



2014 RTEP Window 2 Addendum Joint Proposal

**Allen-Williams Grove 115 kV Greenfield Line +
Allen / Williams Grove Substation Upgrades**

Allen - Gardner Voltage Drop Violation

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Executive Summary

A.1 Description of Proposed Solution

This proposal is a joint submittal by PPL Electric Utilities (“PPL”, “PPL EU”) and FirstEnergy (“FE”) in response to the 2015 PJM RTEP Reliability Open Window 2 Addendum. This proposal has two project portions as identified below that address the violations identified in Section A.3 and together provide significant future benefits to both PPL Electric Utilities and FirstEnergy service areas. This project will be further referred to as the “Allen-Williams Grove 115kV Project.”

Proposal elements #1 through #6 resolve the PJM RTEP Reliability Window 2 Addendum violations on the FirstEnergy transmission system. The violations addressed by these physical elements are listed in Section A.3.

- 1. Allen-Williams Grove 115kV Line:** Construct a new 115kV line from the Allen (FE) substation to the demarcation point. The new line will be approximately 2.6 miles long and utilize single wood pole construction with horizontal post insulators. A new right of way will need to be acquired for this portion of the 115kV line. This segment of line will be owned and operated by FE.
- 2. Allen Substation Upgrades:** Upgrade / expand the existing switching station into a 3 breaker ring bus. This will require acquiring and installing three 115kV breakers, installing the associated bus work, expanding the foot print of the existing switching station, and the relocation of the existing 115/13.8kV transformer. This project component will be owned and operated by FE.
- 3. PPGI Substation Relaying:** Upgrade relays at PPGI 115kV (Allen Terminal) and install new primary, backup, DCB, DTT and breaker failure protection. This project component will be owned and operated by FE.
- 4. Roundtop Substation Relaying:** Install one relay panel on the Roundtop 115kV (Allen Terminal). Includes new primary, backup, DCB and breaker failure protection. This project component will be owned and operated by FE.
- 5. Williams Grove 115kV Transmission Interface:** Install new 300 foot span of 115kV transmission from Williams Grove substation to a new 115kV deadend structure. This project component will be owned and operated by PPL.
- 6. Williams Grove 230 / 115kV Transformation:** Install new 230 /115kV transformer, one 230 kV three insulator MOD switch, one 115kV 2000A circuit breaker and one 115kV three insulator switch. This project component will be owned and operated by PPL.

A.2 Advantages / Alternatives to the Comprehensive Solution

Advantages Analysis

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

Resolves the PJM Reliability Violations: The Allen-Williams Grove 115kV Project resolves 12 reliability violations identified by PJM as part of the RTEP Window 2 Addendum. These violations are listed in detail in Section A.3.

Increased Capacity and Efficiency: The Allen-Williams Grove 115kV Project will serve as a bidirectional BES tie-line between FE and PPL. This proposed solution also adds robustness and redundancy to the PPL Williams Grove Substation area. The 115kV line and 230 / 115kV transformer at Williams Grove provide a BES source for load flow and voltage support to the Williams Grove and Allen load pockets under normal, maintenance and emergency conditions, thus improving reliability under various generation dispatch scenarios.

Strengthened Network: The multiple sources into Williams Grove and the new 115kV line to Allen will create a strong area source with the added benefit of strengthening FE and PPL ties in the greater Hummelstown / Cumberland area.

Avoids Future Costs: While solutions outside the Allen / Williams Grove corridor may directly address the posted violations listed the Window 2 Addendum, they will not be able to strengthen the area network and support growth plans. The PPL / FE comprehensive project addresses both the immediate needs and future expansions. This proposal also makes use of substation facilities that are already in place or planned to be installed before the required in-service date for this reinforcement. In doing so, the FE and PPL proposal avoids having to purchase land for a new substation, thereby keeping the costs for this reinforcement to a minimum.

