

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

PJM Staff Whitepaper
February 2014



EXECUTIVE SUMMARY

On December 11, 2013 the PJM Board of Managers approved changes to the Regional Transmission Expansion Plan (RTEP), totaling over \$4.6 Billion, to resolve identified baseline reliability criteria violations and to incorporate network upgrades associated with new interconnection customers.

Since that time PJM has identified additional baseline reliability criteria violations within the planning horizon. Transmission upgrades have been identified to resolve these reliability criteria violations. In addition, PJM staff has identified a market efficiency project that satisfies the benefit to cost ratio test of 1.25/1. The total increase to the RTEP to include these baseline project additions and include the market efficiency project is \$281.47 million. One project is recommended to be removed from the RTEP and is described in more detail below. With these changes, the RTEP includes over \$29.164 billion of transmission additions and upgrades since the first plan was approved by the Board in 2000.

The additional baseline upgrades are summarized below and were presented for the Board Reliability Committee's (BRC) consideration and for recommendation to the Board for approval.

The PJM Board Reliability Committee was requested to endorse the new baseline reliability projects and associated cost allocations and recommend to the Board approval of the baseline upgrades to the 2014 RTEP. On February 12th, 2014, the PJM Board approved the changes to the RTEP as described within this document.



SUMMARY OF RESULTS

Reliability Baseline Transmission Upgrades

One aspect of the development of the Regional Transmission Expansion Planning Process is an evaluation of the “baseline” system, i.e. the transmission system without any of the generation interconnection requests included in the current planning cycle. This baseline analysis determines the compliance of the existing system with reliability criteria and standards. Transmission upgrades required to maintain a reliable system are identified and reviewed with the Transmission Expansion Advisory Committee (TEAC). The cost of transmission upgrades to mitigate such criteria violations are allocated to the loads of each transmission zone and merchant transmission customers with firm withdrawal rights.

In addition to the baseline reliability assessment, PJM staff also evaluates the market efficiency of the system and identifies transmission upgrades to address transmission system congestion. As part of the 2013 RTEP PJM staff evaluated congestion that is expected to exist on the transmission system throughout the 15-year planning horizon. Constrained transmission facilities expected to cause market congestion were identified and proposals were solicited to address the expected congestion. The proposals were evaluated to determine the extent to which they satisfy the benefit / cost (B/C) threshold of 1.25/1 defined in the Operating Agreement. As a result of this effort a market efficiency project is being recommended to be included in the RTEP.

The baseline assessment completed since the last approval in December 2013 resulted in the need for transmission upgrades in several transmission zones. A summary of the more significant baseline projects with expected costs greater than \$5 million are detailed below. A complete listing of all of the new recommended baseline projects is attached at the end of this white paper. The projects that cost less than \$5 million include circuit breaker upgrades or replacements to address short circuit problems and a substation project to add several circuit breakers to address voltage violations.

Mid-Atlantic Region System Upgrades

- MetEd Transmission Zone
 - Install a second Hunterstown 230/115 kV transformer and reconductor the Hunterstown to Oxford 115 kV line - \$8 M
- Penelec Transmission Zone
 - Install a +250/-100 MVAR SVC at Erie South 230 kV substation - \$42 M
 - Construct a new Central City to Bedford North 115 kV line - \$37.5 M
- PPL Transmission Zone
 - Replace terminal equipment on the Susquehanna T10 to Montour 239 kV line - \$5 M
 - Install a second 500/230 kV transformer at Sunbury - \$25 M

Western Region System Upgrades

- AEP Transmission Zone



- Rebuild seven miles of the Meadow Lake to Reynolds 345 kV line - \$15 M
- ATSI Transmission Zone
 - Build a new East Springfield – London #2 138 kV line - \$7.1 M
 - Build a new London – Tangy 138 kV line - \$38.6 M

