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

PJM Staff Whitepaper
Feb. 2018

For Public Use

EXECUTIVE SUMMARY

On December 5, 2017, the PJM Board of Managers approved changes to the Regional Transmission Expansion Plan (RTEP), totaling $2,831.76 million, primarily to resolve baseline reliability criteria violations and network upgrades to support the reliable interconnection of new generation resources.

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 $397.42 million. In addition, a number of previously approved baseline projects have been canceled or their cost and scope has changed, resulting in a net decrease of $68.64 million. The net impact due to these baseline reliability changes is an increase in the RTEP of $328.78 million.

With these changes, the RTEP will include over $35,439.28 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 February 2018 meeting, the PJM Board approved the updated RTEP as requested.

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 is 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 is detailed below. A complete listing of all of the projects that are being recommended along with their associated cost allocations is included in Attachment A and Attachment B to this white paper. The projects with estimated costs less than $5 million include installation of a new capacitor bank and installation of a new circuit breaker.

Mid-Atlantic Region System Upgrades

- BGE Transmission Zone
  - Reconnect the Crane-Windy Edge 115 kV circuits to the Northeast Substation – $6.0 million
- PPL Transmission Zone
  - Replace Martins Creek 230 kV circuit breakers – $14.30 million
- PSE&G Transmission Zone
  - Construct a new 230/69 kV Hillsdale Substation – $115.0 million
  - Covert Kuller Road Substation to 69/13 kV – $98.3 million

Western Regional System Upgrades

- DEO&K Transmission Zone
  - Reconfigure the Pierce Substation – $9.2 million

Southern Region System Upgrades

- Dominion Transmission Zone
  - Install two 125 MVAR STATCOMS at Rawlings and one at Clover substation – $100.0 million
  - Rebuild the Staunton-Harrisonburg 115 kV transmission line – $37.5 million
  - Rebuild the Fredericksburg-Aquia Harbor 115 kV transmission line – $12.5 million

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 b2978 – Install STATCOMs at Rawlings and Clover Substations

PJM Operations continues to experience high voltage on the 500 kV transmission system in the Carson area during periods of light system load. The high voltage conditions frequently continue after shunt capacitors are taken out of service, shunt reactors have been placed in service, and effective on-cost generation is operated in the lead. High voltage conditions often persist even after taking these actions requiring System Operations to switch out multiple transmission lines (including 500 kV lines) and scheduling necessary generation to run specifically for high voltage control. The charts below show the 500 kV system voltages at several stations in the Dominion transmission zone during the spring of 2016 and the spring of 2017.

