



PPL Electric Utilities

2014 RTEP Project Proposal Window 1

Generation Deliverability Flow Gates #797 and #801

***Solution #5a: Catawissa 500-230kV Substation Addition with One
500-230kV Transformer***

Submitted July 28, 2014

REDACTED VERSION

Catawissa 500-230kV Substation Addition (One Transformer)

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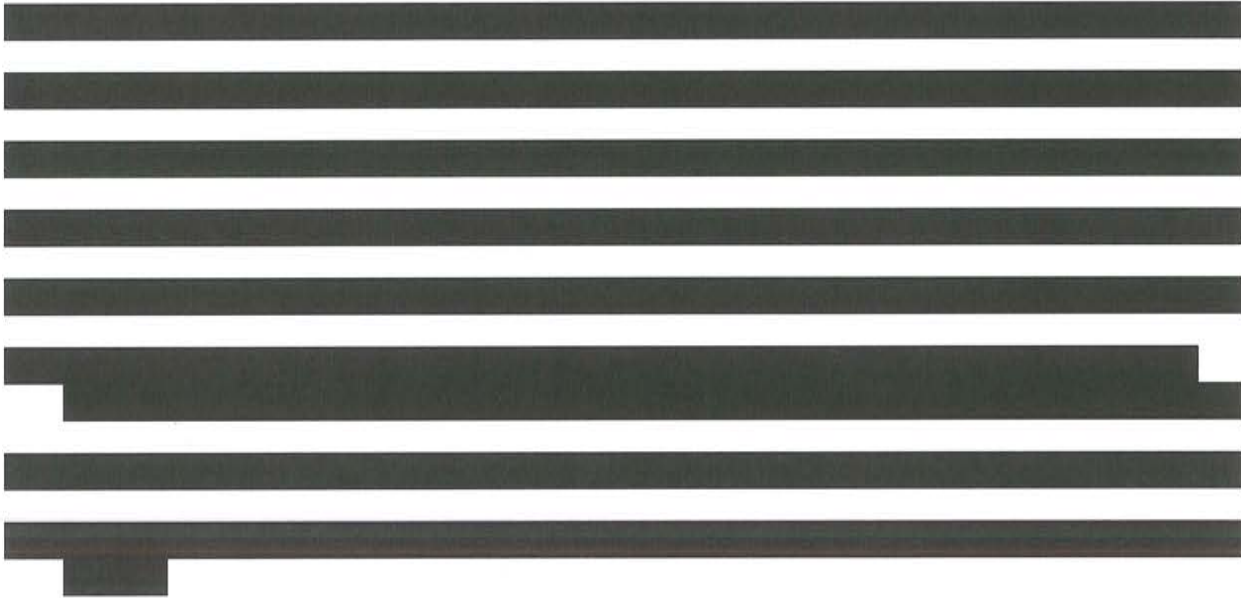


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A Executive Summary

A.1 Name and Address of Proposing Entity

Address:

PPL Electric Utilities Corporation
Two North Ninth Street
GENN5
Allentown, PA 18101-1179
(610) 774 – 5151

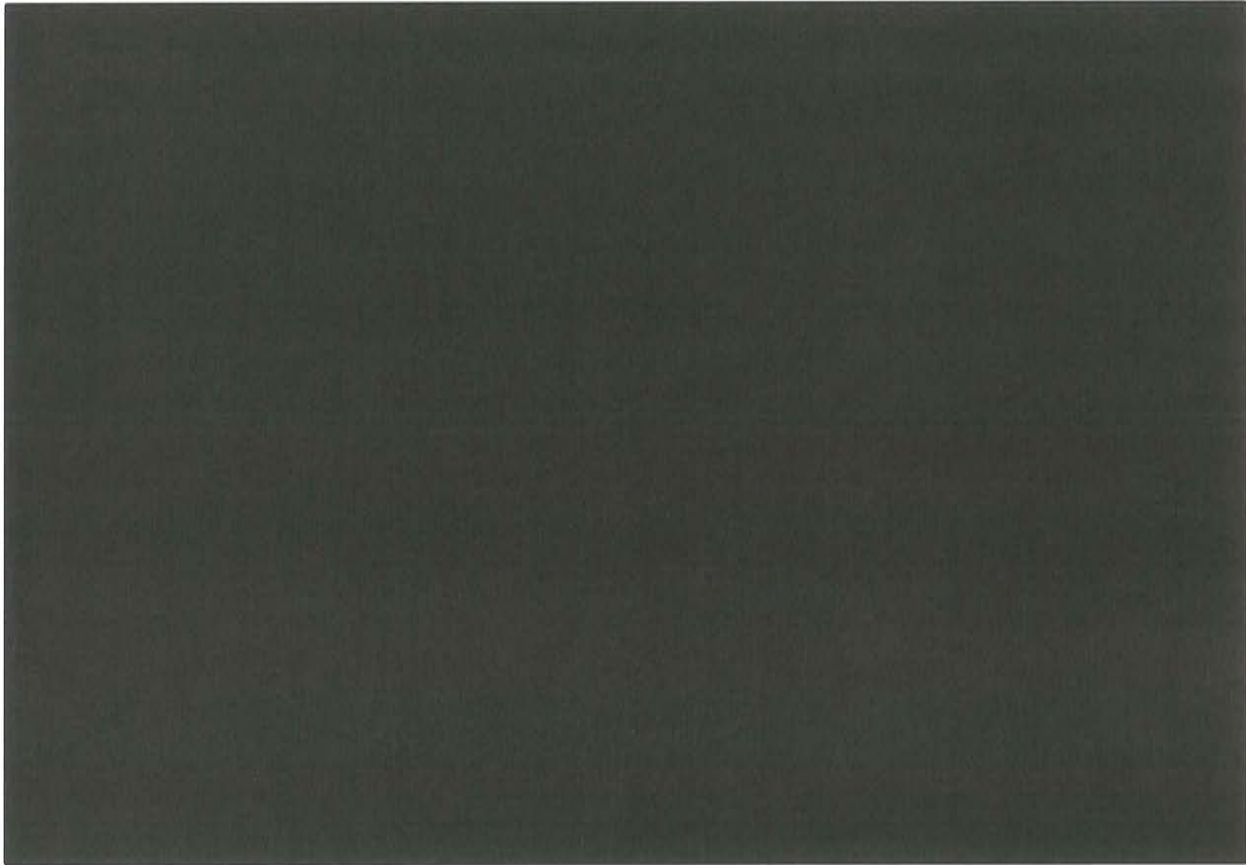
Point of Contact:

Vincent J. Cuce
Manager, Asset Management Transmission & Substation
Business: (610) 774 – 6580
Cellular: (610) 737 – 2015

A.2 Description of Problem and Proposed Solution

PPL Electric Utilities (PPL EU) proposes a new 500-230kV substation, to be named Catawissa Substation [REDACTED] This solution will relieve two Generation Deliverability violations (Flow Gates #797 and #801) on the existing Montour - Milton – Sunbury 230kV line for loss of the Montour – Susquehanna 230kV double-circuit (DCT) lines, as identified in PJM’s 2014 RTEP study results. The substation will change the power flows by bringing together three lines: Susquehanna - Sunbury #2 500kV, Columbia – Frackville 230kV, and Susquehanna – Sunbury #1 230kV. PPL EU will be responsible for planning, siting, design, permitting, construction, operation, and maintenance of the entire project. A map of the proposed development is included in Figure A.2.1.

Figure A.2.1 - Proposed Catawissa 500-230kV Substation Aerial Map



Why This Solution?

PJM identified that the Montour – Milton – Sunbury 230kV line can load to approximately 109% of its summer emergency MVA rating during this contingency under certain Generation Deliverability dispatches. Implementation of this solution reduces the thermal overload on the existing Montour – Milton – Sunbury 230kV line to approximately [REDACTED] of its summer emergency MVA rating.

This solution further provides an opportunity to enhance reliability by eliminating line crossings, improve voltage support in Frackville region, and enable future development of a 69kV substation to serve customers. As primarily a substation solution, many of the risks inherent in line development are mitigated, e.g., permitting, right-of-way acquisition, wildlife impact.

Why PPL EU?

PPL EU has successfully developed, operated, and maintained transmission infrastructure throughout its nearly 100 year history and is well positioned to implement the Catawissa 500-230kV substation. PPL EU focuses on delivery excellence, blending capable people,

mature processes, and rich vendor networks. PPL EU is backed by its parent company, PPL Corporation, one of the largest investor owned public utilities in the U.S. Both companies maintain “investment grade” credit ratings and conduct business according to a set of business standards codified in the PPL EU Standards of Conduct and Integrity.

As a developer, PPL EU:

- Utilizes standard designs and processes for substation development
- Employs best-in-class lifecycle approach to transmission asset management (see Section B1)
- Delivers projects on-time and on-budget, e.g., Paupack 230/69kV substation (see Appendix A)
- Anticipates circumstances specific to the region as the incumbent utility, e.g., topography, development types

As an operator, PPL EU:

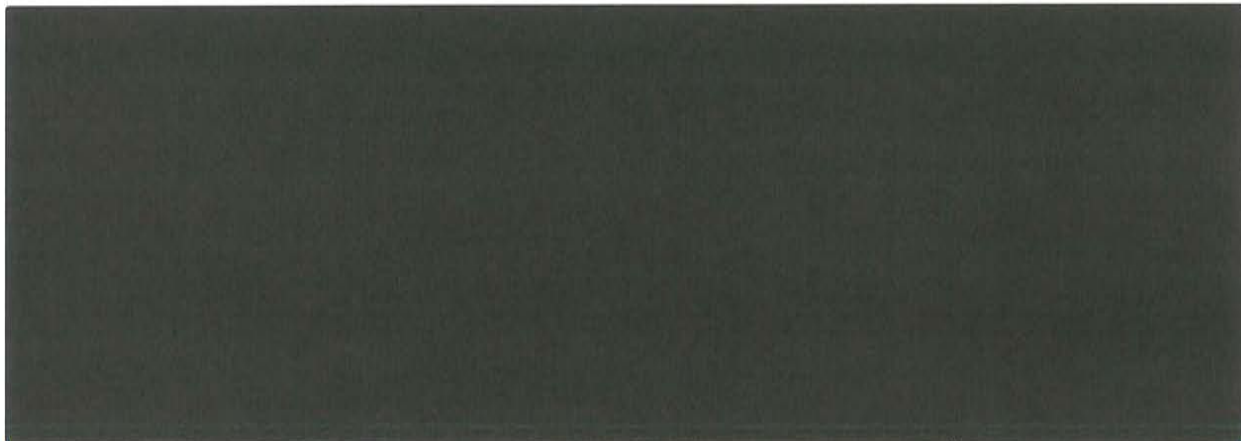
- Conducts business safely with incidence rates lower than industry averages
- Maintains facilities beyond industry standards (top quartile System Average Interruption Frequency Index (SAIFI), multiple awards and recognition for Hurricane Sandy response)
- Builds relationships with local community (\$6M raised for charity in 2013)