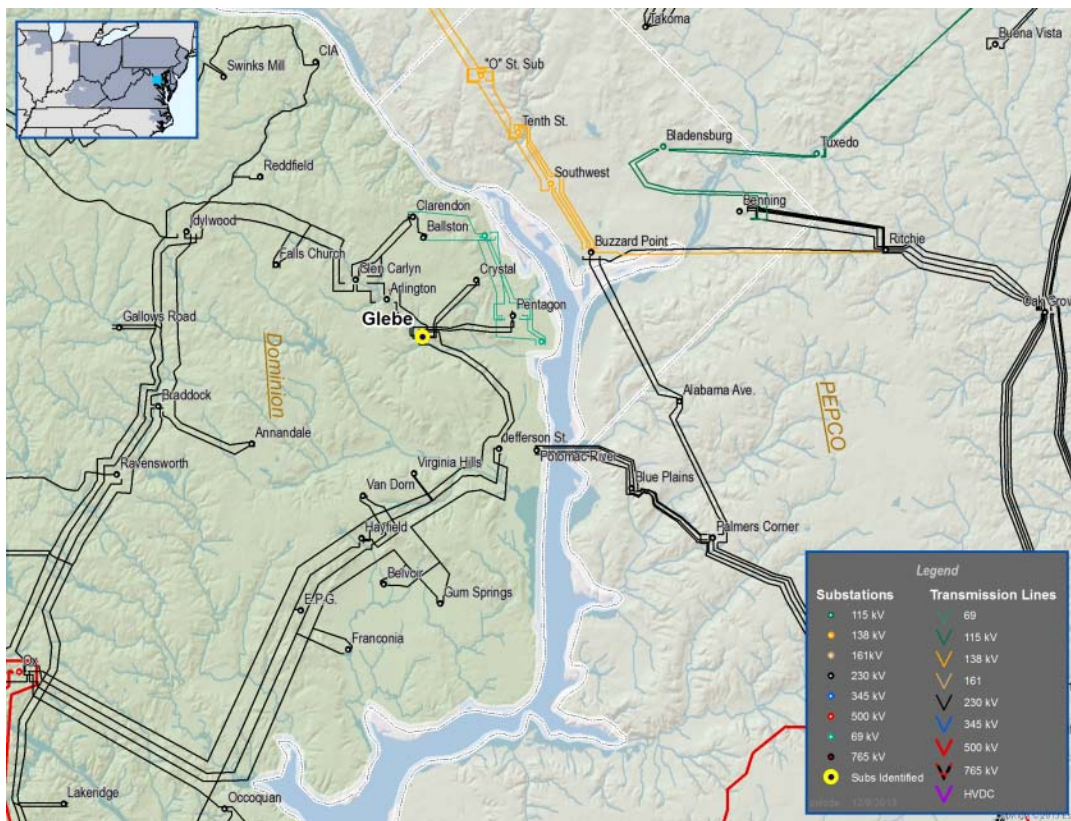
Southern Region System Upgrades

- Dominion Transmission Zone
 - Construct a new underground 230 kV line from Glebe to Potomac River Station C (PEPCo) - \$155.4 M

Following is a more detailed description of the larger scope upgrades that were recommended. A description of the criteria driving the need for the upgrade as well as the required in-service date is provided.