Figure 1. Recorded Voltage – Feb 2016–Apr 2016

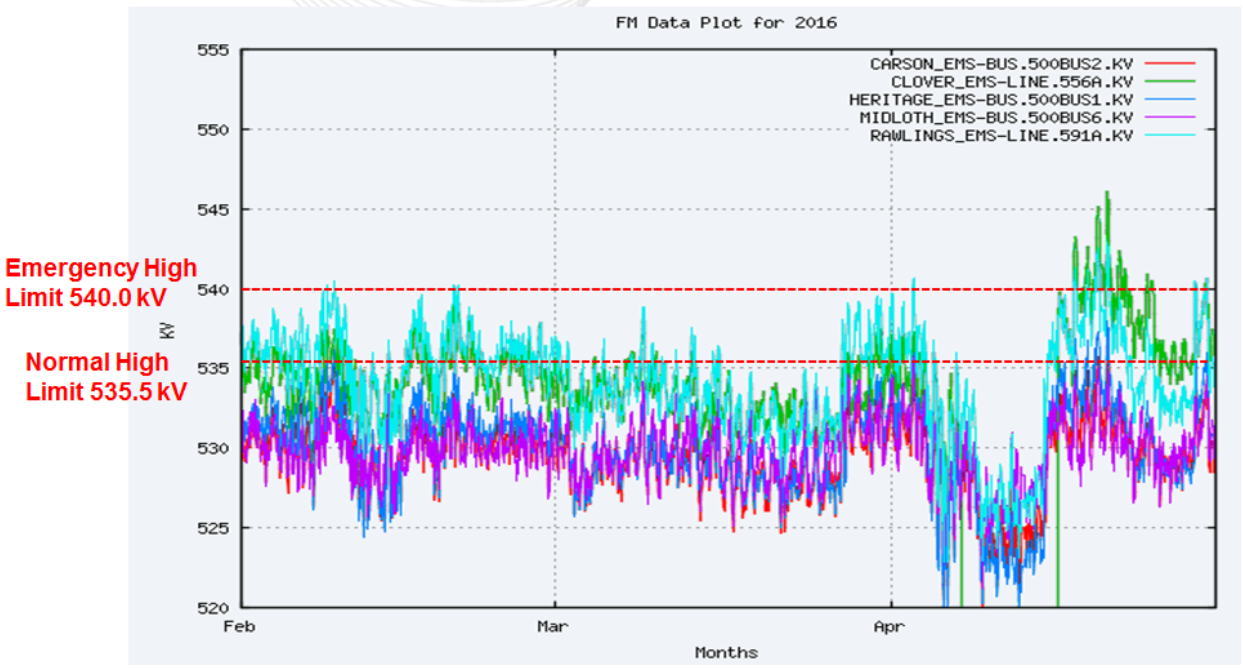
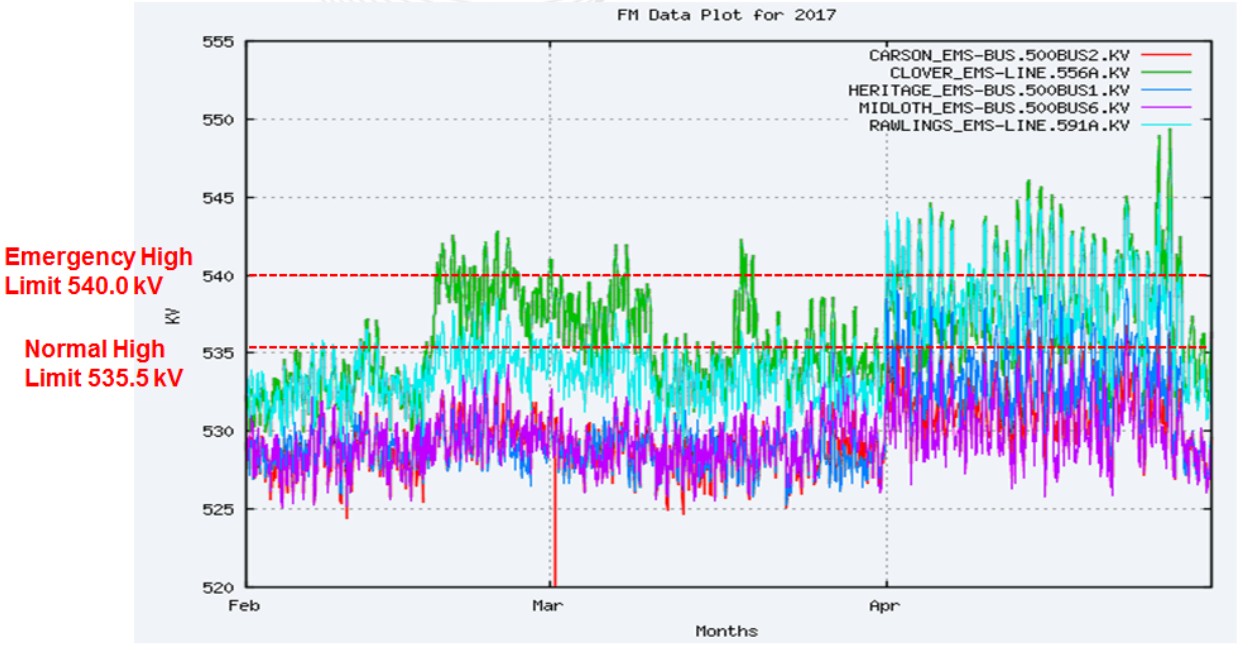