Further description of PPL EU’s capabilities as a transmission developer and operator is presented in Section B.

A.3 Estimated Solution Cost

Development of the new 500-230kV Catawissa Substation and selected upgrades to resolve the Generation Deliverability violations described in Section A.2 is estimated at a total cost of \$102.9M (see Figure A.3.1 for more detail). This estimate is the result of a detailed design process that considered factors specific to this project (e.g., primary, secondary, auxiliary systems) and is informed by recent PPL EU substation project experience.

Figure A.3.1: Summary of Estimated Project Costs



| | | |
|--------------------------------------|--|-----------------|
| Total (Including Contingency) | | \$ 102.9 |
|--------------------------------------|--|-----------------|

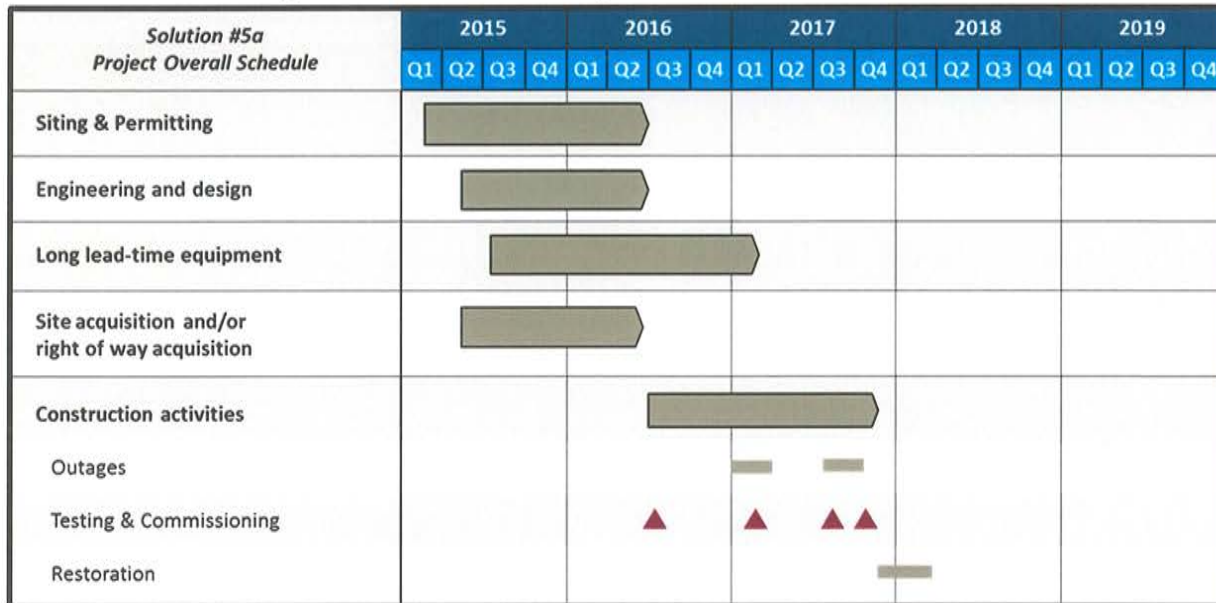
Note 1: Cost in \$ Millions

Note 2: Numbers may not sum due to rounding

A.4 Solution Schedule and Milestones

The solution described within this document will be commissioned and energized by the end of the fourth quarter of 2017 (see Figure A.4.1 for a summary), exceeding PJM’s target date for Generation Deliverability violation resolution. PPL EU is prepared to begin the planning and coordination required to execute against this timetable following the award of the project. PPL EU integrated planning, permitting, engineering, and constructability capabilities allow for efficient execution of the required activities recognizing that multiple stakeholders will be involved across the project lifecycle. The project will be led by the PPL EU Project Management Organization (PMP certified personnel) utilizing our repeatable design and construction processes along the schedule indicated in the figure below.

Figure A.4.1: Overall Project Schedule and Milestones



A.5 Statement of Designated Entity Consideration

PPL EU seeks, through the proposal herein, to be considered the Designated Entity to construct, own, operate, maintain, and finance the proposed solution.

A.6 Affirmation of Pre-Qualification Information

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).