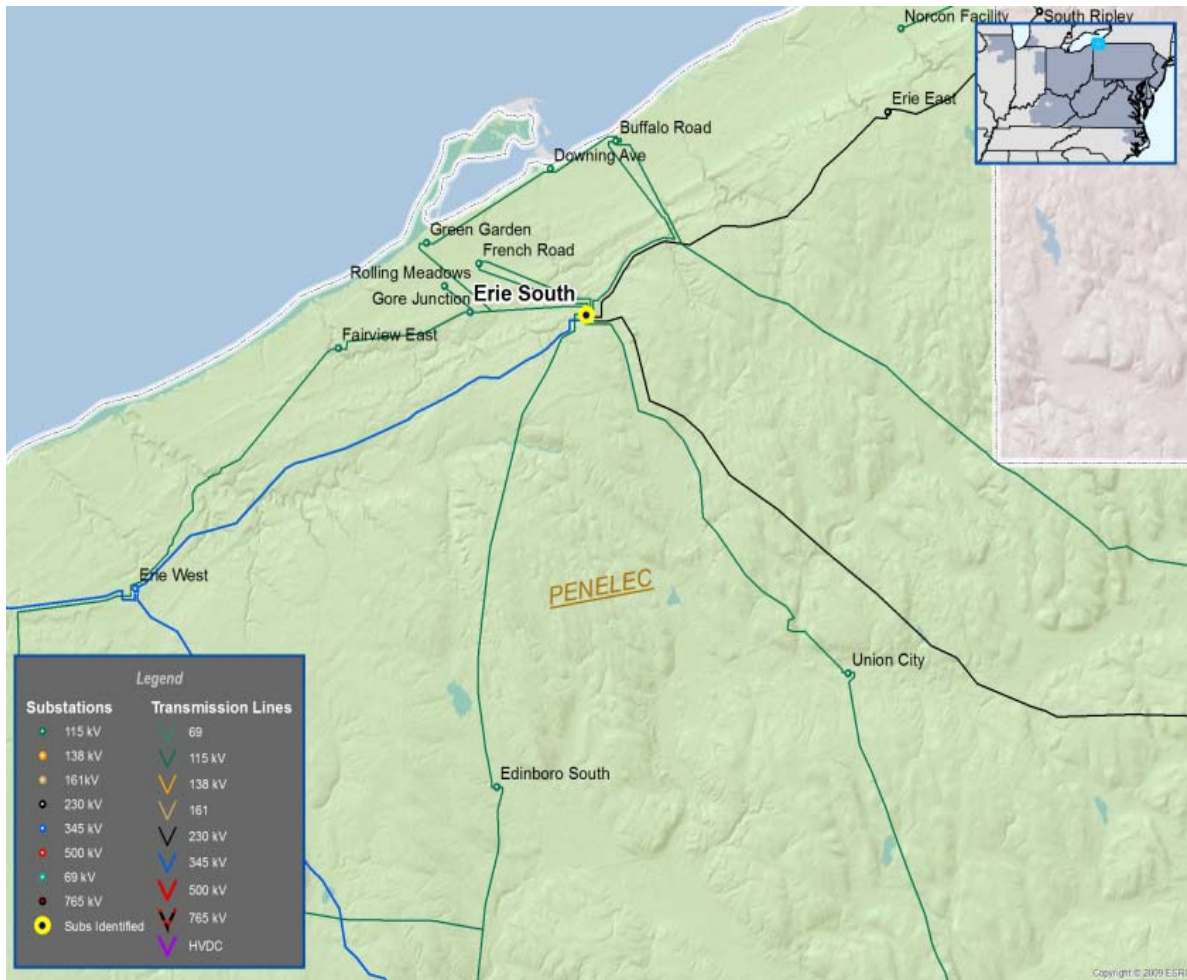
Dominion Thermal Violations

The 2013 RTEP identified a number of thermal issues on the Dominion 230 kV system. Single contingency (NERC category B) and several N-1-1 contingency overloads were identified in the northern Virginia portion of the Dominion system adjacent to the Washington, D.C metropolitan area in the PEPco transmission zone. This part of the Dominion system is experiencing significant load growth primarily due to new computer data centers locating in the area. A number of alternatives including new 500 kV and 230 kV lines were evaluated to address the identified reliability criteria violations. Ultimately a new underground 230 kV line between the Glebe substation in the Dominion transmission zone to Station C at Potomac River in the PEPco transmission zone was selected as the most effective solution. In addition to resolving the thermal issues noted, the project will improve operational flexibility, strengthen the transmission system between the Dominion transmission zone and the PEPco transmission zone and mitigate thermal problems for a right-of-way outage. The estimated cost for the project is \$155.4 M with a required in-service date is June 1, 2018.