Figure 2. Recorded Voltage – Feb 2017–Apr 2017

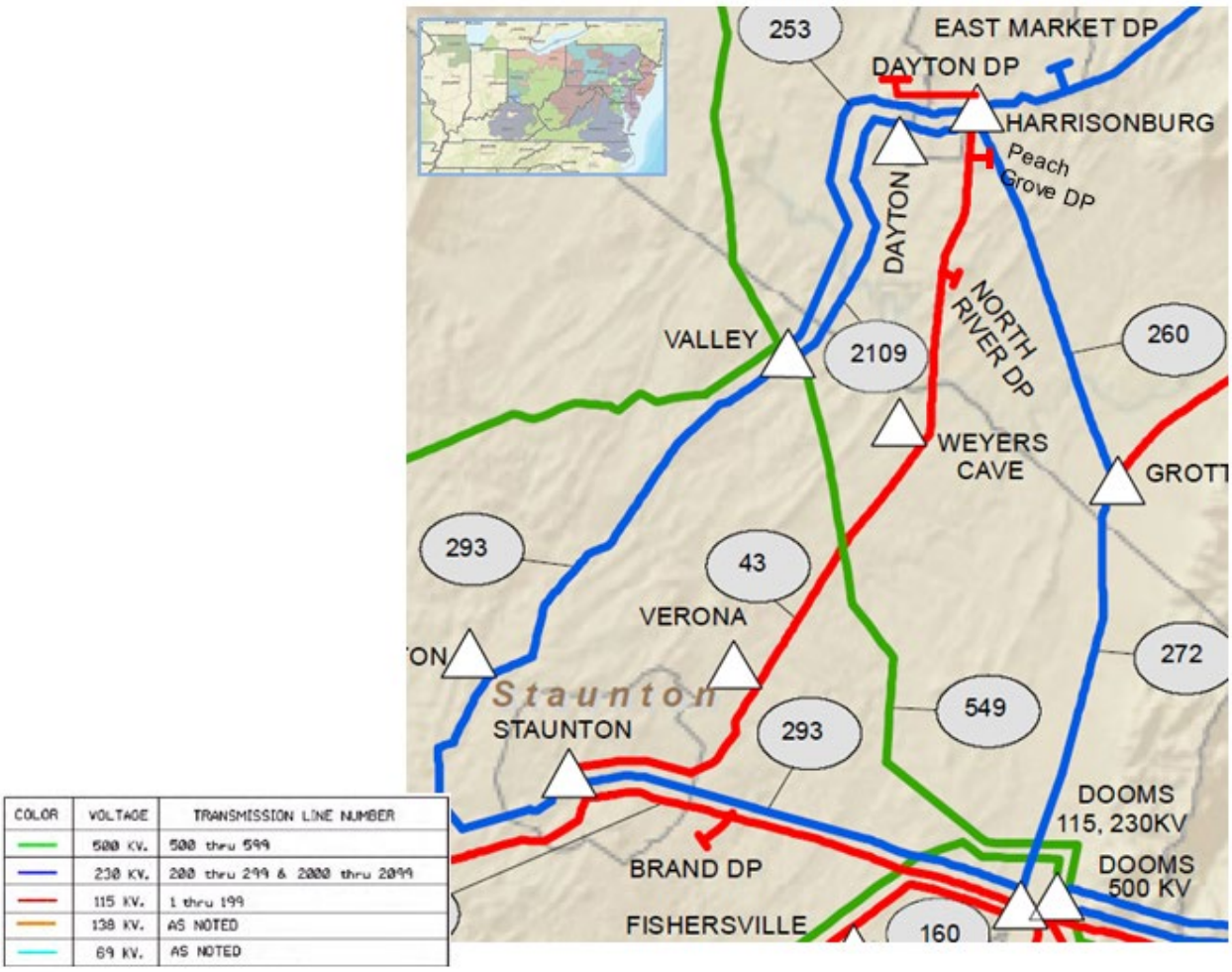


PJM staff evaluated a number of alternatives to address the chronic high voltage condition including shunt reactors and dynamic reactive devices at various locations. Installation of shunt reactors, although less expensive, is not recommended given the number of times the reactors would need to be switched in and out of service and the maintenance that would be required to reliably switch the reactors that often. The recommended solution is to install two 500 kV, 125 MVAR STATCOMS at Rawlings Substation and one STATCOM at Clover Substation. The estimated cost for this work is $100.0 million, and the projected in-service date is May 2021. This project is an immediate need solution for which 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.

Baseline Project b2980 – Rebuild Staunton-Harrisonburg 115 kV Transmission Line in the Dominion Transmission Zone

