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

PJM Staff White Paper

PJM Interconnection
September 2021

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Contents

I. Executive Summary

On July 29, 2021, the PJM Board of Managers approved changes to the Regional Transmission Expansion Plan (RTEP), totaling an overall net increase of $221.77 million, to resolve baseline reliability criteria violations and address changes to existing projects.

Since then, PJM has identified additional baseline reliability criteria violations and the transmission system enhancements needed to solve them, at an estimated cost of $192.2 million. Scope changes to existing projects will result in a net decrease of $6.64 million, and cancellation to existing projects will result in a net decrease of $108.51 million. This yields an overall RTEP net increase of $77.05 million, for which PJM recommended Board approval. With these changes, RTEP projects will total approximately $38,798.7 million since the first Board approvals in 2000.

PJM sought Reliability and Security Committee consideration and full Board approval of the RTEP baseline projects summarized in this white paper. On September 22, 2021, the Board approved the addition of RTEP baseline projects as well as other changes to the RTEP as summarized in this paper.

II. Baseline Reliability Recommendations

A key dimension of PJM's RTEP process is baseline reliability evaluation, which is necessary before subsequent interconnection requests can be analyzed. Baseline analysis identifies system violations to reliability criteria and standards, determines the potential to improve the market efficiency and operational performance of the system, and incorporates any public policy requirements. PJM then develops transmission system enhancements to solve identified violations and reviews them with stakeholders through the Transmission Expansion Advisory Committee (TEAC) and Subregional RTEP Committee prior to submitting its recommendation to the Board. Baseline reliability transmission enhancement costs are allocated to PJM responsible customers.

III. Baseline Reliability Projects Summary

A summary of baseline projects with estimated costs equal to or greater than $10 million is provided below. A complete listing of all recommended projects and their associated cost allocations is included in Attachment A (allocations to a single zone) and Attachment B (allocations to multiple zones). Projects with estimated costs less than $10 million typically include, by way of example, transformer replacements, line reconductoring, breaker replacements and upgrades to terminal equipment, including relay and wave trap replacements.

A. AEP Transmission Zone

- Rebuild Skeggs Branch substation in the clear as Coronado 138/69 kV station and implement 69 kV system upgrades to support the Buchanan 1 and 2 generator deactivations and supplemental needs in the area: $40.17 million

B. APS Transmission Zone

- Reconductor the Charleroi-Union Jct. 138 kV line and upgrade terminal equipment at Charleroi 138 kV: $11 million

C. DL Transmission Zone

- Add forced cooling to increase the normal rating of the Brunot Island-Carson 345 kV High-Pressure Fluid Filled (HPFF) underground cable circuit: $22 million

D. DPL Transmission Zone

- Rebuild the Farmview-S. Harrington 138 kV line: $16.9 million
- Rebuild the Steele-Milford 230 kV line: $63 million
- Rebuild the Vienna-Nelson 138 kV line: $31.25 million

PJM also recommended projects totaling $7.88 million, which include a 138 kV line rebuild, a 138 kV line section reconductor, relay, bus section, circuit breaker replacements and bus, relay and disconnect switch upgrades, whose individual cost estimates are less than $10 million.

A more detailed description of the larger-scope projects that PJM recommended to the Board is provided below.

