

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

PJM Staff Whitepaper

PJM Interconnection

February 2020

For Public Use

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I. Executive Summary

On December 3, 2019, the PJM Board of Managers approved changes to the Regional Transmission Expansion Plan (RTEP), totaling \$163 million, primarily to resolve baseline reliability criteria violations.

Since then, PJM has identified additional baseline reliability criteria violations and the transmission system enhancements needed to solve them, at an estimated cost of \$236.97 million. In addition, three previously approved baseline projects have been canceled, resulting in a net cost decrease of \$3 million. This yields an overall RTEP net increase of \$233.97 million, for which PJM is recommending Board approval. With these changes, RTEP projects will total \$37,818.07 million since the first Board approvals in 2000.

PJM seeks Board Reliability Committee consideration and full Board approval of the additional RTEP baseline projects summarized in this whitepaper.

II. February 2020 Baseline Reliability Recommendations

A key dimension of PJM's RTEP process is baseline reliability evaluation, necessary before subsequent interconnection requests can be analyzed. Baseline analysis identifies system violations to reliability criteria and standards. 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 Committees prior to recommendation to the Board. Baseline reliability transmission enhancement costs are allocated to PJM load.

III. Baseline Reliability Projects Summary

A summary of baseline projects with estimated costs equal to or greater than \$5 million is provided below. A complete listing of all recommended projects and their associated cost allocations is included in Attachment A (for allocation to a single zone) and Attachment B (for allocation to multiple zones). Projects with estimated costs less than \$5 million typically include line rebuilds, new Greenfield stations, reconductoring and replacement of terminal equipment

A. FERC Form No. 715 Transmission Owner Criteria-Driven Enhancements

1. AEP Transmission Zone:

- Rebuild the Garden Creek-Whetstone 69 kV line (~4 mile): \$14 million
- Rebuild the Whetstone-Knox Creek 69 kV line (3.1 mile): \$9 million
- Rebuild the Knox Creek-Coal Creek 69 kV line (2.9 mile): \$9 million
- Rebuild the Bradley-Scarbro 46 kV (7.8) line with 795 ACSR, including remote-end work at Bradley and Scarbro: \$27.7 million
- Rebuild the 2.3-mile Decatur-South Decatur 69 kV line using 556 ACSR: \$9.3 million
- Rebuild Ferguson 69/12 kV station in the clear as the 138/12 kV Bear station, and connect it to a ~1-mile double circuit 138 kV extension from the Aviation-Ellison Rd 138 kV line to remove the load from the 69 kV line: \$6.4 million
- Rebuild the 30-mile Gateway-Wallen 34.5 kV circuit as the 27-mile Gateway-Wallen 69 kV circuit: \$113 million

2. AMPT Transmission Zone:

- Construct a Greenfield 0.3-mile 138 kV double circuit line tapping the Beaver-Black River (ATSI) 138 kV line; Expand the Amherst No. 2 substation with the installation of three-138 kV circuit breakers; one-138/69/12 kV 130 MVA transformer and two-69 kV circuit breakers: \$7.5 million

B. Baseline Load Growth Deliverability & Reliability-Driven Enhancements**1. ATSI Transmission Zone:**

- Reconductor the 8.4-mile section of the Leroy Center-Mayfield Q1 line between Leroy Center-Pawnee Tap to achieve a rating of at least 160 MVA/192 MVA (SN/SE): \$14.1 million

2. DPL Transmission Zone:

- Rebuild approximately 12 miles of Wye Mills-Stevensville 69 kV line to achieve needed ampacity: \$15 million
- Reconductor the Silverside-Darley 69 kV line and replace terminal equipment: \$5.5 million

PJM is also recommending six projects totaling \$6.47 million that include line relay replacement, terminal equipment upgrades, breaker replacements, modifications to clearing times and the installation of a capacitor whose individual cost estimates are less than \$5 million each.