Alternatives Analysis

As part of the analysis, FE evaluated other solutions to resolve the PJM RTEP Window 2 Addendum posted violations for this area. FE submitted two upgrades during the PJM RTEP Window 2 process. Two additional solutions were identified for this area by FE independently as follows:

1. Looping the PPL Cumberland-West Shore 230kV Line into Allen Substation

- Looping the PPL Cumberland-West Shore 230kV transmission line approximately 2 miles into the existing Allen 115kV substation
- Construct a 230kV three (3) breaker ring-bus at Allen substation
- Install a 224MVA 230 / 115kV transformer at Allen substation

- Upgrade relays at Roundtop substation
- Upgrade relays at PPGI substation

2. FE Capacitor Project

- Installing a 28.8 MVAR capacitor bank at the Mountain 115kV substation

Due to the competitive bidding processes set forth in FERC 1000, a solution which offers the viable long term solution to a violation at a reduced cost is highly favorable. The proposed Allen-Williams Grove 115kV Project utilizes a new proposed supplemental project presented by PJM at the December 8, 2014 TEAC meeting. It is less costly than the original FE proposal to loop the Cumberland-West Shore 230kV line into Allen substation and addresses contingency violations not identified in the original PJM Window 2 or PJM Window 2 Addendum.

The remainder of this document focuses exclusively on the comprehensive solution developed in coordination and jointly submitted by PPL and FE.

A.3 Violations Resolved

The proposed solution provides a long-term solution to the violations reported in the RTEP Proposal Window 2 Addendum provided during the Open Window process.

The PPL / FE Allen-Williams Grove 115kV Project mitigates numerous violations reported in the Window 2 Addendum results. Specifically, this project solution addresses the N-1-1 loss of the Middletown Junction-Roundtop (B_ME115-SX-#28) and Gardners-Hunterstown (B_ME115-SX-#6) 115kV lines, which result in the following Window 2 violations:

FG #	Bus	Contingency Voltage (p.u.)	Voltage Drop (%)
N2-VD2	204520 27ALLEN 115kV	0.8656	14.86
N2-VD3	204526 27DILLSBRG 115kV	0.8668	14.84
N2-VD4	204528 27GARDNERS 115kV	0.872	14.45
N2-VD5	204546 27MOUNTAIN 115kV	0.8673	14.72
N2-VD6	204552 27P.P.G.I. 115kV	0.8667	14.74
N2-VD7	204556 27ROUND TP 115kV	0.8672	14.95
N2-VD9	204520 27ALLEN 115kV	0.865	12.57
N2-VD10	204526 27DILLSBRG 115kV	0.8661	12.49
N2-VD11	204528 27GARDNERS 115kV	0.8714	11.99
N2-VD12	204546 27MOUNTAIN 115kV	0.8667	12.45
N2-VD13	204552 27P.P.G.I. 115kV	0.8661	12.47
N2-VD14	204556 27ROUND TP 115kV	0.8666	12.64

Table 1: Voltage Violations Resulting from PJM 2014 Window 2 Addendum Study

FE has identified additional violations not present in PJM's Window 2 Addendum results, which are explained in more detail in Section A.4.

[REDACTED]

A.4 Additional Violations Analysis

The table included below summarizes the [REDACTED] not identified in PJM's Window 2 Addendum:

[REDACTED]

REDACTED

Table 2: [REDACTED] Violations Resulting from PJM 2014 Window 2 Study

[REDACTED]

This jointly submitted FE / PPL solution mitigates [REDACTED] the flowgate violations identified by PJM in its Window 2 Addendum study.

A.5 Network Impact Analysis

[REDACTED]

1. [REDACTED]
2. [REDACTED]

In order to mitigate these violations, the following switch moves are required:

1. [REDACTED]
2. [REDACTED]

As a long term solution to avoid these operational switch moves, PPL EU intends on installing a third 230kV line to Williams Grove as a supplemental project. This can be accomplished by extending the existing Brunner Island-West Shore #1 230 kV line to Williams Grove and terminating the new line into a third 230 kV bay as shown in Appendix 1B.

A.6 Total Proposed Project Cost

The total cost of the proposed Allen-Williams Grove 115kV Project, including the scope elements of both FirstEnergy and PPL, is approximately \$12.41 million. The expected project duration is 42 months from receipt of approval from PJM.

Description	Total Cost (\$M)
REDACTED	
Total Project Cost	\$12.41

Table 3: Estimated Costs for the Allen-Williams Grove 115kV Project

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A.7 Project Execution

Listed below is the timeline for construction of the Allen-Williams Grove 115kV Project. The estimated project timeline is 42 months.

