



PPL Electric Utilities

2014-2015 RTEP Long Term Proposal Window

Juniata Substation Static VAR Compensator Addition

Constraint Addressed:

AP South Interface L/O Black Oak-Bedington

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Primary POC - PPL Electric Utilities:

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Executive Summary

A.1 Description of Proposed Solution

This proposal is a submittal by PPL Electric Utilities (“PPL”, “PPL EU”, “The Company”) in response to the 2014-2015 PJM RTEP Long Term Proposal Window. This proposal has three project components as identified below that address market efficiency constraints within the AP South (FirstEnergy) service territory and provide reliability benefits to PPL EU service areas. This project will be further referred to as the “Juniata Substation 500kV Static VAR Compensator (“SVC”) Project.”

Proposal elements #1 through #3 help resolve significant congestion associated with the AP South interface L/O Black Oak-Bedington Constraint. The violations addressed by these proposal elements are listed in Section A.3.

- 1. Juniata Substation SVC Transmission Interconnection:** Install new 300 foot, single span of 500kV transmission between two 500kV deadend structures located at Juniata substation and a new Static VAR Compensator (“SVC”) yard.
- 2. Juniata Substation North Bus Extension:** Install one new 500kV three insulator Motor Operated Disconnect (“MOD”), one 500kV 3000A circuit breaker, associated relays panels and 3000A 4-inch aluminum bus.
- 3. Juniata Substation SVC Yard Addition:** Install new SVC: rated -100/+500MVAR, ancillary equipment and 500kV transmission interconnections to the Juniata Substation 500kV deadend structures.

A.2 Advantages / Alternatives to the Comprehensive Solution

Advantages Analysis

This comprehensive solution is characterized by the following advantages, among others:

Helps Resolve the PJM RTEP Constraint: Research performed by PPL EU indicates that no single physical solution can comprehensively resolve the AP South constraint with a proposal that meets the PJM mandate for a Benefits-to-Cost (“B/C”) ratio above 1.25.



Increased Capacity and Efficiency: The Juniata Substation 500kV SVC Project adds robustness to the area surrounding PPL EU’s Juniata Substation. The 500kV SVC planned

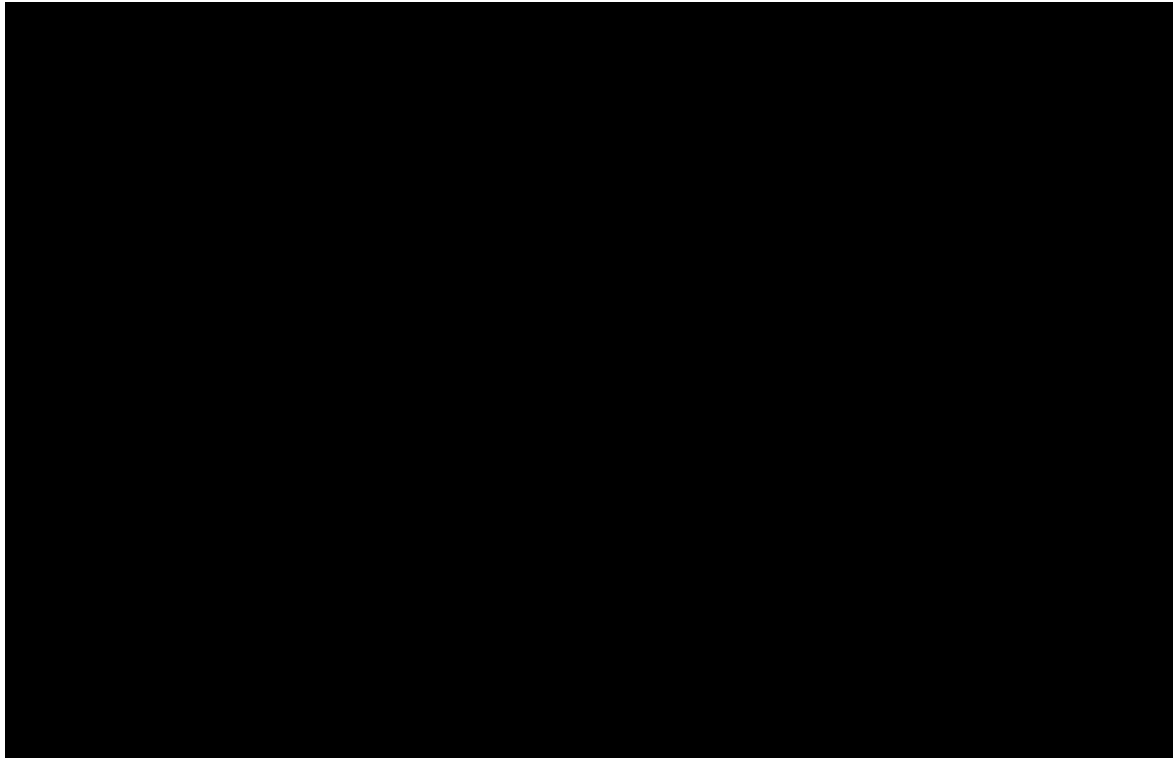
for the Juniata Substation provides tight voltage regulation for improved power quality to the surrounding load pockets, thus improving reliability under various scenarios.