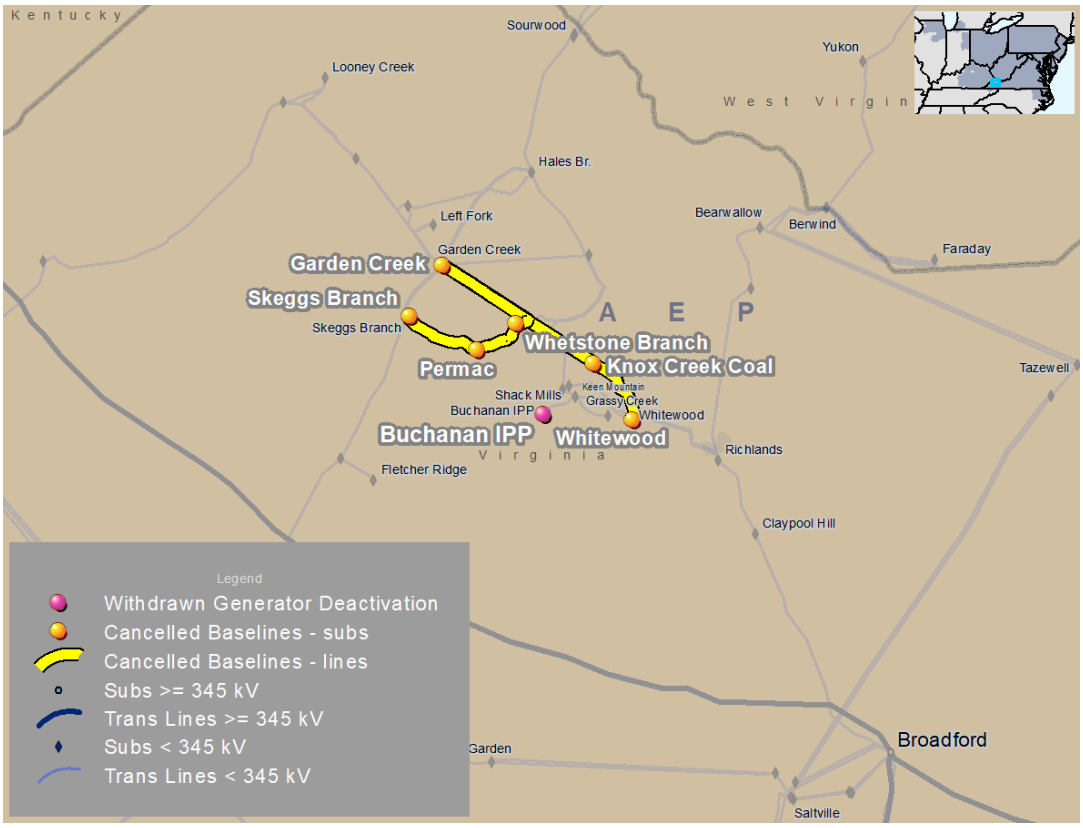
E. Baseline Reliability Project Details

Baseline Project b3333: Skeggs Branch Area Improvements

AEP Transmission Zone

The deactivation of Buchanan 1 and 2, which have a requested deactivation date of June 1, 2023, results in the overload of the Garden Creek-Whetstone, Whetstone-Knox Creek and Knox Creek-Coal Creek 69 kV lines for various N-1 outage combinations. The Richland, Whitewood, Shack Mills, Grassy Creek, Buchanan and Keen Mountain 138 kV buses also become radial for various N-1 outage combinations, and, as a result, these radial-connected 138 kV buses (and 69 kV buses through Richland 138 kV bus) have voltage magnitude and drop violations. The violations from the deactivation study were initially resolved by existing baseline projects b3139-b3141 and b3220. However, there are supplemental needs identified in the area, so a new holistic alternative is being recommended in lieu of the previously identified projects.