Project Component	Activity	Start	Finish
REDACTED			

Table 4: Anticipated Timeline for the Allen-Williams Grove 115kV Project

B Company Evaluation Information

B.1 FirstEnergy Company Evaluation

FirstEnergy Corporation (FirstEnergy)

76 S Main Street

Akron, OH 44308

FirstEnergy is a regional energy provider headquartered in Akron, Ohio. Its subsidiaries and affiliates are involved in the generation, transmission, distribution and sale of electricity, as well as energy management and other energy-related services. FirstEnergy is a publicly traded corporation. JCP&L, Met-Ed and Penelec are wholly-owned direct subsidiaries of FirstEnergy. Mon Power, Potomac Edison and West Penn Power are wholly-owned direct subsidiaries of Allegheny Energy, Inc., which is a wholly-owned direct subsidiary of FirstEnergy. ATSI and TrAILCo are wholly-owned direct subsidiaries of FirstEnergy Transmission, LLC, which is a wholly-owned subsidiary of Allegheny Energy, Inc.

FirstEnergy submitted its prequalification documentation on June 27, 2013 and was subsequently granted pre-qualified status by PJM and given ID number 13-10. Further, in compliance with the PJM Operating Agreement Schedule 6, Subsection 1.5.8(a)(3), on September 29, 2014, FirstEnergy submitted the appropriate updates to Section F of its initial prequalification information. As such, FirstEnergy hereby states that the pre-qualification information provided to PJM, as updated, reflects FirstEnergy's current qualifications for eligibility as a Designated Entity as defined in the Operating Agreement Subsection 1.5.8(a).

FirstEnergy hereby submits by reference as to the specific section in its original pre-qualification documentation (dated June 27, 2013 and subsequently accepted by PJM) as evidence of the following:

- FirstEnergy's technical and engineering qualifications (Prequalification Section B)
- FirstEnergy's experience in:
 - developing, operating and maintaining transmission facilities (Prequalification Section C);
 - adherence to standardized construction, maintenance and operating practices (Prequalification Section E), and including the ability for emergency response and system restoration (Prequalification Section H);
 - working in the geographic region in which the proposed project is located (Prequalification Section D);

- ability to acquire rights of way within the proposed projects geographic region (Prequalification Section I)
- FirstEnergy has adequate financial resources available to construct, operate and maintain the proposed project.
- FirstEnergy has demonstrated its managerial ability to contain costs and adhere to construction schedules for numerous transmission projects that have been constructed by its 10 utilities and 2 transmission companies.
- FirstEnergy will not be offering any construction cost caps or commitments for the proposed project.
- FirstEnergy is amply qualified to construct, operate, and maintain the proposed project (Prequalification Section C).

FirstEnergy hereby indicates its intent to be designated to construct, own, operate, maintain and finance the four components of the proposed Allen-Williams Grove 115kV Project listed below.

- Allen-Williams Grove 115kV Line
- Allen Substation Upgrades
- PPGI Substation Relaying
- Roundtop Substation Relaying

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

B.2 PPL 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 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’s technical and engineering qualifications (Prequalification Section 5.3);
- PPL’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 has adequate financial resources available to construct, operate and maintain the proposed project (Prequalification Section 2.5);
- PPL 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 will not be offering any construction cost caps or commitments for the proposed project;
- PPL 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 two components of the proposed Allen – Williams Grove 115kV Project listed below.

- Williams Grove 115kV Transmission Interface
- Williams Grove 230 / 115kV Transformation

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

C Proposed Solution Constructability Information – FirstEnergy

C.1 Solution Scope

FirstEnergy intends to execute four separate project components as part of its responsibilities in this joint proposal to resolve the Allen / Gardner reliability violations. The most significant portions of this work consist of upgrades to FE’s Allen substation and a new 115kV circuit connecting FE’s Allen substation with PPL’s Williams Grove substation. Two additional components of FE’s work scope include relaying at both its PPGI substation and Roundtop substation.

Solution Components

The FirstEnergy solution scope consists of the four components summarized in the table below. The sections that follow provide additional constructability information about each component.

Section	Component Name	Type	Notes
C.1.1	Allen-Williams Grove 115kV Line	Transmission Line	Greenfield
C.1.2	Allen Substation Upgrades	Substation	Upgrade
C.1.3	PPGI Substation Relaying	Substation	Upgrade
C.1.4	Roundtop Substation Relaying	Substation	Upgrade

Table 5: FirstEnergy Project Component List

C.1.1 Allen-Williams Grove 115kV Line

Route Description

The greenfield portion of FirstEnergy’s project scope constructs a new 115kV line from the Williams Grove 230/115/69kV substation (PPL) to the Allen 115kV substation (FE). The anticipated transmission line length is approximately 2.6 miles.