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

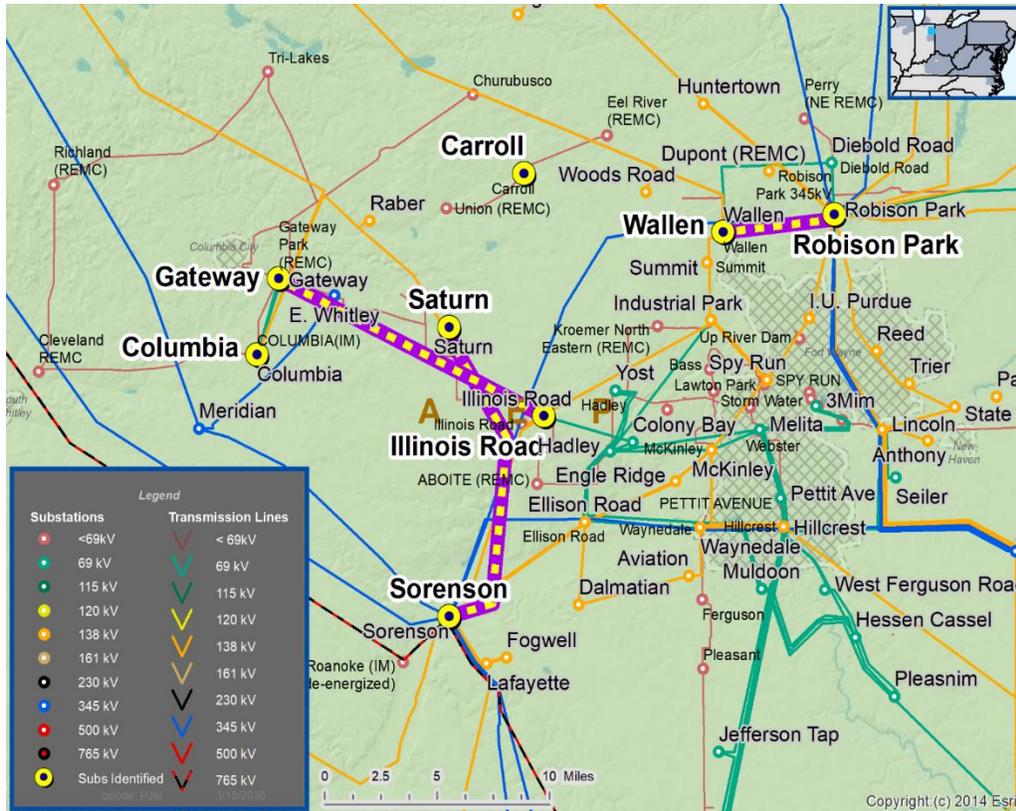
Baseline Project b3151: Western Fort Wayne Area Improvements

AEP Transmission Zone

AEP FERC 715 Transmission Owner Criteria violations were identified in the western Fort Wayne, Indiana area. N-1 and N-1-1 thermal and voltage analysis identified multiple TO criteria violations for contingencies in the Carroll, Sorenson, Columbia and Whitley stations.

PJM worked closely with AEP to evaluate the thermal and voltage violations, and after confirming the validity of the violations, developed the following recommended solution.

Map 1. **Western Fort Wayne Area**



The recommended solution: Baseline Project b3151 addresses the thermal and voltage criteria violations when fully completed. The solution rebuilds the 30-mile Gateway-Wallen 34.5 kV circuit as the 27-mile Gateway-Wallen 69 kV circuit, including the retirement of 3 miles of the Columbia-Whitley 34.5 kV line. At the Gateway station, replace the 34.5 kV equipment with a 69 kV circuit breaker for the new Whitley line.

Rebuild Whitley as a 69 kV station, and replace the Union and Eel River 34.5 kV switches with 69 kV switches. Install a 69 kV switch at the Woodland station.

Replace Carroll and Churubusco 34.5 kV stations with the 69 kV Snapper station. Rebuild the 2.5-mile Columbia-Gateway 69 kV line. Rebuild Columbia as a 138/69 kV station with a 4-breaker ring bus.

Rebuild the 13-mile Columbia-Richland 69 kV line, rebuild 0.5 miles of Whitley-Columbia City 1 and Whitley-Columbia City 2 lines as 69 kV. Rebuild the 0.6-mile double circuit section of the Rob Park-South Hicksville/Rob Park-Diebold Rd. as 69 kV.

The recommended solution addresses the baseline needs in the area. The estimated cost for this project is \$113 million, and the projected in-service date is March 2022. The local transmission owner, AEP, will be designated to complete this work.