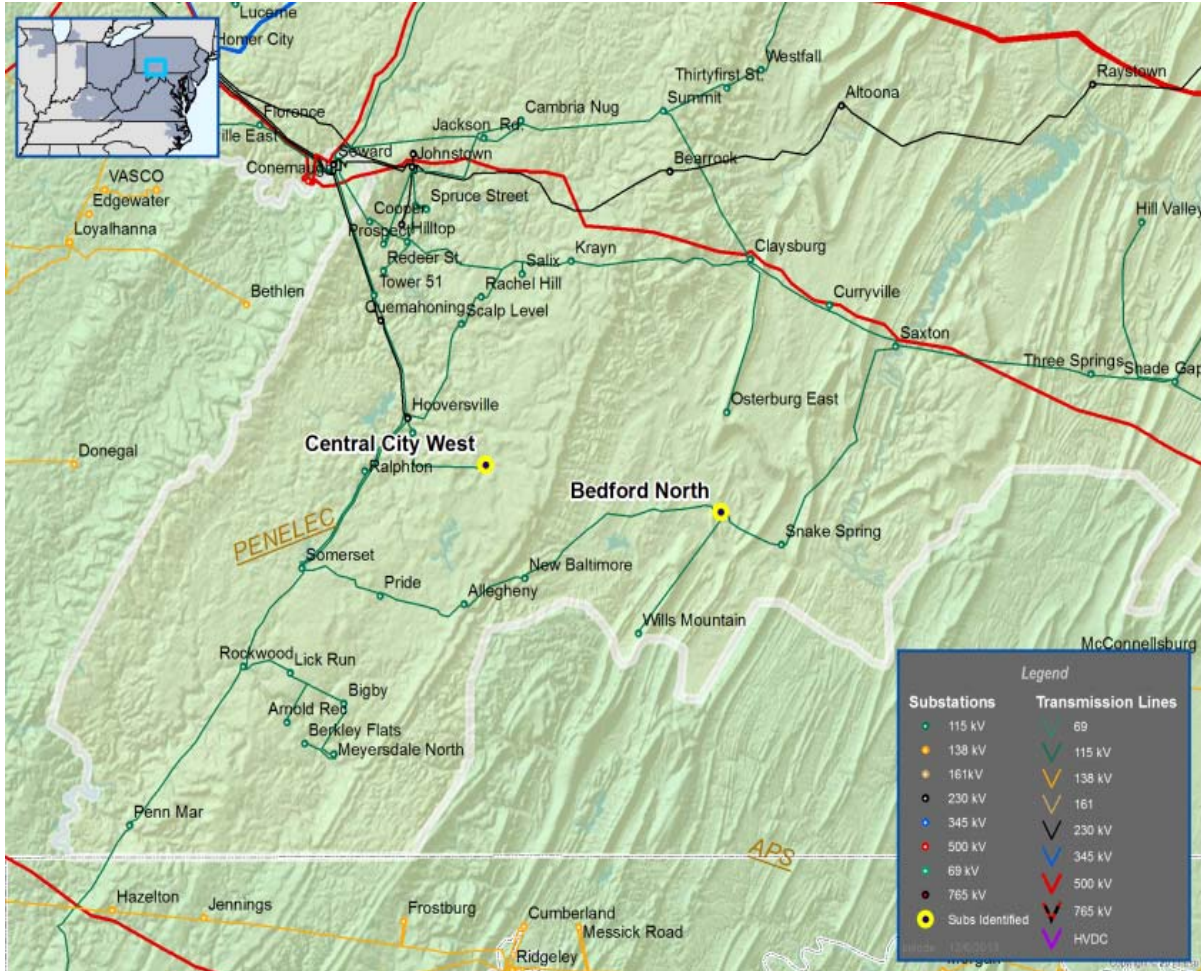
Erie South SVC

The 2013 RTEP identified a number of voltage magnitude and voltage drop violations in the PenElec transmission zone for the load deliverability test as well as for several NERC category C3 N-1-1 contingencies in the Penelec transmission zone. Reactive upgrades at several locations were evaluated. The recommended solution to address these violations is to install a new +250/-100 MVAR SVC at the Erie South 230 kV substation. The required in-service date for the project is June 1, 2018. The estimated cost for the new SVC is \$42 M.