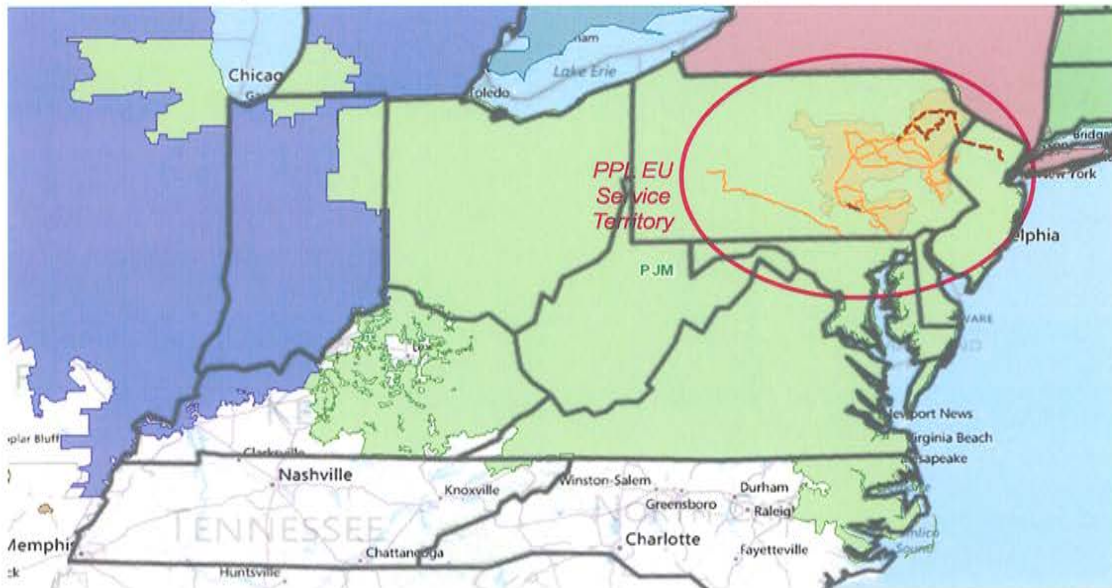
B Company Evaluation Information

B.1 Company Overview

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 owns and operates a large transmission system within the PJM footprint, including 62 substations with a total capacity of 18.3 million kVA and approximately 4,000 transmission pole miles in service. Figure B.1.1 depicts PPL EU’s existing transmission service territory within the broader PJM footprint.

Figure B.1.1: PPL EU Transmission Footprint in PJM



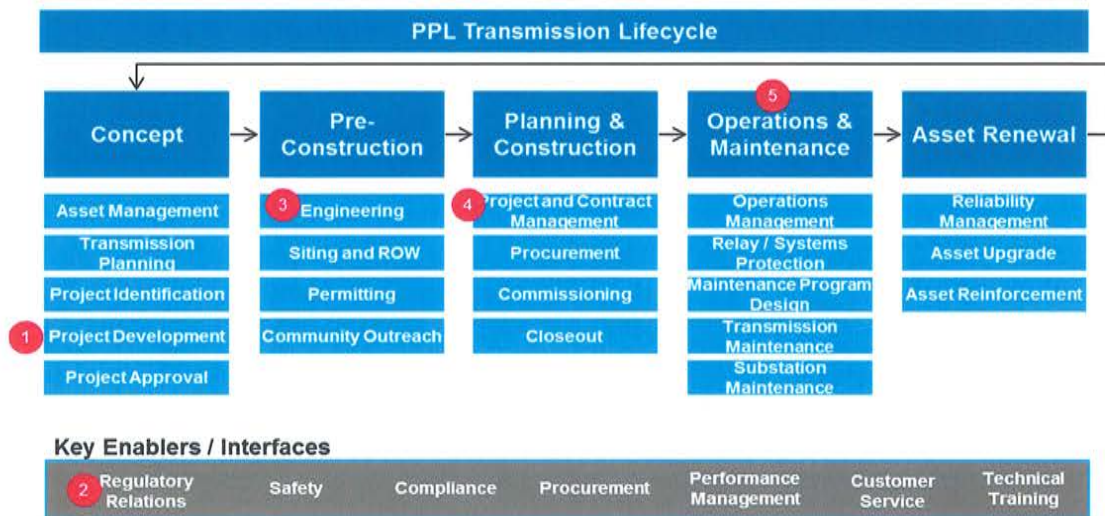
Management of this extensive transmission system and the project experience gained through constructing these assets, has enabled PPL EU to establish unique capabilities that are relevant to the proposed solution to the Montour–Milton-Sunbury 230kV line Generation Deliverability violations. PPL EU not only brings a well-established strong relationship with PJM, strong financial backing, and extensive project experience, but also a scalable contractor model, engineering expertise, and a culture of operational excellence that is required for successful project execution and asset operation.

PPL EU has established an operating model designed to efficiently and effectively invest in, operate and maintain its transmission system. This model establishes clear roles,

responsibilities, processes and procedures to ensure accountability, facilitate timely decision-making, and optimize overall execution. A senior management team with almost 200 years of collective experience is responsible for overseeing an integrated transmission and distribution system. A set of PPL EU-designed operating principles ensure safe and reliable execution of its transmission strategy by aligning and focusing the organization on critical areas for success. Both the management team and the supporting organization have the requisite capabilities to advance transmission as a strategic priority for PPL EU.