The 22 mile long 115 kV line between the Staunton and Harrisonburg substations in the Dominion transmission zone was constructed on wooden H-frame structures in 1958. The line serves the Peach Grove delivery point, North River delivery point, Weyers Cave and Verona substations. These stations serve over 7,600 customers totaling 58 MW of load. Industry guidelines indicate expected life for wood transmission structures is 35–55 years, conductor and connectors is 40–60 years, and porcelain insulators is 50 years. These facilities have reached their end of life given their age and condition and need to be addressed under Dominion's FERC Form 715 transmission planning criteria.

Figure 3. Area Surrounding b2980

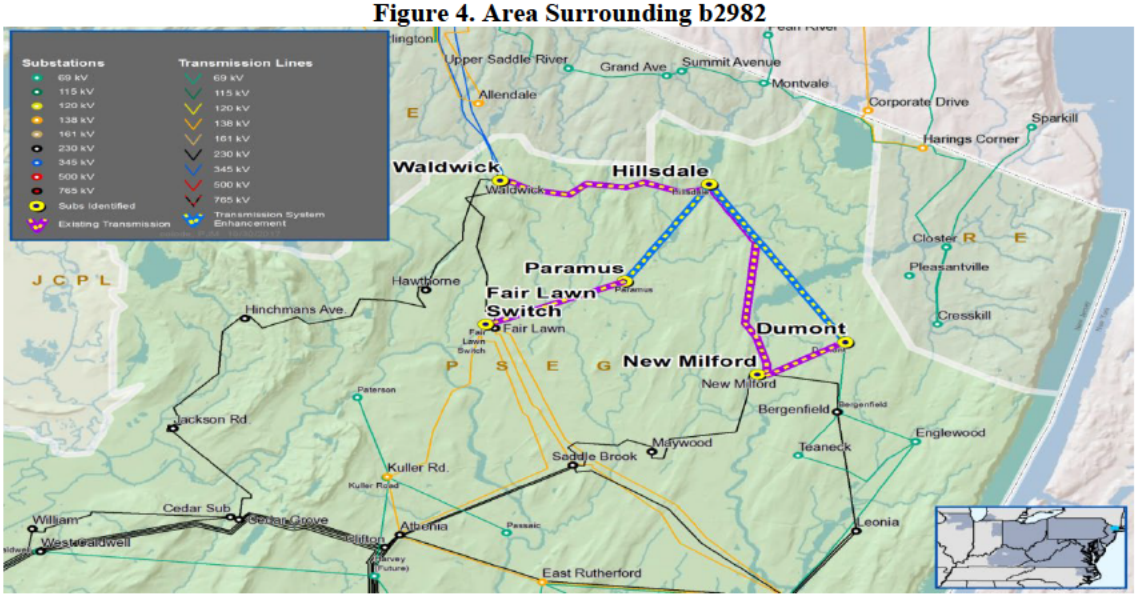


The recommended solution to address the issue is to rebuild the line to current standards. The estimated cost for this work is $37.5 million, and the projected in-service date is October 31, 2022. The local transmission owner, Dominion, will be the Designated Entity to complete this work.