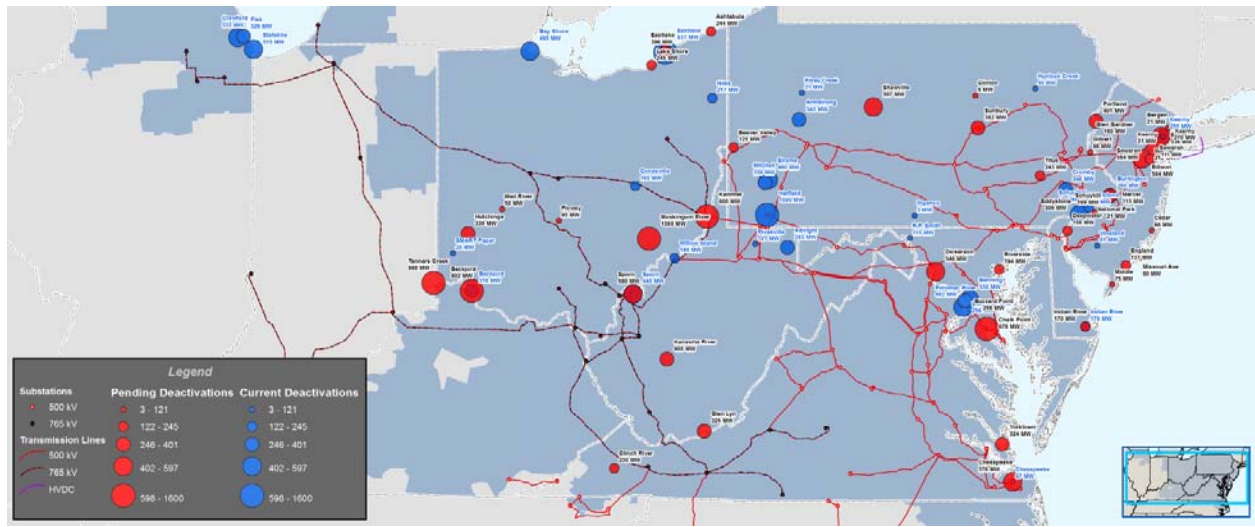


Central City West to Bedford North 115 kV line

The 2013 RTEP identified a thermal overload on the Somerset to Allegheny 115 kV line for the NERC category C3 N-1-1 contingency loss of the Cambria Slope to Summit 115 kV line and the Claysburg to Krayn 115 kV line. The recommended solution to address the thermal violation is to build a new 115 kV line from Central City West substation to Bedford North substation. This project will also eliminate the need for a previously approved baseline upgrade to reconductor the New Baltimore to Bedford North 115 kV line (estimated cost \$8.3 M). The estimated cost for the new line is \$37.5 M. The required in-service date for the new line is June 1, 2018.