Figure B.1.2 highlights capabilities particularly relevant for consideration of this proposed solution.

Figure B.1.2: PPL EU Differentiating Capabilities



B.1.1 Project Development

PPL EU has extensive experience identifying and executing transmission projects, ranging from simple upgrades to large scale greenfield development. More than \$600 million in transmission grid investment is planned in 2014 alone and \$4.7 billion in the transmission and distribution grids over the next five years. Completing these projects requires extensive technical expertise, effective project management capabilities, the ability to work with numerous stakeholders, and effective cost controls over the capital being deployed. The in-flight 500kV new transmission line build Susquehanna-Roseland and 230kV new transmission line build at Northeast Pocono, described in detail in Appendix A, demonstrate PPL EU’s ability to successfully execute the complexities of large projects concurrently.

B.1.2 Regulatory Relations

Strong relationships with federal, state and local government and regulatory agencies have facilitated successful development and operation of transmission projects. Throughout PPL EU's nearly 100-year history, PPL EU has worked with agencies, communities and customers to site, permit, and license transmission projects within our transmission service territory. For example, National Park Service was a key stakeholder relationship developed to address the requirement for the Susquehanna–Roseland project to cross three national parks. Additionally, PPL EU has an outstanding success rate with obtaining siting application approvals through Pennsylvania's Public Utility Commission (PUC).

B.1.3 Engineering

With the increase in infrastructure investments, the Engineering department has gained a broad mix of recent design experience including both new capacity additions and upgrades, as well as varied electrical system specifications, weather and geographic topography conditions. PPL EU has designed over 1,000 miles in support of new line builds, existing transmission rebuilds, reconductoring and fiber optic cable additions.

Transmission Engineering utilizes current industry standards and adopts new technologies to improve process efficiency and effectiveness. Updated standards incorporate specifications such as 2-shield wires and high reliability performance lines. New state-of-the-art technology such as a Power Line Computer Aided tool called PLS – CADD acts as a centralized tool for designing and drafting. PPL EU is also a member of key industry forums such as the Electrical Power Research Institute (EPRI) and the EHV Engineering Committee, which build capabilities through collaboration with other members.

PPL EU's Engineering group not only leverages extensive experience in-house, but also has vast experience in managing contracted engineered services with 12+ engineering firms:

[REDACTED], among others. These contractors have extensive knowledge and experience designing all transmission line voltage classes both within PJM as well as outside the PJM territory.

B.1.4 Project and Contract Management

The PPL EU Project Management team ensures that project activities are completed to scope, schedule and budget in order to achieve the business objectives and requirements of the company. The team is part of a dedicated organization using best-in-class process and with employees who maintain the Project Management Professional (PMP) certification. The Project Management team remains connected to projects throughout the

entire development lifecycle, beginning with a specific Project Manager assigned to a project in the early stages of Project Planning and Design. The Project Management team has experience managing projects across all service territories and across all types and sizes of projects. Depending on the size and scope of a particular project, Project Managers are responsible for managing and overseeing anywhere from one to fifteen projects at the same time. For the largest and most complex projects PPL EU will assign the most experienced Project Managers to ensure that the project is handled in the most efficient and effective method possible.

The ability to execute projects both large and small is built on a scalable contractor model across the transmission asset lifecycle, while maintaining stringent standards relating to safety, quality, and delivery. PPL EU has established a preferred set of contractors, Contractors of Choice (COC), through an extensive, formal request-for-proposal (RFP) process. The Contract Management team has established relationships with contractors nationwide, which creates a strong ability to effectively source the best contractor(s) for each piece of work required by PPL EU. This contracting process delivers a best practice contracting approach that complies with the National Contract Management Association standards and processes.