A line route evaluation has not been performed to determine the final line route for the Allen-Williams Grove 115kV Project. The assumed route for the 115kV line will be as straight line as possible from Williams Grove to Allen barring intervention, property acquisition, and unforeseen natural obstacles. New 115kV structures will be utilized throughout. Although the final transmission route has not been finalized, FirstEnergy does not anticipate significant logistical challenges for several reasons (more clearly illustrated in the aerial maps in Appendix 1A):

- The Allen-Williams Grove 115kV Line component will be located in a largely rural area with few natural obstructions that present right of way challenges.

- The area separating the Allen and Williams Grove substations largely consists of farmland with numerous clear trajectories that can accommodate the proposed 115kV line.
- The location of the 115kV transmission and Williams Grove substation is conveniently located in close proximity to existing PPL 230kV lines for which right of way has previously been acquired with minimal logistical challenge.

The point of demarcation between PPL and FE project scope will be at the first dead end structure outside of PPL’s Williams Grove substation. PPL will be responsible for the siting, construction and preparation of the Williams Grove deadend structure for FE to terminate its incoming 115kV transmission.

Alternative Routes Study

Upon project award a detailed Line Route Evaluation (LRE) will be performed to determine the final route.

Electrical & Physical Characteristics

In general, construction of the line will utilize single circuit wood-pole construction with braced post insulators.

The proposed transmission line has the following specifications:

Parameter	Value
Nominal Voltage Rating	115kV
AC or DC?	AC
Line MVA Normal and Emergency Rating	232/282 MVA (SN/SE)
Line and Shield Conductor Type and Size	Line Conductor - 795 54/7 KCMIL ACSR Shield Wire – #6 Alumo Weld
Overhead or Underground/Submarine	Overhead Construction
Single or Double Circuit Towers	Single circuit wood pole with post insulators

Table 6: FirstEnergy Transmission Line Specifications

Additional detail, including FirstEnergy aerial maps of the proposed line routing, and electrical one-line diagrams can be found in the accompanying Appendix 1A.

C.1.2 Allen Substation Upgrades

General Description

As part of the Allen substation upgrade FirstEnergy proposes to expand the existing Allen 115kV bus to a 3-breaker ring.

Electrical Design

FirstEnergy's upgrades at the Allen Substation will consist of the following:

- Three 145kV 40 kA breakers
- Nine 115kV CCVT
- 115kV wide band wave traps
- Line tuners
- Five relay panels
- Three 115kV slip over CT's
- Three substation surge arrestors
- Six 145kV 1200 Amp disconnect switches

Relay Communications Plan

New relays will be installed at Allen substation as part of the 115kV ring bus conversion/construction. The relay / communication upgrades required as part of the FirstEnergy substation upgrades can be found in the accompanying Appendix 1B.

C.1.3 PPGI Substation Relaying

General Description

As part of the PPGI relaying modifications FirstEnergy proposes to upgrade the relays on the 115kV Allen Terminal. Additionally, FirstEnergy proposes to install new primary, backup, DCB, DTT and breaker failure protections.

Electrical Design

FirstEnergy's upgrades at PPGI Substation will consist of one new pre-wired relay panel.

Relay Communications Plan

Communications modification will be required as part of the activities described above. The relay / communication upgrades required as part of the FirstEnergy substation upgrades can be found in the accompanying Appendix 1B.

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C.1.4 Roundtop Substation Relaying

General Description

As part of the Roundtop relaying modifications FirstEnergy proposes to upgrade the relays on the 115kV Allen Terminal. Additionally, FirstEnergy proposes to install new primary, backup, DCB and breaker failure protections.

Electrical Design

FirstEnergy's upgrades at Roundtop Substation will consist of one new pre-wired relay panel.

Relay Communications Plan

Communications modification will be required as part of the activities described above. The relay / communication upgrades required as part of the FirstEnergy substation upgrades can be found in the accompanying Appendix 1B.

C.1.5 Transmission Facilities Constructed by Others

Transmission Line Relocations

As part of the FirstEnergy scope of work, no transmission line relocations will be constructed by others.

Substation Expansion or Modification

As part of the FirstEnergy scope of work, 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

FirstEnergy will evaluate all potential environmental impacts and will submit for the necessary permits. It is anticipated that the environmental permits will be readily obtained with no unusual conditions.

C.2.2 Right of Way and Land Acquisition Plan

FirstEnergy will negotiate with affected property owners for additional rights to operate at 115kV. Rights for access routes will also be negotiated as needed.

C.2.3 Permitting Plan and Approach

FirstEnergy will obtain all required permits and local approvals.