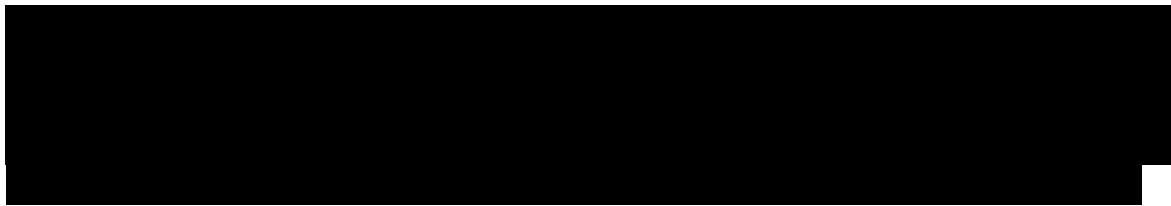
Strengthened Network: The multiple sources into Juniata Substation and new 500kV SVC will create a strong area source. This comes with the added benefit of strengthening the power transfer capability throughout the PJM area.

Cost Conscious Advanced Technology: While solutions proposed within the AP South service territory can resolve the AP South market efficiency constraint, the vast majority of eligible solutions are cost prohibitive for non-incumbent transmission entities. The PPL EU Juniata Substation 500kV SVC Project creatively applies the principles of static VAR compensation to address congestion outside of PPL service territories with a cost competitive solution by allowing the interface limit to be raised when needed. Furthermore, this proposal also makes use of substation facilities that are already in place, thus avoiding the need to purchase new land or undertake significant permitting / siting efforts. In doing so, PPL EU has prepared a solution that employs advanced technology at a low capital cost.

Alternatives Analysis

As part of the analysis, PPL EU evaluated other solutions to resolve the AP South L/O Black Oak-Bedington constraints affecting this area. The additional solutions PPL EU identified are as follows:





Due to the competitive bidding processes set forth in FERC Order No. 1000, a solution which maximizes long term market efficiency benefits to consumers at a low cost is objectively superior to competing solutions. The proposed Juniata Substation 500kV SVC Project is significantly less costly than any option PPL EU investigated during the proposal window.

The remainder of this proposal focuses exclusively on the market efficiency solution developed by PPL EU.

A.3 Violations Resolved

As mentioned above, PPL EU’s proposed solution provides long-term relief to a major portion of the market efficiency constraints reported in the RTEP Long Term Proposal Window briefing with the Transmission Expansion Advisory Committee (“TEAC”).