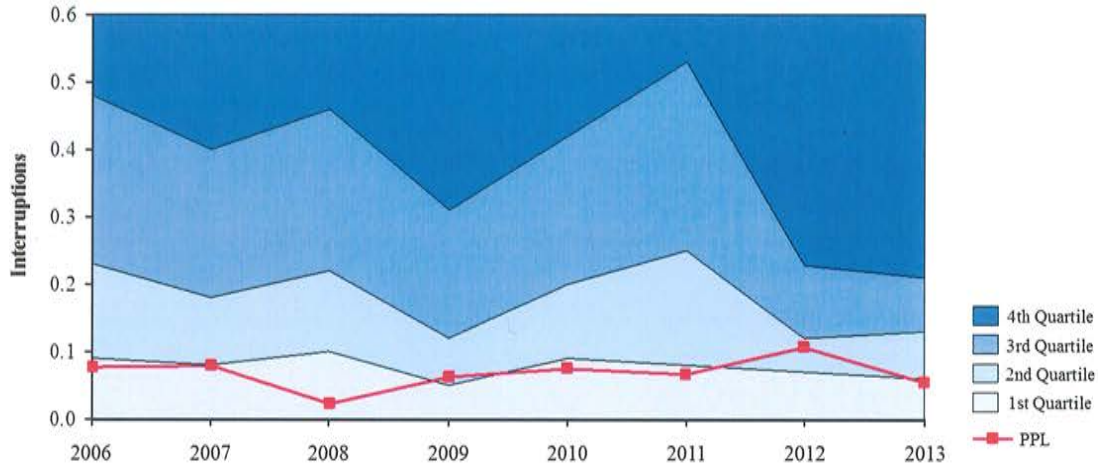
B.1.5 Operations & Maintenance

PPL EU has a strong history of execution excellence, as demonstrated by our exemplary track record of compliance, safety, reliability, and cost containment. Compliance with North American Electric Reliability Corporation (NERC) standards has always been, and continues to be, a high priority and PPL EU has routinely been recognized by ReliabilityFirst (RF) as a benchmark for compliance. In 2012, RF audited PPL EU on behalf of NERC for both Reliability Standards associated with Operations and Critical Infrastructure Protection (CIP) Reliability Standards, the company received high marks for both. PPL EU adopts standards and processes in advance of compliance requirements and offers regular training programs. Safety is a PPL EU core value embedded throughout PPL EU. The Safety program strives to minimize Occupational Safety and Health Administration (OSHA) designated Recordable Events and results are consistently better than industry peers.

Commitment to system performance through effective, preventive and real-time operations and maintenance programs is evidenced in the reliability performance metrics for PPL EU's system. As shown in Figure B.1.3, Transmission System Average Interruption Frequency Index ("T-SAIFI") performance has been at or near top-quartile performance for the past six years, averaging less than 0.1 interruptions over the period from 2006 through 2013 (excluding major events).

Figure B.1.3: PPL EU T-SAIFI Historical Trend (In Interruptions)

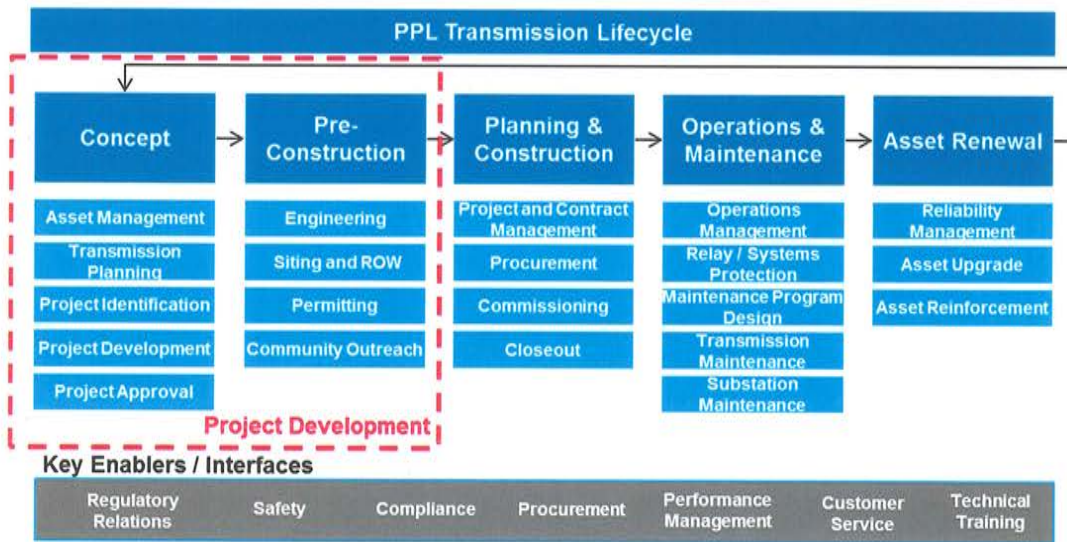
**EEI Benchmarking Survey Transmission SAIFI Performance by Year
(Excluding Major Events)**



B.2 Technical and Engineering Qualifications and Experience

PPL EU has nearly 100 years of experience in transmission development and construction, building everything from core 69kV connection projects to 500kV lines. With refined processes to manage the complexities inherent in all types of transmission projects, PPL EU organizes and operates with project execution in mind. Project control is maintained through strong governance, clear project review processes, and tools for stringent project estimating and control. The early phases are grounded in the principles of constructability, cross-functional collaboration and front-loaded engineering and design to avoid or minimize future scope, schedule or cost changes. For example, during the Concept phase the operations and maintenance teams provide input into new project development on optimal design and construction in terms of ease and cost to maintain the assets. PPL EU uses a blended approach of in-house teams and approved contractor resources to allow for high quality project execution at the lowest overall cost. Regardless of internal or external resources, all projects are delivered through the structured project development model shown in Figure B.2.1.

Figure B.2.1: PPL EU Transmission Lifecycle



Proven success in large capital projects such as the recent Susquehanna–Roseland project illustrates PPL EU’s effectiveness in executing its end-to-end transmission operating model. Certain elements of this operating model are highlighted below.

Widespread Contractor Support

With recent project experience at Susquehanna–Roseland and Northeast Pocono projects, PPL EU has built strong relationships with many large firms that have nation-wide capabilities. These relationships will allow access to talent with familiarity with the rules and regulations in Pennsylvania through the development and construction phase. In the event that the current vendor base cannot adequately support the project needs, the Sourcing organization has developed an extensive RFP process that comprehensively vets potential contractors for safety, performance, quality, Days Away, Restricted, or Transfer (DART) rates, and safety incidents.