C.2.4 Discussion of Potential Public Opposition

An LRE will be performed. The study will provide support for final route selected. Assuming route directly from Allen to Williams Grove substation is the most appropriate route, additional right-of-way may be need where/if transmission lines need to cross. FirstEnergy will negotiate with affected property owners for the additional rights.

C.3 Solution Cost Estimate

The estimated project cost for FirstEnergy's four components is \$[REDACTED]M 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 FirstEnergy's costs can be found in the accompanying Appendix 1D.

C.4 Solution Schedule

A 42 month project schedule is required to complete the scope of FirstEnergy's proposed project components. Embedded within the component schedules below are 36 months for planning & design, right-of-way, siting & permitting activities (including any necessary Certificates of Public Convenience and Necessity) as well as long lead procurement. The following 6 months are reserved for construction and testing & commissioning. These activities will be coordinated in parallel with PPL's scope of work in more detail upon selection of FirstEnergy as the Designated Entity for these proposal components. A preliminary estimate of the integrated project schedule is provided below.

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Project Component	Activity	Start	Finish
REDACTED			

Table 7: Anticipated Timeline for FirstEnergy Project Components

C.5 Ongoing Transmission Facility Items

C.5.1 Operations Plan

The proposed Allen-Williams Grove 115kV Project will be operated from FirstEnergy’s “FE East” control center. FirstEnergy will operate the Allen-Williams Grove facilities in accordance with the company’s existing operational standards and procedures already on file with PJM.

C.5.2 Maintenance Plan

The Allen-Williams Grove 115kV Project facilities will be maintained consistent with FirstEnergy’s existing maintenance practices already on file with PJM.

C.6 Assumptions

The following assumptions were made for the FirstEnergy components as part of the proposed Allen-Williams Grove 115kV Project:

1. A portion of the right-of-way may overlap part of the existing 500kV right-of-way (i.e. the line will be constructed adjacent or cross the Juniata-TMI 500kV line.)
2. A letter of notification is required to the PAPUC.

D Proposed Solution Constructability Information – PPL

D.1 Solution Scope

PPL proposes to build a two-component solution in order to accommodate FirstEnergy’s incoming 115kV transmission connection. PPL’s proposal consists of one transmission component and one substation component that will hereafter be considered as distinct for the purposes of developing more detailed cost estimates. As mentioned previously, FirstEnergy and PPL have agreed to a project scope split location at the 115kV deadend structure described in Section D.1.1.

Solution Components

The PPL solution scope consists of the two components summarized in the table below. The sections that follow provide additional constructability information about each component.

Section	Component Name	Type	Notes
D.1.1	Williams Grove 115kV Transmission Interface	Transmission Line	Greenfield
D.1.2	Williams Grove 230 / 115kV Transformation	Substation	Upgrade

Table 8: PPL Project Component List

D.1.1 Williams Grove 115kV Transmission Interface

General

PPL proposes to build a new span of 115kV transmission line with an approximate distance of 300 feet from its Williams Grove substation to a new PPL 115kV deadend structure. The deadend structure will be the point of demarcation between PPL and FirstEnergy infrastructure associated with this project proposal.

Electrical & Physical Characteristics

PPL stocked Light Duty Steel Poles & Arms will be used for the deadend structure. The deadend structure will be directed embedded and guyed. The line will carry (1) 3/8” H.S.

Steel OHGW and (1) .752’’ 48F OPGW. Steel poles and guy anchors will be backfilled with 2A modified, compacted in 6’’ lifts.

The 300 foot span of transmission from Williams Grove substation to the new 115kV deadend structure will be designed and built for single circuit. PPL’s circuit will utilize 1590 Lapwing ACSR 45/7 conductor (one per phase).

For the 115kV line, one (1) 3/8’’ H.S. Steel OHGW and (1) .752’’ 48 count OPGW will be installed for overhead lightning shielding. The total length of OHGW is approximately 350 feet and the total length of OPGW is approximately 500 feet.

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

Parameter	Value
Nominal Voltage Rating	115kV
AC or DC?	AC
Line MVA Normal and Emergency Rating	323/400 MVA (SN/SE)
Line and Shield Conductor Type and Size	Line Conductor - 1590 45/7 KCMIL ACSR Shield Wire – 3/8’’ H.S. Steel OPGW – 0.752’’ 48-count fiber
Overhead or Underground/Submarine	Overhead Construction
Single or Double Circuit Towers	Single circuit light duty three pole deadend structure

Table 9: PPL 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 2A.