Map 1. b3333: Skeggs Branch Area Improvements



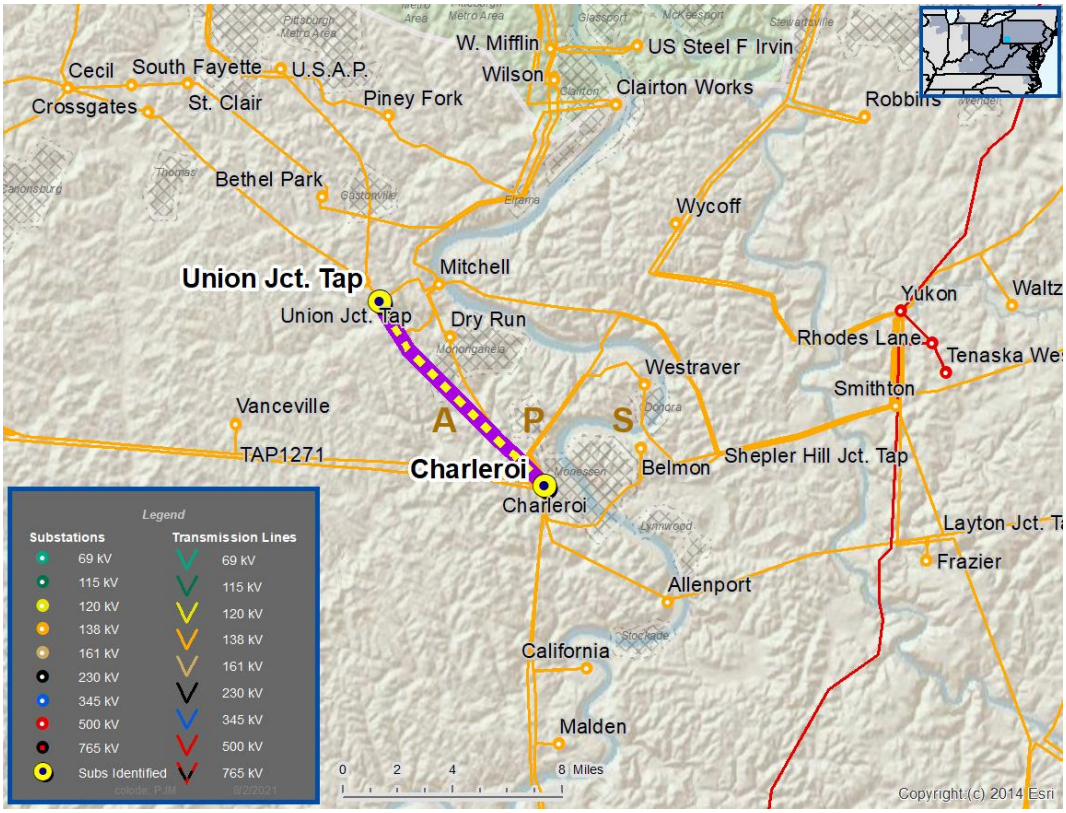
The recommended solution is to rebuild the Skeggs Branch substation in the clear as Coronado substation (the existing Skeggs Branch substation will be retired), by establishing new 138 kV and 69 kV buses, and installing a 138/69 kV 130 MVA transformer, 138 kV circuit switcher and a 69 kV breaker. Approximately 1.2 miles of 138 kV extension will be built to the Coronado substation, and a 46.1 MVAR capacitor bank and 138 kV circuit breaker will be installed at the Whitewood substation. The project will rebuild approximately 9 miles of 69 kV line from the Coronado station to the Coal Creek 69 kV line, and six-wire the short double circuit section between Whetstone Branch and structure 340-28 to convert the line to a single circuit. The Garden Creek to Whetstone Branch 69 kV line section, along with the Knox Creek and Horn Mountain 69 kV switching stations, will be retired. At the Clell 69 kV switching station, two 600 A phase-over-phase (POP) switches and poles will be replaced with a single two-way 1200 A POP switch and pole. At Permac and Marvin 69 kV switching stations, a 600 A switch and structure will be replaced with a two-way 1200 A POP pole switch and pole. At Whetstone Branch 69 kV substation, a 600 A two-way POP switch will be replaced with a 1200 A two-way POP switch, and the No. 22 POP switch to Skeggs Branch will be removed. At Garden Creek 69 kV substation, the Richlands (via Coal Creek) 69 kV line (circuit breaker F and disconnect switches) will be removed and relay settings will be updated. The project also includes remote-end work at Clinch River and Clinchfield 69 kV substations. The estimated cost for this project is $40.17 million, with a required in-service date of June 2023. The projected in-service date is December 2023, and the local transmission owner, AEP, will be designated to complete this work.

Baseline Project b3325: Charleroi-Union Jct. 138 kV

APS Transmission Zone

The deactivation of Waukegan 7 and 8 and Will County 4, which have a requested deactivation date of May 31, 2022, results in the overload of the Charleroi-Union Jct. 138 kV line for an N-2 outage.

Map 2. b3325: Charleroi-Union Jct. 138 kV



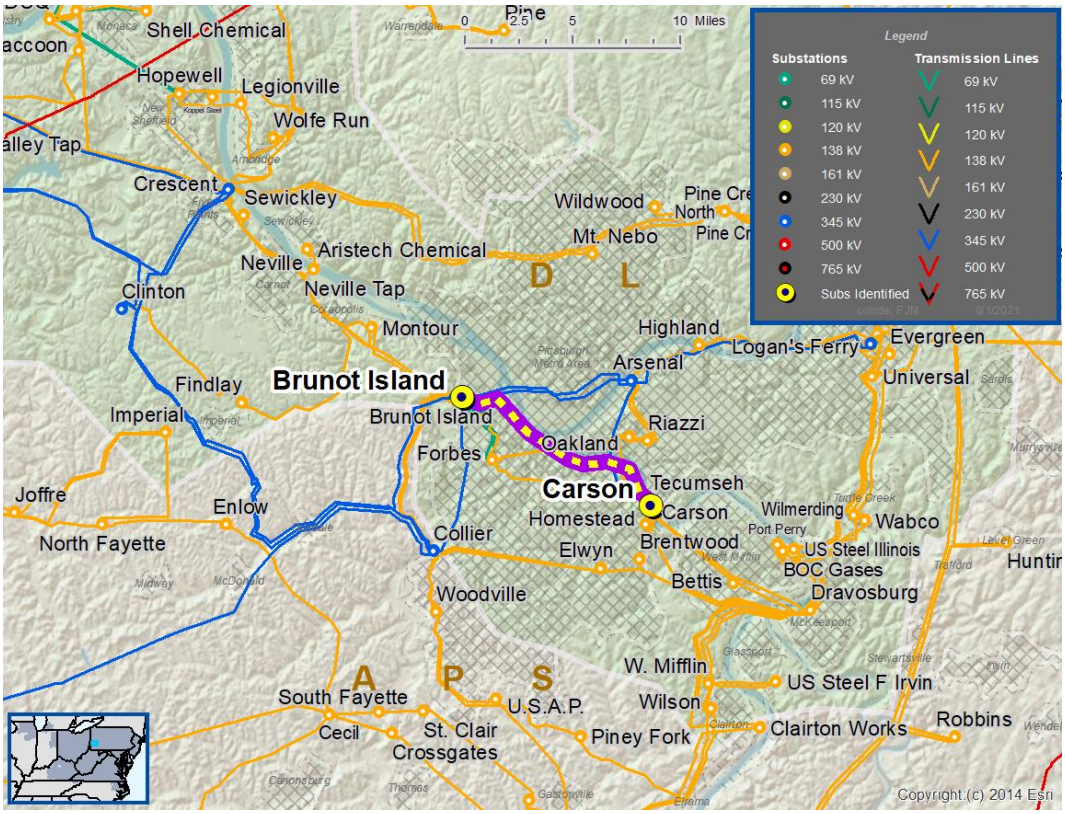
The recommended solution is to reconductor the Charleroi-Union Jct. 138 kV line and upgrade the terminal equipment at Charleroi 138 kV. The estimated cost for this project is $11 million, with a required in-service date of June 2022. The projected in-service date is June 2023, and operating measures have been identified to mitigate reliability impacts in the interim. The local transmission owner, APS, will be designated to complete this work.