Secure and Cost Effective Supply

Due to the significant volume of projects executed over the last several years, PPL EU receives preferred customer prices that are equal to or better than its peers, and has secured supply when others in the industry are unable to find needed resources and / or materials. For example, materials management for Susquehanna–Roseland was outsourced to HD Supply, a model that would likely be replicated for the proposed project. HD Supply’s widespread footprint positions this partner to effectively manage equipment purchasing, product tracking, and securing lay-down yard, in the territory.

Siting, Permitting and Right-of-Way

The Siting, Permitting and Right-of-Way departments have built a strong set of capabilities to support the proposed solution. The siting process includes the determination of a Project Study Area, identification of Alternative Corridors, identification of Alternative Routes within these Corridors, and Selection of the Preferred Route. Through early stakeholder engagement and public outreach, PPL EU has been successful at avoiding constraints and leveraging opportunities to minimize impact to the public and environment, while maintaining reasonable costs and preserving engineering and construction feasibility. PPL EU has an excellent success rate for securing approval for siting applications from PA PUC.

The Right-of-Way team is heavily integrated with the Siting team, which facilitates more effective community outreach and greater consensus on route development. In the past six years, PPL EU has successfully acquired over 140 right-of-way miles. PPL EU prides itself on taking a “property owner perspective” when acquiring right-of-way and accommodates landowner requests when practical. Acquiring right-of-way is a complex process necessitating the coordination of many stakeholders. PPL EU Permitting has a track record of successfully obtaining the necessary local, state and federal government permits and licenses for proposed transmission projects. Figure B.2.2 is a sample listing of projects and the corresponding permits and/or licenses that have recently been acquired to construct transmission projects:

Figure B.2.2: Example of Recent Permits / Licenses Acquired

| Project Name | Permit / License Acquired |
|------------------------|--|
| Susquehanna – Roseland | License for Right-of-Way – Delaware Forest |
| Susquehanna – Roseland | Letter of Authorization – Lackawanna Forest |
| Susquehanna – Roseland | License for Right-of-Way – Game Lands 183 & 300 |
| Susquehanna – Roseland | Special Use Permit – PA Game Commission |
| Susquehanna – Roseland | PennDOT Permits (Min. Use, HOP, LAP) |
| Susquehanna – Roseland | DEP – Submerged Land License Agreement |
| Susquehanna – Roseland | PA Turnpike Commission Access & Restoration |
| NE Pocono Reliability | Special Use Permits – PA Game Commission |
| NE Pocono Reliability | NPDES Permit – Peckville-Varden Transmission Line |
| NE Pocono Reliability | NPDES Permit – Paupack Substation |
| NE Pocono Reliability | NPDES Permit – Paupack Taps, Transmission Line |
| NE Pocono Reliability | NPDES Permit – Paupack-Honesdale Transmission Line |
| NE Pocono Reliability | NPDES Permit – Pocono Substation |

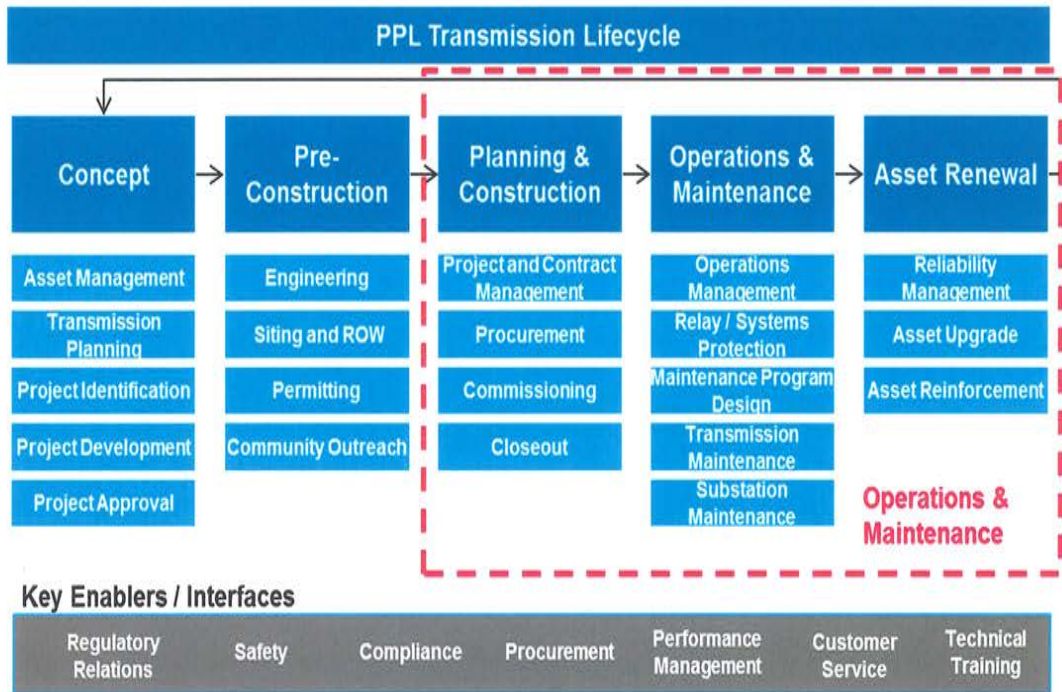
| Project Name | Permit / License Acquired |
|-----------------------------------|--|
| NE Pocono Reliability | NPDES Permit – Pocono to Paupack Transmission Line |
| NE Pocono Reliability | Two (2) Joint Permits (one per county) - Pocono to Paupack Transmission Line |
| NE Pocono Reliability | Joint Permits – Peckville-Varden Transmission Line |
| NE Pocono Reliability | Joint Permits – Paupack-Honesdale Transmission Line |
| NE Pocono Reliability | I-84 Clearing Permits |
| NE Pocono Reliability | PennDOT Permits |
| Blooming Grove – Hemlock | Road Use Agreement – Delaware Forest |
| Blooming Grove – Hemlock | License for Right-of-Way – Delaware Forest |
| Blooming Grove – Hemlock | DEP – GP8 Permit |
| Susquehanna – Harwood Reconductor | DEP – GP8 and GP11 Permit |
| Blooming Grove – Jackson | DEP – GP8 and GP11 Permit |
| Sunbury – Dauphin | NPS – Special Use Permit Appalachian Trail |