Baseline Project b2982 – Construct New 230/69 kV Hillsdale Substation in the PSEG Transmission Zone

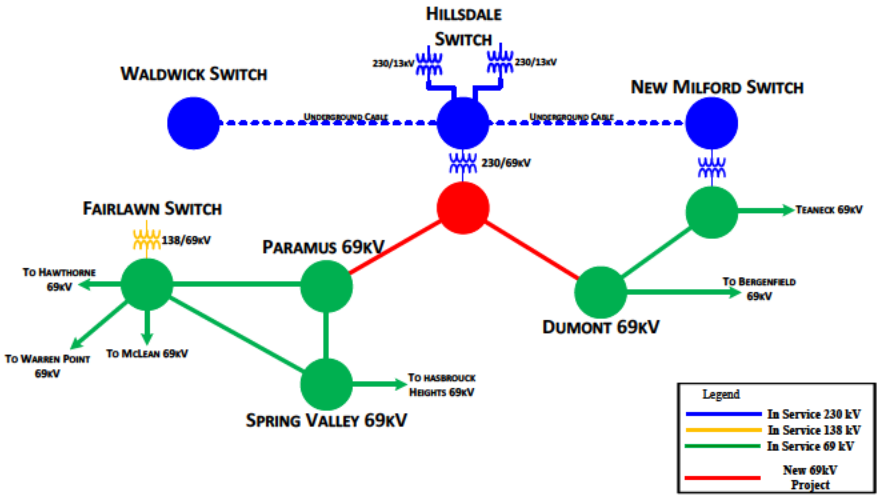
Hillsdale Substation is supplied by two underground 230 kV lines and serves approximately 17,000 customers totaling more than 80 MVA of load. An N-1-1 event would result in a complete loss of electric supply to the station for more than 24 hours. This is a violation of PSE&G acceptable load drop levels and durations defined in the PSE&G FERC Form 715 criteria.

Figure 4. Area Surrounding b2982



The recommended solution to address this issue is to introduce a third source to the station by constructing a new 230/69 kV Hillsdale Substation and connect this new 69 kV substation to the Paramus and Dumont 69 kV substations. The estimated cost for this work is $115.0 million, and the required in-service date is June 2018. The local transmission owner, PSE&G, will be the Designated Entity to complete this work.