Baseline Project b3319: Brunot Island-Carson 345 kV

DL Transmission Zone

The deactivation of Cheswick 1, which has a requested deactivation date of April 1, 2022, results in the overload of the Brunot Island-Carson 345 kV cable for an N-2 underground common trench failure outage. The criteria used to identify the overload is part of Duquesne Light Company's FERC 715 Planning Criteria.

Map 3. b3319: Brunot Island-Carson 345 kV



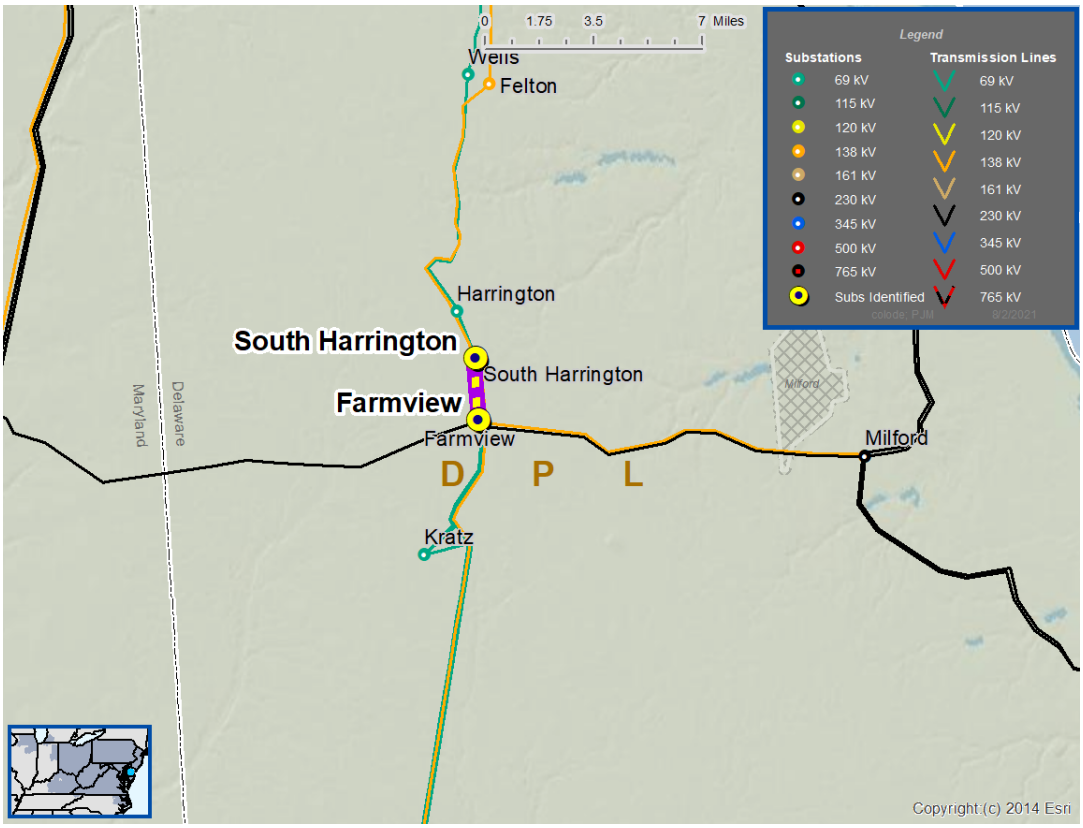
The recommended solution is to add forced cooling to increase the normal rating of the Brunot Island-Carson 345 kV High-Pressure Fluid Filled (HPFF) underground cable circuit. The estimated cost for this project is $22 million, with a required in-service date of June 2022. The projected in-service date is December 2024, and operating measures have been identified to mitigate reliability impacts in the interim. The local transmission owner, DL, will be designated to complete this work.