The Juniata Substation 500kV SVC Project specifically addresses market efficiency constraints associated with the following interface points:

Facility Name	Area	Type	2015 Input / 2015 Topology		2015 Input / 2019 Topology	
			Frequency (Hours)	Market Congestion (\$M)	Frequency (Hours)	Market Congestion (\$M)
AP South L/O BED-BLA	PJM	Interface	1627	\$103.6	1448	\$79.4

Table 1: Congestion Interface Points from the PJM 2014-2015 Long Term Window Study

A.4 Additional Violations Analysis

PPL EU performed both an internal desktop review and enlisted external parties to analyze the impact of the proposed Juniata Substation upgrades. These studies confirmed that none of the project components associated with this proposal create additional thermal or voltage violations given the current system topography and infrastructure ratings.

It should be noted that these results are based on the current 2015 system configuration, and changes could occur that require additional violation analyses before the project in-service date of Q2-2018.

A.5 Network Impact Analysis

PPL EU performed contingency analysis on the proposed topology with the addition of the new Juniata Substation SVC. Based upon that review PPL EU has determined that there

are no adverse impacts resulting from the addition of the project components associated with this proposal.

A.6 Total Proposed Project Cost

The total cost of the proposed Juniata Substation 500kV SVC Project is approximately \$33.95million. The expected project duration is 34 months from receipt of approval from PJM.

Description	Total Cost (\$M)
REDACTED	
Total Project Cost	\$33.95

Table 2: Estimated Costs for the Juniata Substation 500kV SVC Project

A.7 Project Execution

Listed below is the timeline for construction of the Juniata Substation 500kV SVC Project. The estimated project timeline is 34 months.

Project Component	Activity	Start	Finish
REDACTED			

Table 3: Anticipated Timeline for the Juniata Substation 500kV SVC Project

B Company Evaluation Information

B.1 PPL EU Company Evaluation

PPL Electric Utilities Corporation

2 North Ninth Street, GENN5

Allentown, PA 18101

PPL EU engages in the regulated transmission and distribution of electricity, providing high-quality, safe and reliable service to customers across central and eastern Pennsylvania. With the support of its parent company, PPL Corporation, PPL EU has access to the best practices and leading capabilities of one of the largest investor-owned companies in the U.S. utility sector.

PPL EU's pre-qualification information on record with PJM and as posted on PJM's website, submitted on June 28, 2013 through the Office of the Interconnection prior to the opening of the Market Efficiency project proposal window, reflects the company's current qualifications to be eligible for Designated Entity status as defined in the PJM Amended and Restated Operating Agreement ("PJM OA") in Section 1.5.8(a) (PJM Designation 13-12).

PPL EU hereby submits by reference as to the specific section in its original pre-qualification documentation (dated June 28, 2013 and subsequently accepted by PJM) as evidence of the following:

- PPL EU's technical and engineering qualifications (Prequalification Section 5.3);
- PPL EU's experience in:
 - developing, operating and maintaining transmission facilities (Prequalification Sections 4.0 through 4.3);
 - adherence to standardized construction, maintenance and operating practices (Prequalification Section 5.12 and 5.13), and including the ability for emergency response and system restoration (Prequalification Section 5.16);
 - working in the geographic region in which the proposed project is located (Prequalification Section 2.3);
 - ability to acquire rights of way within the proposed projects geographic region (Prequalification Section 5.8);
- PPL EU has adequate financial resources available to construct, operate and maintain the proposed project (Prequalification Section 2.5);

- PPL EU has demonstrated its managerial ability to contain costs and adhere to construction schedules for numerous transmission projects executed across its nearly 100-year history serving this territory;
- PPL EU will not be offering any construction cost caps or commitments for the proposed project;
- PPL EU is amply qualified to construct, operate, and maintain the proposed project (Prequalification Section 3.0 through 3.6).

PPL EU hereby indicates its intent to be designated to construct, own, operate, maintain and finance the three components of the proposed Juniata Substation 500kV SVC Project listed below.

- Juniata Substation SVC Transmission Interconnection
- Juniata Substation North Bus Extension
- Juniata Substation SVC Yard Addition

In doing so, PPL EU has made clear its intent to be considered the Designated Entity for these project components.