Generation Deactivation

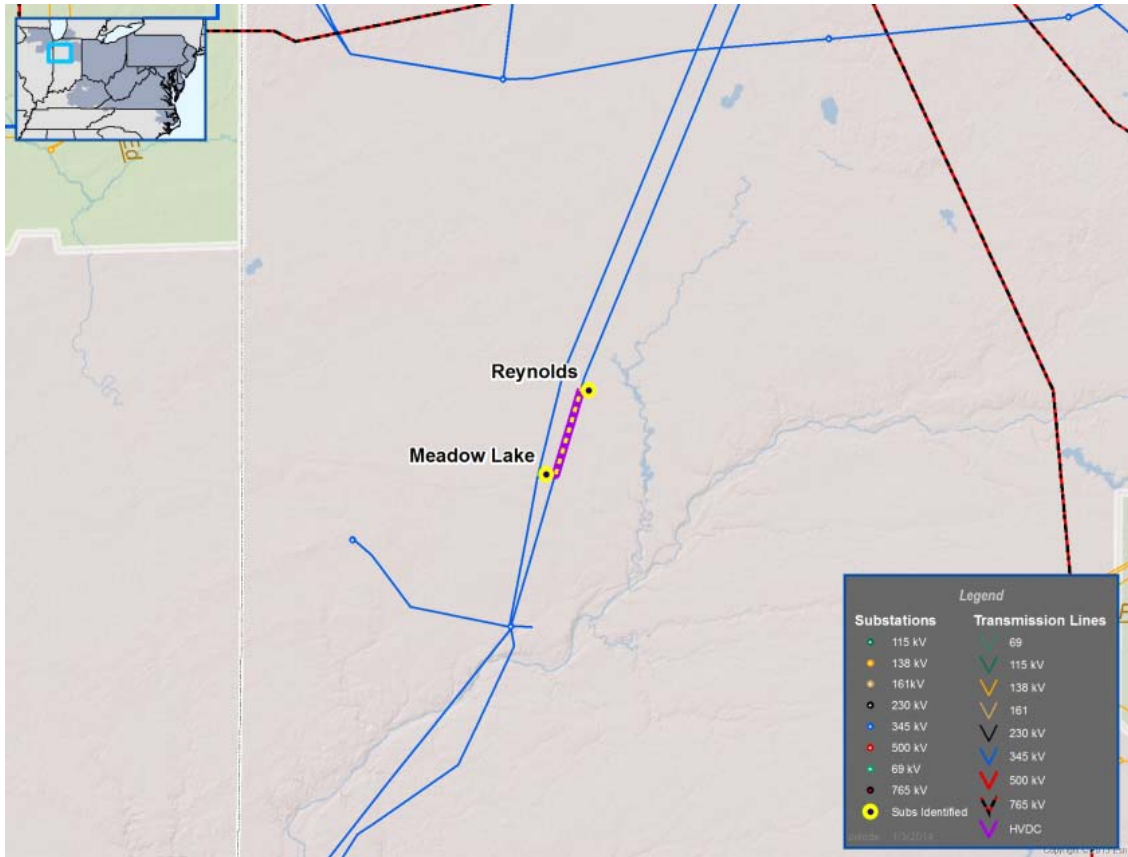


There are several upgrades being recommended to address reliability criteria violations being driven by generator deactivations. The proposed deactivation of the Chalk Point 1 and 2 units (683 MW) and the Dickerson 1, 2 and 3 units (546 MW) in the PEPCO transmission zone is driving the need for several new upgrades in the PP&L transmission zone. Specifically generation deliverability violations were identified on the existing Sunbury 500/230 transformer. The recommended solution to address the overload is to install a second Sunbury 500/230 kV transformer. The estimated cost for the project is \$25 M. In addition, generation deliverability violations were identified on the Montour to Susquehanna 230 kV line. The recommended solution to address the overload is to replace limiting terminal equipment on the line with an estimated cost of \$5 M. The required in-service date for these projects is June 1, 2017 to coincide with the proposed deactivation of the units.

In addition to the new transmission upgrades noted above, additional transmission upgrades are required to address reliability criteria violations for the deactivation of the Mad River (90 MW) generation in the ATSI transmission zone. Specifically a new 138 kV line between London and Tangy and a new 138 kV line between East Springfield and London are being recommended to address NERC category C3 N-1-1 violations. The estimated cost for this project is \$45.7 M.