Baseline Project b3330: Farmview-S. Harrington 138 kV

DPL Transmission Zone

The deactivation of Indian River 4, which has a requested deactivation date of May 31, 2022, results in the overload of the Farmview-S. Harrington 138 kV line for various N-1 outage combinations.

Map 4. b3330: Farmview-S. Harrington 138 kV



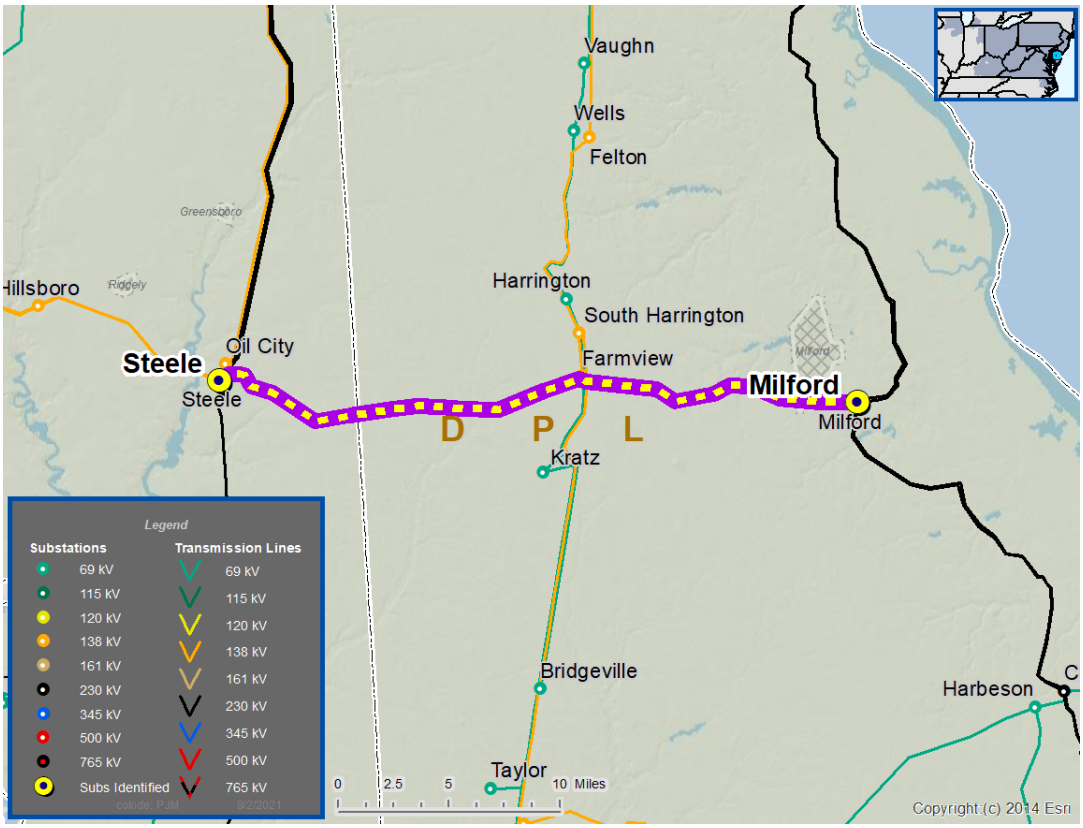
The recommended solution is to rebuild the Farmview-S. Harrington 138 kV line. The estimated cost for this project is $16.9 million, with a required in-service date of June 2022. The projected in-service date is June 2026, and operating measures are not available in the interim. PJM Planning/Operations and DPL are continuing to investigate mitigation. The local transmission owner, DPL, will be designated to complete this work.

Baseline Project b3332: Steele-Milford 230 kV

DPL Transmission Zone

The deactivation of Indian River 4, which has a requested deactivation date of May 31, 2022, results in the overload of the Steele-Milford 230 kV line for various N-1 outage combinations.

