



2014 RTEP Window 2, Addendum No. 2 Joint Proposal

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

Allen - Gardner Voltage Drop Violation

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Contacts for Technical Inquiries

Primary POC - PPL Electric Utilities:

Matthew B. Green

[*mbgreen@pplweb.com*](mailto:mbgreen@pplweb.com)

610-774-4784

Secondary POC - FirstEnergy:

John P. Syner

[*jsyner@firstenergycorp.com*](mailto:jsyner@firstenergycorp.com)

724-830-5478

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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 Corporation (“FirstEnergy”, “FE”) in response to the 2015 PJM RTEP Reliability Open Window 2, Addendum No. 2. 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 EU and FE service areas. This project will be further referred to as the “Revised Allen-Williams Grove 115kV Project.”

Proposal components #1 through #6 resolve the PJM RTEP Reliability Window 2 violations on the FE transmission system (violations are listed in Section A.3).

1. **Allen-Williams Grove 115kV Line:** [REDACTED]
2. **Allen Substation Upgrades:** [REDACTED]
3. **PPGI Substation Relaying:** [REDACTED]
4. **Roundtop Substation Relaying:** [REDACTED]
5. **Williams Grove 115kV Transmission Interface:** [REDACTED]
6. **Williams Grove 230 / 115kV Transformation:** [REDACTED]

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:

[REDACTED]

Increased Capacity and Efficiency:

[REDACTED]

Strengthened Network:

[REDACTED]

Avoids Future Costs:

[REDACTED]

Alternatives Analysis

As part of the analysis, FE evaluated other solutions to resolve the PJM RTEP Window 2 Addendum No. 2 violations for this area. Previously, FE submitted two upgrades during the PJM RTEP Window 2 process, and the two additional solutions identified independently by FE are as follows:

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

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

- [REDACTED]
- [REDACTED]

2. FE Capacitor Project

- [REDACTED]

Due to the competitive bidding processes set forth in FERC 1000, a proposal that offers the viable long term solution to a violation at a reduced cost is highly favorable. This revised proposal is less costly than both the original FE proposal (Cumberland-West Shore 230kV) and the original Window 2 Addendum proposal prepared by PPL EU and FE. Despite the cost and scope reductions incorporated for this revised proposal, the PPL EU / FE comprehensive solution still 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 revised comprehensive solution developed and jointly submitted by PPL EU 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 No. 2 provided during the Open Window process.

The PPL EU / FE Revised Allen-Williams Grove 115kV Project mitigates numerous violations reported in the Window 2 Addendum No. 2 problem statement. Specifically, this project solution addresses the N-1-1 loss of the Middletown Junction-Roundtop (B_ME115-SX-#28) and Gardner-Hunterstown (B_ME115-SX-#6) 115kV lines, which result in the following 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 No. 2 Study

FE has identified additional violations not present in PJM's Window 2 Addendum No. 2 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 No. 2:

[REDACTED]

REDACTED

Table 2: Additional [REDACTED] Resulting from PJM 2014 Window 2 Addendum No. 2 Study

[REDACTED]

This jointly submitted FE / PPL EU solution mitigates [REDACTED] the flowgate violations identified by PJM in its Window 2 Addendum No. 2 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]



A.6 Total Proposed Project Cost

The total cost of the Revised Allen-Williams Grove 115kV Project, including the scope elements of both FE and PPL EU, is approximately \$11.94 million. The expected project duration is 42 months from receipt of approval from PJM.

Description	Total Cost (\$M)
REDACTED	
Total Project Cost	\$11.94

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

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A.7 Project Execution

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

Project Component	Activity	Start	Finish
REDACTED			

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

B Company Evaluation Information

B.1 FirstEnergy 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 Revised 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 EU 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 two components of the Revised Allen-Williams Grove 115kV Project listed below.

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

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 – 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 EU’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 FE 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 FE’s project scope constructs a new 115kV line from the Williams Grove 230/115/69kV substation (PPL EU) 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 Revised Allen-Williams Grove 115kV Project. FE will strive to maintain a line route as close to straight-line as possible from Williams Grove to Allen. This plan is subject to intervention, property acquisition, and /or unforeseeable natural obstacles. New 115kV structures will be utilized throughout. Although the final transmission route has not been finalized, FE 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 EU 230kV lines for which right of way has previously been acquired with minimal logistical challenge.

The point of demarcation between PPL EU and FE project scope will be at the first transmission dead end structure outside of PPL EU’s Williams Grove substation. PPL EU 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
REDACTED	

Table 6: FirstEnergy Transmission Line Specifications

Additional detail, including FE 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

[REDACTED]

Electrical Design

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

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

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 FE substation upgrades can be found in the accompanying Appendix 1B.

C.1.3 PPGI Substation Relaying

General Description

[REDACTED]

Electrical Design

[REDACTED]

Relay Communications Plan

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

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C.1.4 Roundtop Substation Relaying

General Description

[REDACTED]

Electrical Design

[REDACTED]

Relay Communications Plan

Communications modification will be required as part of the activities described above. The relay / communication upgrades required as part of the FE 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 FE scope of work, no transmission line relocations will be constructed by others.

Substation Expansion or Modification

As part of the FE 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

FE 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

FE 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

FE 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 needed where / if transmission lines need to cross. FE will negotiate with affected property owners for the additional rights.

C.3 Solution Cost Estimate

The estimated project cost for FE'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 FE'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 FE'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 EU's scope of work in more detail upon selection of FE 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
<p>REDACTED</p>			

Table 7: Anticipated Timeline for FirstEnergy Project Components

C.5 Ongoing Transmission Facility Items

C.5.1 Operations Plan

The Revised Allen-Williams Grove 115kV Project will be operated from FE’s “FE East” control center. FE 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 Revised Allen-Williams Grove 115kV Project facilities will be maintained consistent with FE’s existing maintenance practices already on file with PJM.

C.6 Assumptions

The following assumptions were made for the FE components as part of the Revised 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 (“LON”) is required to the PAPUC.

D Proposed Solution Constructability Information – PPL EU

D.1 Solution Scope

PPL EU proposes to build a two-component solution in order to accommodate FE’s incoming 115kV transmission connection. PPL EU’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, FE and PPL EU have agreed to a project scope split location at the 115kV transmission deadend structure described in Section D.1.1.

Solution Components

The PPL EU 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 EU Project Component List

D.1.1 Williams Grove 115kV Transmission Interface

General

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

Electrical & Physical Characteristics



[REDACTED]

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

Parameter	Value
REDACTED	

Table 9: PPL EU 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

[REDACTED]

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 2B.

Electrical Design

[REDACTED]



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 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 EU'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 EU scope of work, no transmission line relocations will be constructed by others.

Substation Expansion or Modification

As part of the PPL EU 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 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 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 does not anticipate the need to acquire any additional land for these project components.

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 for PPL EU components is \$██████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 EU'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 EU'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 FE's scope of work in more detail upon selection of PPL EU 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.

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Project Component	Activity	Start	Finish
REDACTED			

Table 10: Anticipated Timeline for PPL EU 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 EU 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 EU 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

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

Schedule

- [REDACTED]
- [REDACTED]

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