2017 Retool Analysis

Part of the scope of the RTEP is to update previous studies with the latest assumptions to ensure the system is compliant with reliability criteria. These retool analyses can identify the need for new transmission upgrades or adjustments to previously approved upgrades. 2013 RTEP retool analysis of 2017 identified violations on the Meadow Lake to Reynolds 345 kV line in the AEP transmission zone for the generation deliverability test as well as for a NERC category C common mode outage. The recommended solution to address this violation is to rebuild approximately 7 miles of the 11 mile line. The estimated cost for the project is \$17 M and the required in-service date for the upgrade is June 1, 2017.



Market Efficiency Project

As noted above, in addition to the reliability criteria assessment that is done as part of the RTEP, PJM staff also evaluates the market efficiency of the system and where appropriate develops transmission upgrades to address system congestion. In the 3rd quarter of 2013, a proposal window was opened to solicit stakeholder suggestions to address the market efficiency issues. Six entities submitted 17 proposals as part of the solicitation. The anticipated benefit of each proposed project was calculated and compared to the estimated cost of the project to determine a benefit to cost ratio.

PJM staff identified three proposed projects that exceeded the required 1.25/1 benefit to cost ratio, each addressing the congestion on the same facilities. The three projects are summarized in the table below.



	2013_2-4B	2013_2-6B	2013_2-6D
Developer	First Energy	Northeast Transmission Development (LS Power)	Northeast Transmission Development (LS Power)
Description	Install 2nd Hunterstown 230/115 kV transformer; Reconductor Hunterstown - Oxford 115 kV line	Install new Hunterstown - Cumberland 230 kV line	Install a new 500/138 kV substation on the existing Conemaugh-Hunterstown 500 kV line, a new 138 kV substation and a new, approximately 6-mile double-circuit transmission line connecting these two new substations
Project Costs (\$ millions)	8.0	63.9	61.7
In-service year	2017	2018	2018
Type	Lower Voltage	Lower Voltage	Lower Voltage
Benefit/Cost Ratio	6.14	1.32	1.54
Reliability impact	(1) Overdutied Circuit Breaker	Impact not studied	Initial study shows violations on a transformer and three lower voltage facilities
Maximum allowable costs for B/C >1.25	39.4	67.5	76.2

Of the three projects that satisfied the required B/C threshold, one project had a significantly higher benefit to cost ratio than the other two. The scope of the project with the highest B/C ratio includes adding a 2nd 230/115 kV transformer at Hunterstown and reconductoring the Hunterstown – Oxford 115 kV line. The other two projects, which were significantly more expensive, both included new greenfield substations and transmission lines. Given the B/C ratio for these two alternative projects were just above the required 1.25/1 ratio, any increase in scope of either of the alternatives would likely result in the overall project not meeting the required B/C ratio. Considering the calculated B/C ratio, the estimated time to complete the project and the construction and regulatory risk associated with each project, PJM staff is recommending the project to install a 2nd 230/115 kV transformer at Hunterstown along with reconductoring the Hunterstown to Oxford 115 kV line. The estimated cost of the recommended project is \$8 M and is expected to be placed in-service in 2017.



Review by the Transmission Expansion Advisory Committee (TEAC)

The results of the analyses summarized in this report were reviewed with the TEAC and Subregional RTEP Committees. The most recent analyses, along with the recommended solutions, were reviewed at the January 8th, 2014 TEAC meeting. Written comments were requested to be submitted to PJM communicating 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

On October 11, 2012 the PJM Transmission Owners, filed proposed tariff revisions to Schedule 12 of the OATT to modify the methods used for the allocation of costs of transmission upgrades approved pursuant to the RTEP to a new "use based" methodology. In an Order issued on January 31, 2013, the FERC conditionally accepted and nominally suspended the proposed cost allocation methods for filing, to be effective February 1, 2013 subject to refund and to a future order in PJM's Order 1000 compliance filing. On July 22, 2013, the PJM Transmission Owners submitted their 2nd Order No. 1000 compliance filing in response to the March 22, 2013 Order. A FERC order has yet to be issued on this second compliance filing.