Map 5. b3332: Steele-Milford 230 kV



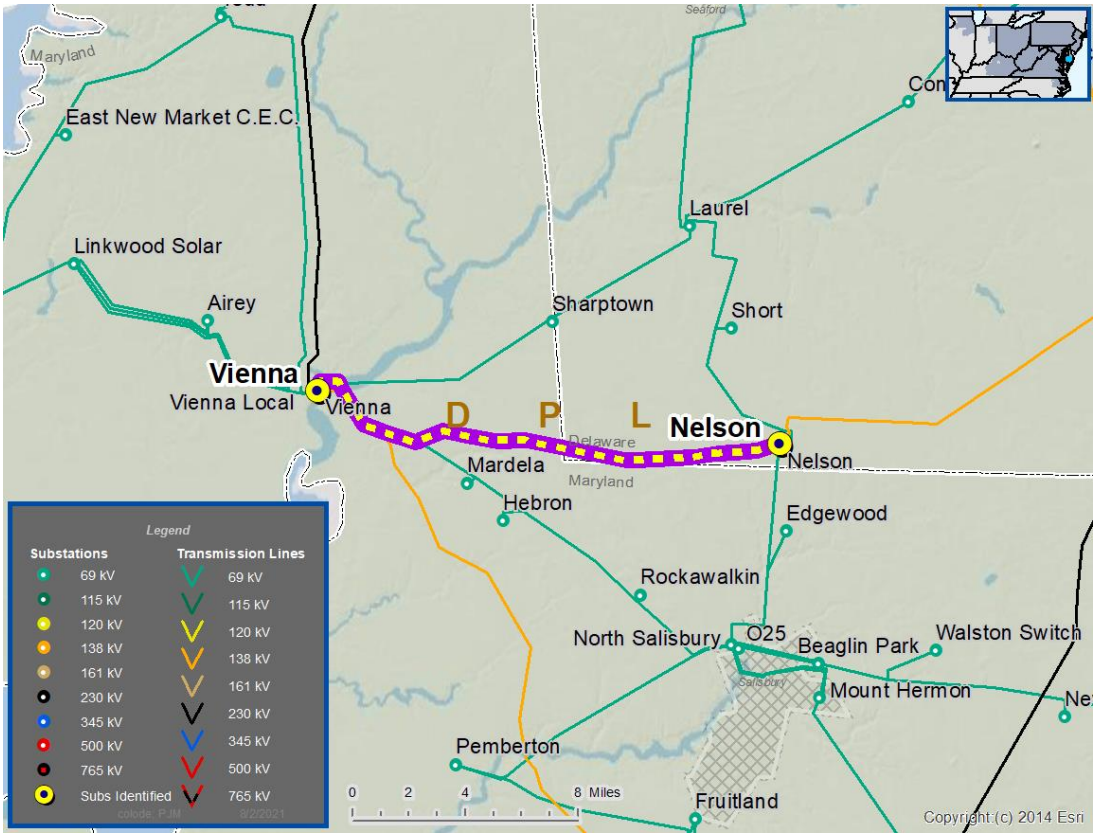
The recommended solution is to rebuild the Steele-Milford 230 kV line. The estimated cost for this project is $63 million, with a required in-service date of June 2022. The projected in-service date is June 2027, and operating measures are not available in the interim. PJM Planning/Operations and DPL are continuing to investigate mitigation. The local transmission owner, DPL, will be designated to complete this work.

Baseline Project b3326: Vienna-Nelson 138 kV

DPL Transmission Zone

The deactivation of Indian River 4, which has a requested deactivation date of May 31, 2022, results in the overload of the Vienna-Nelson 138 kV line for an N-2 and various N-1 outage combinations.

Map 6. b3326: Vienna-Nelson 138 k



The recommended solution is to rebuild the Vienna-Nelson 138 kV line. The estimated cost for this project is $31.25 million, with a required in-service date of June 2022. The projected in-service date is June 2026, and operating measures are not available in the interim. PJM Planning/Operations and DPL are continuing to investigate mitigation. The local transmission owner, DPL, will be designated to complete this work.

IV. Changes to Previously Approved Projects

F. Cancellations

The following cancellations were recommended:

AEP Transmission Zone

- The following four baseline projects were originally recommended to address violations identified for the Buchanan 1 and 2 generator deactivation study. However, there are supplemental needs identified in the area, so a new holistic alternative is being recommended (b3333) in lieu of the projects listed below:
  - Baseline project b3139 (rebuild the Garden Creek-Whetstone 69 kV line) is no longer needed. The project had an estimated cost of $14 million.

- Baseline project b3140 (rebuild the Whetstone-Knox Creek 69 kV line) is no longer needed. The project had an estimated cost of $9 million.

- Baseline project b3141 (rebuild the Knox Creek-Coal Creek 69 kV line) is no longer needed. The project had an estimated cost of $9 million.

- Baseline project b3220 (install a 14.4 MVAR capacitor bank at Whitewood 138 kV) is no longer needed. The project had an estimated cost of $1.2 million.