C Proposed Solution Constructability Information

C.1 Solution Scope

PPL EU proposes to implement a three-component solution in order to alleviate AP South market efficiency constraints under loss of the Black Oak-Bedington circuit. PPL EU’s proposal consists of one transmission component and two substation components. The sections that follow provide additional constructability information about each component.

Section	Component Name	Type	Notes
C.1.1	Juniata Substation SVC Transmission Interconnection	Transmission	Greenfield
C.1.2	Juniata Substation North Bus Extension	Substation	Upgrade
C.1.3	Juniata Substation SVC Yard Addition	Substation	Greenfield

Table 4: Juniata Substation 500kV SVC Project Component List

C.1.1 Juniata Substation SVC Transmission Interconnection

General

PPL EU proposes to build a new span of 500kV transmission line with an approximate distance of 300 feet from its Juniata Substation to a new SVC yard located north of Juniata on land already owned by PPL EU. This work will require a single-span of 500kV transmission across Pennsylvania State Highway 34 and two 500kV deadend structures, the first located at the Juniata Substation and the second located in the new SVC yard.

Electrical & Physical Characteristics



In summary, the proposed transmission line has the following specifications:

Parameter	Value
REDACTED	

Table 5: Transmission Line Specifications

Additional detail, including aerial maps of the proposed siting, line routing, and electrical one-line diagrams can be found in the accompanying Appendix A.

C.1.2 Juniata Substation North Bus Extension

General Description

PPL EU proposes to modify its Juniata Substation to support the addition of a -100/+500 MVAR SVC located across Pennsylvania Highway 34 on land PPL EU currently owns. To accommodate this addition and interconnection, PPL EU will need to add one 500kV disconnect switch with Motor Operated Disconnect (“MOD”), one 500kV breaker, associated relays & controls and 4-inch aluminum bus-work to the existing Juniata Substation yard.

Additional detail, including PPL EU aerial maps of the proposed modifications, general arrangements and electrical one-line diagrams can be found in the accompanying Appendix B.

Electrical Design



Relay Communications Plan

Transmission Line Protection: PPL EU's 69kV – 500kV transmission lines are protected with primary and backup relays. Further details on PPL EU's Transmission Line Protection Standards are included in the accompanying Appendix C.

Circuit Breaker Protection: Circuit Breaker ("CB") failure protection clears the fault when protective relaying trips a CB and the CB fails to interrupt the current. Protection schemes consist of several elements including relays, voltage and current transformers, control power supply (DC batteries, fusing), control cables and CBs. CB failure schemes are specifically employed to provide backup protection in the event a CB fails to operate properly during fault clearing. The operation of a CB failure scheme trips all local and remote CBs associated with power system sources feeding the fault. Further details on PPL EU's Circuit Breaker Protection Standards are included in the accompanying Appendix C.

C.1.3 Juniata Substation SVC Yard Addition

General Description

PPL EU proposes to connect the Juniata Substation to a new yard across Pennsylvania State Highway 34 that will accommodate a 500kV SVC. The scope of work included as part of the SVC yard includes supply and installation of the SVC equipment plus relaying & controls and interconnections that will connect the SVC to the 500kV deadend structure described in Section C.1.1.

Additional detail, including PPL EU aerial maps of the proposed modifications, general arrangements and electrical one-line diagrams can be found in the accompanying Appendix B.

Electrical Design



Relay Communications Plan

Please refer to the Relay Communications Plan details in Section C.1.2, above, and the more detailed discussion of PPL EU's Protection Standards included in Appendices B and C.

C.1.4 Transmission Facilities Constructed by Others

Transmission line Relocation

As part of this project proposal, no transmission line relocations will be constructed by others.

Substation Expansion or Modification

As part of this project proposal, no substation expansions or modifications will be constructed by others.