D.1.2 Williams Grove 230 / 115kV Transformation

General Description

PPL proposes to modify its Williams Grove substation to support FirstEnergy’s incoming 115kV line transmission line. To accommodate this new transmission, PPL will need to add one 230 / 115kV transformer, one 115 kV breaker and associated relays and controls to the substation plan.

Additional detail, including PPL aerial maps of the proposed modifications, general arrangements and electrical one-line diagrams can be found in the accompanying Appendix 2B.

Electrical Design

At Williams Grove Substation, this project involves the installation of one 230 / 115kV Transformer and one 230kV three insulator switch w/ MOD. In addition, PPL will incorporate one 115kV 2000A circuit breaker, one 115kV three insulator vertical break switch, three 115kV lightning arrestors, and one 138kV line dead end structure to build out

the low side of the transformer. Two triplex panels will be required for transformer relay and control, and FirstEnergy Line primary and backup relaying.

Relay Communications Plan

Transmission Line Protection: PPL's 69kV – 500kV transmission lines are protected with primary and backup relays. Further details on PPL's Transmission Line Protection Standards are included in the accompanying Appendix 2B.

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's Circuit Breaker Protection Standards are included in the accompanying Appendix 2B.

D.1.3 Transmission Facilities Constructed by Others

Transmission line Relocation

As part of the PPL scope of work, no transmission line relocations will be constructed by others.

Substation Expansion or Modification

As part of the PPL scope of work, no substation expansions or modifications will be constructed by others.

D.2 Environmental, Permitting and Land Acquisition

D.2.1 Environmental Impact Review Methodology and Preliminary Results

PPL Electric 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 and endangered (T&E) species or their habitats, and evaluation of the cultural resources that may be within or in the vicinity of the 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.

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

PPL EU plans to expand the aforementioned substation beyond the fence area of the existing substation but within the boundaries of the current PPL EU property line. The company does not anticipate the need to acquire any additional land.

D.2.3 Permitting Plan and Approach

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

- Desktop Permitting Assessment
- Environmental Studies
- PADEP Chapter 102 Design and Permitting

D.3 Solution Cost Estimate

The estimated project cost is \$ [REDACTED] M 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's costs can be found in the accompanying Appendix 2D.

D.4 Solution Schedule

A 12 month project schedule is required to complete the scope of PPL's proposed project components. Embedded within the component schedules below are 8 months for planning & design, right-of-way, siting & permitting activities (including any necessary Certificates of Public Convenience and Necessity) as well as long lead procurement. The following 4 months are reserved for construction and testing & commissioning. These activities will be coordinated in parallel with FirstEnergy's scope of work in more detail upon selection of PPL as the Designated Entity for these proposal components.

Successful completion of the project will require coordination between engineering, right-of-way / land acquisition, long-lead time equipment procurement, CPCN / permitting, operations and construction activities. A preliminary estimate of the integrated project schedule is provided below.

<Intentionally left blank>

Project Component	Activity	Start	Finish
REDACTED			

Table 10: Anticipated Timeline for PPL Project Components

D.5 Ongoing Transmission Facility Items

D.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.

D.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 will ensure will ensure equipment is on hand that matches elements included as part of this physical solution so that spares on-hand are compatible.

D.6 Assumptions

The PPL project execution model relies upon a set of assumptions described in the list below. Additional technical assumptions not list below are embedded within the narratives above and this proposal's accompanying attachments.

Financial / Estimating

- Estimate assumes unimpeded access to works areas
- Estimate assumes no new access roads will be necessary
- Estimate assumes laydown area shall be part of the overall substation capital budget
- Estimate assumes work pads and pull pads shall remain post-construction (no restoration required)

Schedule

- Long-lead time items: transformers 12-18 months, steel poles up to 30 weeks
- Proposed outages will be granted to support construction execution

Appendices

Reference	Description
Appendix 1A	FirstEnergy Transmission Component Details
Appendix 1B	FirstEnergy Substation Component Details
Appendix 1C	FirstEnergy Line Protection and Breaker Failure Protection Philosophy
Appendix 1D	FirstEnergy Detailed Cost Estimate
Appendix 2A	PPL EU Transmission Component Details
Appendix 2B	PPL EU Substation Component Details
Appendix 2C	PPL EU Line Protection and Breaker Failure Protection Philosophy
Appendix 2D	PPL EU Detailed Cost Estimate
Appendix 3	List of Attachments