Baseline Project b3148: Rebuild Bradley-Scarbro 46kV Line

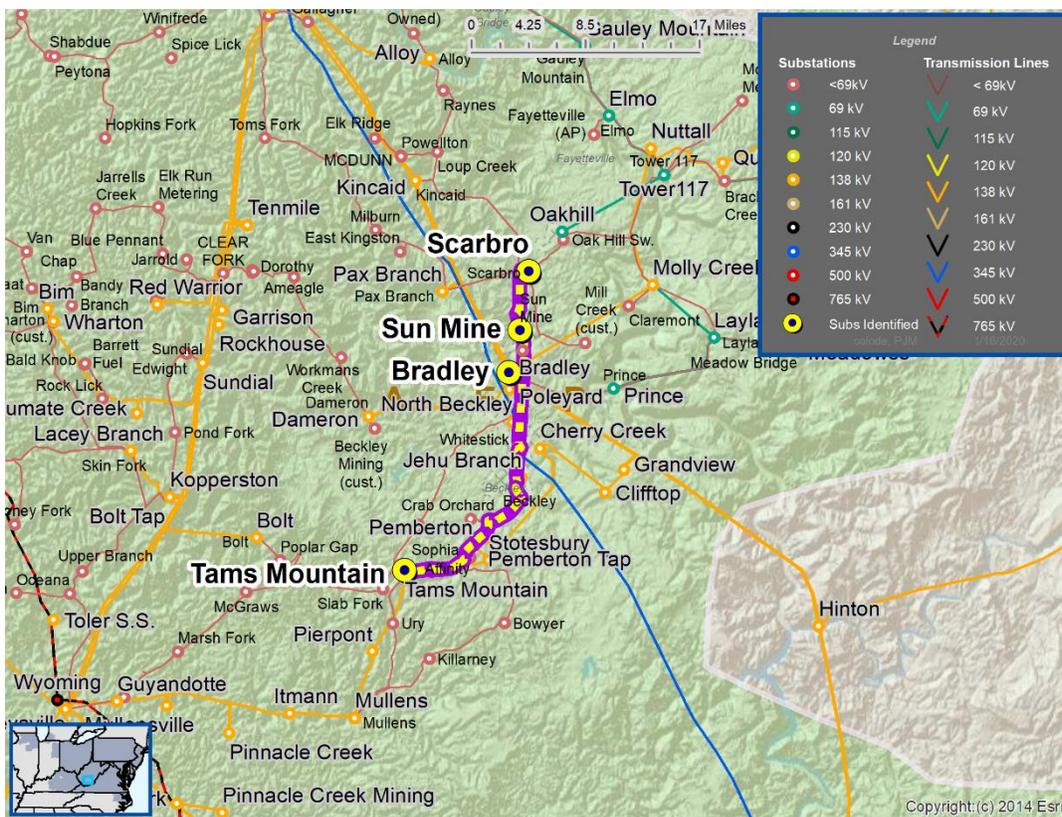
AEP Transmission Zone

AEP FERC 715 N-1-1 thermal and voltage violations are identified on the Bradley-Sun 46 kV line section and Tams Mountain-Glen White 46 kV line section for N-1-1 contingencies in the 2021 Winter RTEP Case.

Additionally, voltage magnitude violations are seen at the Beckley 46 kV, Whitestick 46 kV, Bradley 46 kV and Mt Hope 46 kV substations. Voltage drop violations are seen at the Sun 46 kV station, Mt Hope 46 kV station, Bradley 46 kV station, Whitestick 46 kV station, and Beckley 46 kV stations.

Additionally, Bradley-Scarbro 46 kV circuit has equipment material/condition/performance/risk issues shown in Supplemental Need AEP-2019-AP049.

Map 2. **Bradley-Scarbro 46 kV**



The recommended solution is to rebuild the 46 kV Bradley-Scarbro line (~7.8 miles). The new 46 kV line will be built with 795 ACSR (120 MVA) and 69 kV standards. Additional work includes Bradley remote-end station work, replace 46 kV bus, and install new 12 MVAR capacitor bank. The switch at Sun station will be replaced with a 2-way SCADA-controlled MOAB switch. Remote-end work and associated equipment at Scarbro station is required for this solution. Additionally, PJM is recommending the retirement of the Mt. Hope station, transferring load to the existing Sun station. The estimated cost for this project is \$27.7 million, and the projected in-service date is June 2021. The local transmission owner, AEP, will be designated to complete this work.

IV. Transmission Owner Criteria Projects

Of the \$236.97 million of the new recommended baseline transmission system enhancements, approximately \$202 million is driven by transmission owner planning criteria, which makes up 85.4 percent of the new project cost estimates.

V. Changes to Previously Approved Projects

PJM recommends that the Board cancel the following projects:

- Baseline project b1521 (Replace the Bergen 230 kV breaker 'GSU1') is recommended for cancellation, as this work is no longer required.
- Baseline project b1522 (Replace the Bergen 230 kV breaker 'GSU2') is recommended for cancellation, as this work is no longer required.
- Baseline project b1523 (Replace the Bergen 230 kV breaker 'GSU3') is recommended for cancellation, as this work is no longer required.