C.2 Environmental, Permitting and Land Acquisition

C.2.1 Environmental Impact Review Methodology and Preliminary Results

PPL EU will coordinate the environmental studies required for state and federal permits potentially necessary for completing the project. These environmental studies generally involve wetland delineations, assessments for Threatened & Endangered ("T&E") species or their habitats, and evaluation of the cultural resources that may be within or in the vicinity of the Right of Way ("ROW"). Once these existing environmental conditions are identified and documented, they will be incorporated into the project drawings for the civil and environmental permitting submittals.

C.2.2 Right-of-Way and Land Acquisition Plan

PPL EU plans to build the aforementioned SVC yard beyond the fence area of the existing substation but within the boundaries of neighboring property currently owned by PPL EU. The company does not anticipate the need to acquire any additional land.

C.2.3 Permitting Plan and Approach

A Letter of Notification (“LON”) to the Pennsylvania Public Utility Commission (“PUC”) is required for project components outside of the current Juniata Substation fence line. The work scope within the substation is typically not deemed transmission line and is not covered by siting regulations. If a LON is needed, siting would take 5-7 months in total to prepare and receive approval from the PUC. This has been factored into PPL EU’s proposed project execution schedule, and execution will be completed more quickly if an LON is not required.

In accordance with the aforementioned scope of work, PPL EU will also conduct environmental permitting for the project based on the following:

- Desktop Permitting Assessment
- Engineering and Environmental Site Review
- Wetland Delineation
- PADEP Chapter 102 Design and Permitting
- PADEP Chapter 105 Permitting

C.3 Solution Cost Estimate

The estimated project cost is \$33.95 and should be interpreted as a budget estimate. The bottom up development and top down verification provides an 80% confidence level in the project estimate, based on the baseline scope of work and assumptions. A more detailed breakdown of PPL EU’s costs can be found in the accompanying Appendix D.

C.4 Solution Schedule

A 34 month project schedule is required to complete the scope of the Juniata Substation 500kV SVC Project. Successful completion of the project will require coordination between engineering, ROW / land acquisition, long-lead time equipment procurement, CPCN / permitting, operations and construction activities. A preliminary estimate of the integrated project schedule is provided below. These activities will be finalized in greater detail upon selection of PPL EU as the Designated Entity for this project.

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Project Component	Activity	Start	Finish
REDACTED			

Table 6: Anticipated Timeline for Juniata Substation 500kV SVC Project Components

C.5 Ongoing Transmission Facility Items

C.5.1 Operations Plan

Operations Plan Overview

These facilities will be operated by PPL EU at the direction of PJM and controlled and maintained by PPL EU consistent with the current operations and maintenance practices used by PPL EU. PPL EU's Transmission Control Center ("TCC") is tasked with the responsibility of monitoring and operating a reliable transmission grid as defined by PJM, RFC and NERC. The TCC operates 24 hours a day, 365 days a year in a NERC/R-certified state-of-the-art, secure facility with both primary and disaster recovery sites. All TCC employees are trained by NERC certified trainers and receive NERC, PJM Transmission Operator, PJM Generation, and PPL EU training certifications.

C.5.2 Maintenance Plan

Maintenance Plan Overview

PPL EU will integrate these facilities into its existing transmission maintenance program. PPL EU currently groups equipment into functional groups allowing optimum scheduling of equipment maintenance under a single outage window. Inspection activities are timed to maintain the desired performance levels defined for each individual asset.

PPL EU owns and maintains a fleet of spare substation equipment to include at least one of each major piece of equipment, such as power transformers, CB's, CCVT's, etc. Items such as spare transformers are kept at strategically located substations based on the location of in-service units. PPL EU will ensure equipment is on hand that matches elements included as part of this physical solution so that spares on-hand are compatible. PPL EU has included spare parts for the SVC component of this proposal.

C.6 Assumptions

[REDACTED]

Financial / Estimating

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

Permitting

- [Redacted]
- [Redacted]

Schedule

- [Redacted]
- [Redacted]

Appendices

Reference	Description
Appendix A	Transmission Component Details
Appendix B	Substation Component Details
Appendix C	Line Protection and Breaker Failure Protection Philosophy
Appendix D	Detailed Cost Estimate
Appendix E	List of Attachments