	ComEd	6/1/2021
b2942.1	Install a 100MVAR 345kV shunt reactor at Hayes substation	\$5.70	ATSI	ATSI	10/31/2017
b2942.2	Install a 200MVAR 345kV shunt reactor at Bayshore substation	\$5.00	ATSI	ATSI	10/31/2018
b2944	Install two 345 kV 80 MVAR shunt reactors at Mainesburg station	\$11.49	PENELEC	PENELEC	6/1/2017
b2649.1	Rebuild of 1.7 mile tap to Metcalf and Belfield DP (MEC) due to poor condition. The existing summer rating of the tap is 48 MVA and existing conductor is 4/0 ACSR on wood H-frames. The proposed new rating is 176 MVA using 636 ACSR conductor.	\$3.57	Dominion	Dominion	12/31/2019

Reliability Project Multiple Zone Allocations

None.