These changes yield a net RTEP decrease of \$3 million.

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

Project needs and recommended solutions as discussed in this report were reviewed with stakeholders during 2019, most recently at the December 2019 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 whitepaper publication date.

VII. 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 were 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.

VIII. Board Approval

The PJM Board Reliability Committee was requested to endorse the new baseline reliability projects and associated cost allocations, and recommend to the full Board, approval of the projects in this white paper to be included in PJM's RTEP. The baseline projects will be incorporated into the published RTEP after approval by the PJM Board. The RTEP will be published on PJM's website.

Attachment A – Reliability Project Single-Zone Allocations

Upgrade ID	Description	Cost Estimate (\$M)	Trans Owner	Cost Responsibility	Required IS Date
b3015.8	Upgrade terminal equipment at Mitchell for Mitchell – Elrama 138 kV line	\$2.00	APS	APS	6/1/2021
b3064.3	Upgrade line relaying at Piney Fork and Bethel Park for Piney Fork – Elrama 138 kV line and Bethel Park – Elrama 138 kV line.	\$0.60	APS	APS	6/1/2021
b3139	Rebuild the Garden Creek - Whetstone 69 kV line (~4 mile)	\$14.00	AEP	AEP	6/1/2023
b3140	Rebuild the Whetstone - Knox Creek 69 kV line (3.1 mile)	\$9.00	AEP	AEP	6/1/2023
b3141	Rebuild the Knox Creek - Coal Creek 69 kV line (2.9 mile)	\$9.00	AEP	AEP	6/1/2023
b3143.1	Reconductor the Silverside – Darley 69 kV circuit	\$1.39	DPL	DPL	6/1/2024
b3143.2	Reconductor the Darley – Naamans 69 kV circuit	\$2.09	DPL	DPL	6/1/2024
b3143.3	Replace three (3) existing 1200 A disconnect switches with 2000 A disconnect switches and install three (3) new 2000 A disconnect switches at Silverside 69 kV station	\$0.48	DPL	DPL	6/1/2024
b3143.4	Replace two (2) 1200 A disconnect switches with 2000 A disconnect switches, replace existing 954 ACSR and 500 SDCU stranded bus with (2) 954 ACSR stranded bus. Reconfigure four (4) CTs from	\$0.60	DPL	DPL	6/1/2024

	1200 A to 2000 A and install two (2) new 2000 A disconnect switches, new (2) 954 ACSR stranded bus at Naamans 69 kV station				
b3143.5	Replace four (4) 1200 A disconnect switches with 2000 A disconnect switches. Replace existing 954 ACSR and 1272 MCM AL stranded bus with (2) 954 ACSR stranded bus. Reconfigure eight (8) CTs from 1200 A to 2000 A and install Four (4) new 2000 A (310 MVA SE / 351 MVA WE) disconnect switches, new (2) 954 ACSR (331 MVA SE / 369 MVA WE) stranded bus at Darley 69 kV station	\$0.95	DPL	DPL	6/1/2024
b3144	Jackson Road – Nanty Glo 46 kV SJN Line: Upgrade Bus Conductor & Relay Panels	\$1.50	PENELEC	PENELEC	6/1/2024
b3144.1	At Jackson Road 46 kV, replace line relaying and substation conductor	\$0.00	PENELEC	PENELEC	6/1/2024
b3144.2	At Nanty Glo 46 kV, replace line relaying and substation conductor	\$0.00	PENELEC	PENELEC	6/1/2024
b3146	Replace the Richmond 69 kV breaker "140" with 40 kV breaker (b)	\$0.42	PECO	PECO	6/1/2021
b3147	Modify 138 kV blue bus total clearing times at TSS111 Electric Junction to 11 cycles for fault on 345/138 kV Transformer 81, and to 13 cycles for faults on 138 kV Line	\$0.25	ComEd	ComEd	12/31/2020

	11106, 138 kV Line 11102 and 345/138 kV Transformer 82				
b3148.1	Rebuild the 46 kV Bradley-Scarbro line. The new line will be rebuilt adjacent to the existing one leaving the old line in service until the work is completed. The new 46 kV line will be built with 795 ACSR (120 MVA) and 69 kV standards.	\$22.20	AEP	AEP	12/1/2021
b3148.2	Bradley remote end station work, replace 46 kV bus, install new 12 MVAR capacitor bank.	\$3.30	AEP	AEP	12/1/2021
b3148.3	The switch at Sun Station will be replaced with a 2-way SCADA-controlled MOAB switch	\$0.90	AEP	AEP	12/1/2021
b3148.4	Remote end work and associated equipment at Scarbro Station.	\$1.30	AEP	AEP	12/1/2021
b3148.5	Retire Mt Hope Station and transfer load to existing Sun Station.	\$0.00	AEP	AEP	12/1/2021
b3149	Rebuild the 2.3 mile Decatur – South Decatur 69 kV line using 556 ACSR in order to alleviate the overloads.	\$9.30	AEP	AEP	6/1/2024
b3150	Rebuild Ferguson 69/12 kV station in the clear as the 138/12 kV Bear station and connect it to a ~1 mile double circuit 138 kV extension from the Aviation – Ellison Rd 138 kV line to remove the load from the 69 kV line.	\$6.40	AEP	AEP	6/1/2024