Figure 5. Network Diagram After B2982 Is In Service

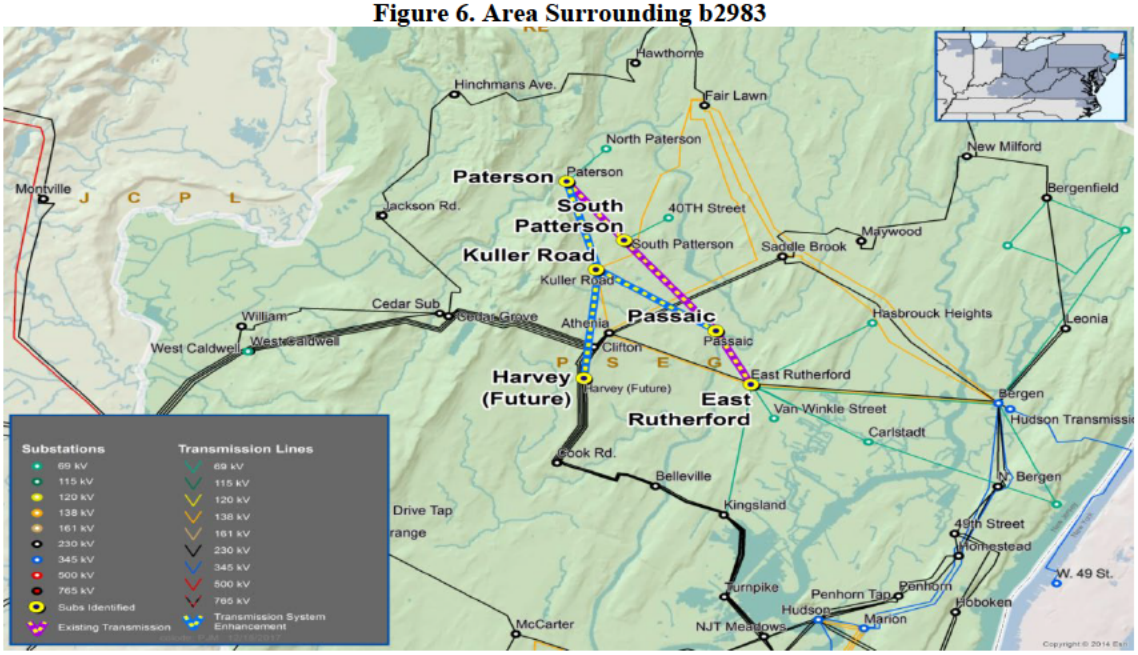


Baseline Project b2983 – Convert Kuller Road Substation to a 69/13 kV Station

Kuller Road Substation is supplied by two underground 138 kV lines and supplies more than 60 MVA of load to 18,000 customers. An N-1-1 event would result in a complete loss of electric supply to the station

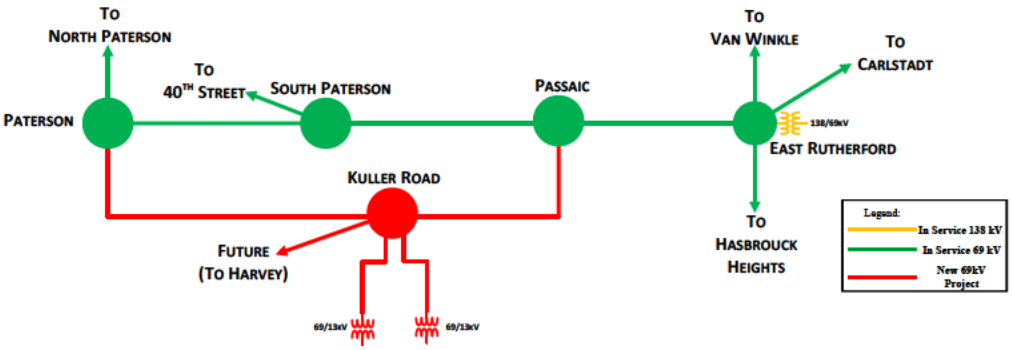
for more than 24 hours. This is a violation of PSE&G acceptable load drop levels and durations defined in the PSE&G FERC Form 715 criteria.

Figure 6. Area Surrounding b2983



The recommended solution is to build a new 69/13 kV substation at Kuller Road and serve the existing distribution load from this new substation. The new 69/13 kV substation will be interconnected with the Passaic, Paterson and Harvey 69 kV substations. The estimated cost for this work is $98.3 million, and the required in-service date is June 2018. The local transmission owner, PSE&G, will be the Designated Entity to complete this work.

Figure 7. Network Diagram After B2983 Is In Service



Changes to Previously Approved Projects

Cost and scope of two previously approved RTEP baseline projects have changed, resulting in an increase of $30.47 million. Four projects, totaling $99.11 million, are being canceled as they are no longer needed to satisfy reliability criteria. Three of these projects totaling almost $90 million are in the Delmarva Power transmission zone and involved converting existing 138 V lines to 230 kV and installing a new 230 / 138 kV transformer. Given the lower load forecasts over the last several RTEP planning cycles and other changes in the area, these projects are no longer required. The net change to the RTEP to incorporate all of these changes is a decrease of $68.64 million.

Review by the Transmission Expansion Advisory Committee (TEAC)

The need for the projects noted in this report was reviewed with stakeholders at several meetings throughout 2017, most recently at the January 2018 TEAC and Subregional RTEP Committee meetings. Written comments were requested to be submitted to PJM to communicate any concerns with the recommendations. 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 and Attachment B. Attachment A shows the projects with cost allocations to a single zone. Attachment B shows the projects with cost allocations to multiple zones.