ATSI Transmission Zone

- Baseline project b2675 (install a 26.4 MVAR capacitor and associated terminal equipment at Lincoln Park 138 kV substation) is no longer needed due to a shift in flows caused by an upgrade on the Leroy Center-Mayfield 345 kV line (b3152). The project had an estimated cost of $1 million.

DL Transmission Zone

- The following baseline projects were originally identified during the Beaver Valley 1 and 2 deactivation study. Subsequently, the deactivation request was withdrawn, eliminating the reliability need for the projects:

  - Baseline project b3012.2 (construct two new 138 kV ties from a new FirstEnergy substation to a new Duquesne substation by using two separate structures) is no longer needed. The project had an estimated cost of $4.6 million.

  - Baseline project b3012.4 (establish the new 138 kV tie line in place of the existing Elrama-Mitchell 138 kV line) is no longer needed. The project had an estimated cost of $1 million.

  - Baseline project b3015.1 (construct a new Elrama 138 kV substation and connect seven 138 kV lines to the new substation) is no longer needed. The project had an estimated cost of $16.6 million.

  - Baseline project b3015.3 (reconductor 3 miles of the Dravosburg-West Mifflin 138 kV line) is no longer needed. The project had an estimated cost of $1.7 million.

  - Baseline project b3015.4 (run new 10 miles of conductor on existing tower to establish the new Dravosburg-Elrama [Z-75] circuit) is no longer needed. The project had an estimated cost of $6.7 million.

  - Baseline project b3015.7 (reconductor 2 miles of Wilson-West Mifflin 138 kV line) is no longer needed. The project had an estimated cost of $1.7 million.

  - Baseline project b3061 (reconductor the West Mifflin-Dravosburg [Z-73] and Dravosburg-Elrama [Z-75] 138 kV lines) is no longer needed. The project had an estimated cost of $5.7 million.

– Baseline project b3062 (install a 138 kV tie breaker at West Mifflin station) is no longer needed. The project had an estimated cost of $4 million.

– Baseline project b3063 (reconductor approximately 5 miles of the Wilson-Dravosburg [Z-72] 138 kV line) is no longer needed. The project had an estimated cost of $4.8 million.

– Baseline project b3064 (expand the Elrama 138 kV substation to loop in the existing USS Steel Clairton-Piney Fork 138 kV line) is no longer needed. The project had an estimated cost of $8.75 million.

– Baseline project b3065 (install a 138 kV tie breaker at Wilson station) is no longer needed. The project had an estimated cost of $4 million.

JCPL Transmission Zone

- Baseline project b2586 (upgrade the Allenhurst-Elberon 34.5 kV transmission line) is no longer needed because the Allenhurst-Elberon 34.5 kV line will be upgraded as part of the MCRP project (b3130). The project had an estimated cost of $14.76 million.

These changes yield a net RTEP decrease of $108.51 million.

G. Scope/Cost Changes

The following scope/cost modifications were recommended:

AEP Transmission Zone

- Baseline project b3278 (Abington area improvements) has undergone a scope change. The change in scope affects the replacement of MOAB switches at Saltville station on the high side of the 138/69/34.5 kV transformer T1 with a high-side circuit switcher (b3278.1). An AEP supplemental solution requires the Saltville station to be reconfigured in a breaker-and-a-half configuration, which eliminates the need for the circuit switcher. Instead, the project will now install two breakers and bus differential protection at the Saltville station (b3278.3). The new project cost has an estimated cost of $0.36 million. For the time being, b3278.1 will be placed on hold, and in the event the supplemental project is cancelled, the new modified scope (b3278.3) will be cancelled and the original scope (b3278.1) will be reactivated.

Dominion Transmission Zone

- Baseline project b3246 (Manassas area improvements) has undergone a scope change. During the engineering of the original scope, it was determined that four delivery points required scope changes based on conversations with NOVEC and the City of Manassas Electric Department. The project will no longer include the 0.36-mile line segment rebuild between Lomar and Cannon Branch 115 kV. The total cost of the project has decreased from $45.5 million to $38.5 million, yielding an RTEP decrease of $7 million.

These changes yield a net RTEP increase of $6.64 million.

V. Review by the Transmission Expansion Advisory Committee (TEAC)

Project needs and recommended solutions as discussed in this report were reviewed with stakeholders during 2021, most recently at the August 2021 TEAC and Subregional RTEP Committee meetings. Written comments were requested to be submitted to PJM to communicate any concerns with project recommendations. No comments have been received as of this white paper publication date.

VI. Cost Allocation

Cost allocations for recommended projects are shown in Attachment A (for allocation to a single zone) and Attachment B (for allocation to multiple zones).