b3151.1	Rebuild the ~30 mile Gateway – Wallen 34.5 kV circuit as the ~27 mile Gateway – Wallen 69 kV circuit	\$43.30	AEP	AEP	6/1/2024
b3151.2	Retire the ~3 miles Columbia – Whitley 34.5 kV line.	\$0.50	AEP	AEP	6/1/2024
b3151.3	At Gateway station, remove all 34.5 kV equipment and install one (1) 69 kV circuit breaker for the new Whitley line entrance.	\$1.00	AEP	AEP	6/1/2024
b3151.4	Rebuild Whitley as a 69 kV station with two (2) line and one (1) bus tie circuit breakers.	\$4.20	AEP	AEP	6/1/2024
b3151.5	Replace the Union 34.5 kV switch with a 69 kV switch structure.	\$0.60	AEP	AEP	6/1/2024
b3151.6	Replace the Eel River 34.5 kV switch with a 69 kV switch structure.	\$0.60	AEP	AEP	6/1/2024
b3151.7	Install a 69 kV switch at Bobay adjacent to Woodland Station.	\$0.60	AEP	AEP	6/1/2024
b3151.8	Replace Carroll and Churubusco 34.5 kV stations with the 69 kV Snapper station. Snapper will have two (2) line circuit breakers, one (1) bus tie circuit breaker and a 14.4 Mvar cap bank	\$8.70	AEP	AEP	6/1/2024
b3151.9	Remove 34.5 kV circuit breaker "AD" at Wallen station.	\$0.30	AEP	AEP	6/1/2024
b3151.10	Rebuild the 2.5 mile Columbia – Gateway 69 kV line.	\$6.20	AEP	AEP	6/1/2024
b3151.11	Rebuild Columbia station in the clear as a 138/69 kV station with two (2) 138/69 kV	\$15.00	AEP	AEP	6/1/2024

	transformers and 4-breaker ring buses on the high and low side. Station will reuse 69 kV breakers “J” & “K” and 138 kV breaker “D”.				
b3151.12	Rebuild the 13 mile Columbia – Richland 69 kV line.	\$29.30	AEP	AEP	6/1/2024
b3151.13	Rebuild the 0.5 mile Whitley – Columbia City No.1 line as 69 kV.	\$1.00	AEP	AEP	6/1/2024
b3151.14	Rebuild the 0.5 mile Whitley – Columbia City No.2 line as 69 kV.	\$0.70	AEP	AEP	6/1/2024
b3151.15	Rebuild the 0.6 mile double circuit section of the Rob Park – South Hicksville / Rob Park – Diebold Road as 69 kV	\$1.00	AEP	AEP	6/1/2024
b3152	Reconductor the 8.4 mile section of the Leroy Center - Mayfield Q1 line between Leroy Center - Pawnee Tap to achieve a rating of at least 160 MVA / 192 MVA (SN/SE).	\$14.10	ATSI	ATSI	6/1/2024
b3153	Construct a greenfield 0.3 mile 138 kV double circuit line tapping the Beaver-Black River (ATSI) 138 kV line; Install five (5) monopole 138 kV double circuit steel structures with concrete foundations and string 1590 ACSR conductor. Expand the Amherst No.2 substation with the installation of three (3) 138 kV circuit breakers; one (1) 138/69/12 kV 130 MVA transformers; two (2) 69 kV circuit breaker.	\$7.50	AMPT	ATSI	6/1/2020

	Install one (1) 69 kV breaker towards Nordson.				
b3154	Install one (1) 13.2 MVAR 46 kV capacitor at the Logan substation	\$1.70	PENELEC	PENELEC	6/1/2024
b3155	Rebuild approximately 12 miles of Wye Mills - Stevensville line to achieve needed ampacity	\$15.00	DPL	DPL	12/1/2023

Attachment B – Reliability Project Multi-Zone Allocations

None