Cost allocations for the projects were calculated in accordance with the Schedule 12 of the Open Access Transmission Tariff (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. 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 ($ million)	Trans Owner	Cost Responsibility	Required IS Date
b2816	Re-connect the Crane – Windy Edge 110591 & 110592 115 kV circuits into the Northeast Substation with the addition of a new 115 kV three115kV 3-breaker bay.	$6.00	BGE	BGE	June 1, 2018
b2977	Proposal 2017_1-6A	$9.17	DEOK	DEOK	June 1, 2021
b2977.1	Install a new 345kV breaker "1422" so Pierce 345/138KV transformer #18 is now fed in a double breaker, double bus configuration.	$0.00	DEOK	DEOK	June 1, 2021
b2977.2	Remove X-533 No. 2 to the first tower outside the station. Install a new first tower for X-533 No. 2.	$0.00	DEOK	DEOK	June 1, 2021
b2977.3	Install new 345KV breaker B and move the Buffington-Pierce 345kV feeder to the B-C junction. Install a new tower at the first tower outside the station for the Buffington-Pierce 345 kV345kV line.	$0.00	DEOK	DEOK	June 1, 2021
b2977.4	Remove breaker A and move the Pierce 345/138kV transformer #17 feed to the C-D junction.	$0.00	DEOK	DEOK	June 1, 2021
b2977.5	Replace breaker 822 at Beckjord 138kV substation to increase the rating from Pierce to Beckjord 138 kV138kV to 603 MVA603MVA.	$0.00	DEOK	DEOK	June 1, 2021
b2978	Install two 125 MVAR STATCOMs at Rawlings Substation and one 125 MVAR STATCOM at Clover Substation.	$100.00	Dominion	Dominion	May 31, 2021
b2979	Replace Martins Creek 230 kV circuit breakers with 80 kA rating.	$14.30	PPL	PPL	June 1, 2018
b2980	Rebuild 115kV Line #43 between Staunton and Harrisonburg (22.8 miles) to current standards with a summer emergency rating of 261 MVA at 115 kV.115kV	$37.50	Dominion	Dominion	Oct. 31, 2022
b2981	Rebuild 115kV Line #29 segment between Fredericksburg and Aquia Harbor to current 230 kV230kV standards (operating at 115kV) utilizing steel H-frame structures with 2-636 ACSR to provide a normal continuous summer rating of 524 MVA at 115kV (1047 MVA at 230 kV).230kV)	$12.50	Dominion	Dominion	Dec. 31, 2022
b2982	Construct a 230/69kV station at Hillsdale Substation and tie to Paramus and Dumont at 69 kV69kV.	$115.00	PSEG	PSEG	June 1, 2018
b2983	Convert Kuller Road to a 69/13kV station	$98.25	PSEG	PSEG	June 1, 2018
b2984	Reconfigure the bus at Glory and install a 50.4 MVAR 115 kV capacitor	$3.30	PENELEC	PENELEC	June 1, 2021

Upgrade ID	Description	Cost Estimate ($ million)	Trans Owner	Cost Responsibility	Required IS Date
b2985	Replace the 230 kV CB #225 at Linwood Substation (PECO) with a double circuit breaker (back to back circuit breakers in one device).	$1.40	PECO	PECO	June 1, 2022

Reliability Project Multiple Zone Allocations

Upgrade ID	Description	Cost Estimate ($M)	Trans Owner	Cost Responsibility	Required IS Date
b2978	Install two 500 kV, 125 MVAR STATCOMs at Rawlings Substation and one 125 MVAR STATCOM at Clover Substation.	$100.00	Dominion	AEC (0.83%) / AEP (7.08%) / APS (2.86%) / ATSI (3.94%) / BGE (2.11%) / ComEd (6.66%) / Dayton (1.06%) / DEOK (1.65%) / DL (0.88%) / Dominion (56.43%) / DPL (1.25%) / EKPC (0.94%) / JCPL (1.87%) / ME (0.95%) / NEPTUNE (0.22%) / PECO (2.66%) / PENELEC (0.95%) / PEPCO (1.99%) / PPL (2.42%) / PSEG (3.13%) / RE (0.13%)	May 31, 2021