Pursuant to FERC order, the allocations for the baseline reliability upgrades being recommended to the PJM Board will be developed using the new "use based" allocation methodology. The allocations for the market efficiency project, pursuant to the FERC approved methodology, will be allocated to the transmission zones that benefit from the upgrade.

Board Approval

The PJM Board Reliability Committee was requested to endorse the new baseline reliability projects and associated cost allocations and recommend to the Board approval of the baseline upgrades to the 2014 RTEP. On February 12th, 2014, the PJM Board approved the changes to the RTEP as described within this document.



Appendix – RTEP Baseline Upgrade Cost Allocation

Single Zone Allocations

Upgrade ID	Description	Cost (M)	Trans Owner	Required IS Date
b1813.12	Replace the Blooming Grove 230 kV breaker 'Peckville'	\$0.35	PPL	11/30/2016
b2354.1	Replace Churchtown 69kV breaker 'D'	\$0.30	AEC	6/1/2015
b2434	Build a new London - Tangy 138 kV line	\$38.60	ATSI	6/1/2014
b2435	Build a new East Springfield - London #2 138 kV line	\$7.10	ATSI	6/1/2014
b2438	Install two reactors at Tosco 230 kV	\$2.50	PSEG	6/1/2014
b2439	Replace the Tosco 138kV breaker 'CB1/2 (CBT)' with 63kA	\$0.35	PSEG	6/1/2014
b2440	Replace the Cabot 138kV breaker 'C9-KISKI VLY' with 63kA	\$0.25	APS	6/1/2014
b2441	Install +250/-100 MVAR SVC at the Erie South 230 kV station	\$42.00	PENELEC	6/1/2018
b2442	Install three 230 kV breakers on the 230 kV side of the Lewistown #1, #2 and #3 transformers	\$2.30	PENELEC	6/1/2018
b2444	Willow - Eureka 138 kV line: reconductor 0.26 mile of 4/0 CU with 336 ACSS, new rating on the line will be 163/197 MVA (SN/SE)	\$0.10	AEP	6/1/2017
b2445	Tidd - Mahans Lake 138 kV line: completion of sag study will increase rating to 191/250 MVA (SN/SE)	\$0.15	AEP	6/1/2017
b2446	Replace wave trap and protective relays.	\$2.50	PPL	6/1/2017
b2447	Replace wave trap and protective relays.	\$2.50	PPL	6/1/2017
b2448	Install a second 900MVA 500-230kV transformer and associated equipment.	\$25.00	PPL	6/1/2017
b2449	Rebuild the 7-mile 345 kV line between Meadow Lake and Reynolds 345 kV stations	\$15.00	AEP	6/1/2017
b2450	Construct a new 115 kV line from Central City West to Bedford North	\$37.50	PENELEC	6/1/2018



Appendix – RTEP Baseline Upgrade Cost Allocation continued

Multiple Zone Allocations

Upgrade ID	Description	Cost Estimate (\$M)	Cost Allocation	Required IS Date
b2443	Construct new underground 230 kV line from Glebe to Station C, rebuild Glebe Substation, construct 230 kV high-side bus at Station C with option to install 800 MVA PAR	\$155.40	Dominion 97.11%, PEPCO 2.71%, ME 0.18%	6/1/2018
b2452	Install 2nd Hunterstown 230/115 kV transformer and reconductor Hunterstown - Oxford 115 kV line	\$8.02	Dominion 36.92%, MetEd 23.85%, PEPCO 15.75%, BGE 14.70%, APS 8.30%, DEOK 0.48%	6/1/2017



REVISION HISTORY

Version 1 - Original Version – February 2014

Version 2 – 3/13/2014

- Added a revision history
- Page 7 incorrectly had the cost of b2449 - Rebuild the 7-mile 345 kV line between Meadow Lake and Reynolds 345 kV stations as \$19 M when it is actually \$15 M. The cost was updated to \$15 M in the narrative.