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

VII. Board Approval

The PJM Reliability and Security Committee is requested to endorse the changes to the RTEP proposed in this white paper, and recommended to the full Board for approval the changes to existing RTEP projects as detailed in this white paper to be included in PJM's RTEP. On September 22, 2021, the Board approved the addition of RTEP baseline projects as well as other changes to the RTEP as summarized in this paper. The RTEP is published annually on PJM's website.

Attachment A – Reliability Project Single-Zone Allocations

Upgrade ID	Description	Cost Estimate ($M)	Transmission Owner	Cost Responsibility	Required In-Service Date
b3278.3	Saltville Station: Install two 138 kV breakers and bus diff protection	$0.36	AEP	AEP	12/1/2025
b3318	Reconductor the Shanor Manor - Butler 138 kV line with an upgraded circuit breaker at Butler	$1.50	APS	APS	6/1/2022
b3319	Add forced cooling to increase the normal rating of the Brunot Island-Carson (302) 345 kV High Pressure Fluid Filled (HPFF) underground cable circuit	$22.00	DL	DL	6/1/2022
b3324	Replace the bus section at Olive	$0.10	AEP	AEP	6/1/2022
b3325	Reconductor the Charleroi - Union 138 kV line and upgrade terminal equipment at Charleroi	$11.00	APS	APS	6/1/2022
b3326	Rebuild the Vienna - Nelson 138 kV line	$31.25	DPL	DPL	6/1/2022
b3327	Upgrade the disconnect switch and Kent	$0.18	DPL	DPL	6/1/2022
b3328	Upgrade the disconnect switch and CT at Vienna	$0.25	DPL	DPL	6/1/2022
b3329	Rebuild the Farmview - Milford 138 kV line	$5.50	DPL	DPL	6/1/2022
b3330	Rebuild the Farmview - S. Harrington 138 kV line	$16.90	DPL	DPL	6/1/2022
b3331	Upgrade stranded bus and relay at Seaford	$0.35	DPL	DPL	6/1/2022
b3332	Rebuild the Steele - Milford 230 kV line	$63.00	DPL	DPL	6/1/2022
b3333.1	Rebuild Skeggs Branch substation in the clear as Coronado substation. Establish New 138 kV and 69 kV Buses. Install 138/69 kV 130 MVA transformer, 138 kV circuit switcher and 69 kV breaker. Retire Existing Skeggs Branch substation.	$6.32	AEP	AEP	6/1/2023
b3333.2	New ~1.2 mi 138 kV extension to new Skeggs Branch substation location.	$4.62	AEP	AEP	6/1/2023

b3333.3	Install 46.1 MVAR Cap bank at Whitewood substation along with a 138 kV breaker.	$1.05	AEP	AEP	6/1/2023
b3333.4	Rebuild ~9 mi 69 kV line from new Skeggs branch station to Coal Creek 69 kV line. 6-wire the short double circuit section between Whetstone Branch and Str. 340-28 to convert the line to single circuit. Retire Garden Creek to Whetstone Branch 69 kV line section.	$26.25	AEP	AEP	6/1/2023
b3333.5	Retire Knox Creek SS	$0.06	AEP	AEP	6/1/2023
b3333.6	Retire Horn Mountain SS. This will be served directly from 69 kV bus at New Skeggs branch Substation.	$0.05	AEP	AEP	6/1/2023
b3333.7	At Clell SS, replace two 600 A POP Switches and Poles with single 2 Way 1200 A POP Switch and Pole.	$0.34	AEP	AEP	6/1/2023
b3333.8	At Permac, replace 600 A Switch and structure with 2 Way 1200 A POP Pole Switch and pole.	$0.31	AEP	AEP	6/1/2023
b3333.9	At Marvin SS, replace 600 A Switch and structure with 2 Way 1200 A POP Pole Switch and pole.	$0.31	AEP	AEP	6/1/2023
b3333.10	At Whetstone Branch substation, replace 69 kV 600 A 2 Way POP Switch with 69 kV 1200 A 2 Way POP Switch. Remove 69 kV to Skeggs Branch (Switch "22" POP).	$0.57	AEP	AEP	6/1/2023
b3333.11	At Garden Creek substation, remove 69 kV Richlands (via Coal Creek) line (Circuit Breaker F and disconnect switches) and update relay settings	$0.14	AEP	AEP	6/1/2023
b3333.12	Remote end work at Clinch River substation	$0.08	AEP	AEP	6/1/2023
b3333.13	Remote end work at Clinchfield substation.	$0.08	AEP	AEP	6/1/2023

Attachment B – Reliability Project Multi-Zone Allocations

None