During the development of the Susquehanna-Roseland project, PPL EU developed a strong capability across its Governmental and External Affairs group. In a challenging environment, PPL EU successfully established a process to allow groups to conduct reviews and on-site examinations to promote transparency and cooperation. With the potential for the proposed project to impact environmentally sensitive areas as further detailed in Section C, PPL EU will leverage this capability to coordinate with the Pennsylvania Department of Natural Resources. PPL EU understands the importance of engaging stakeholders and developing relationships and would engage local consultants as needed to augment PPL EU's existing network of relationships with federal, state, and local stakeholders.

B.3 Operations & Maintenance Qualifications and Experience

PPL EU is committed to achieving leading operations reliability and system performance for its transmission system. Figure B.3.1 depicts the functions that support the operations and maintenance portion of the transmission asset lifecycle.

Figure B.3.1: PPL EU Transmission Lifecycle



PPL EU, as the owner of the conductor assets will provide all required maintenance at PPL EU’s standards. PPL EU’s stringent prioritized maintenance programs are developed based on established reliability standards, asset management driven-programs, and overall equipment criticality. While all transmission operators face tradeoffs related to optimizing capital, O&M, reliability and overall value, PPL EU has developed a proactive asset renewal program that carefully weighs the most prudent and cost-effective methods to ensure system performance at a sustainable cost. This focus on reducing the number of degraded elements, as well as reducing system vulnerabilities, identifies the most critical infrastructure and prioritizes the most important renewal work. A programmatic approach to preventive maintenance facilitates improvements to field productivity by reducing emergent work initiated by equipment failures, allowing workers to focus on scheduled work. PPL EU’s maintenance model and vegetation management program are well suited to efficiently and effectively maintain the proposed solution.

Maintenance Model

A flexible maintenance model allows PPL EU to provide maintenance support free of geographic constraints. Currently, PPL EU retains asset management responsibilities centrally while using a mix of in-sourcing and outsourcing for in-field maintenance work [REDACTED]. The team relies on electronic communications from inspectors, including detailed inventory and images of each structure, which allows PPL

EU to easily scale the operation to any geographic area. This model is utilized across the PPL EU service territory where pictures are taken to manage the maintenance requirements remotely. Trips to the field are the exception and usually do not extend beyond a detailed walk down of the line at the end of construction. PPL EU is confident that its successful experience managing maintenance contractors will allow it to capably manage the maintenance requirements of the proposed project.

Operations Model

PPL EU facilities will be operated at the direction of PJM and controlled and maintained consistent with the current PPL EU operations and maintenance practices.

To operate and maintain the transmission grid reliably, PPL EU manages a Transmission Control Center (TCC) that adheres to the guiding principles of safety, reliability and production in that order.

In addition to real time operations, PPL EU develops a construction and maintenance outage plan. TCC Planning processes requests to upgrade transmission facilities and translates those to equipment outages using the PJM outage criteria time lines. The TCC plans all outage requests, limits risks to the electric system and PPL EU customer base, and responds to any unplanned events. Transmission outage planning, including risk and conflict analysis, is crucial to promoting safety, preserving the reliability of the bulk and non-bulk transmission system, and eliminating volatility in the work portfolio.

Vegetation Management

PPL EU Vegetation Management leverages “open book,” long-term, managed business relationships with two of the largest vegetation management contractors in North America [REDACTED]. Over the last three years, 100% of the vegetation management plan has successfully been completed for 138kV, 230kV and 500kV lines. PPL EU has had zero tree-related events on 230kV or 500kV transmissions facilities during that timeframe. PPL EU will be able to utilize its contractor base to maintain the same high standards for the proposed solution.

B.4 Emergency Response and Restoration

PPL EU has an industry leading emergency preparedness and response program, led by a dedicated Emergency Preparedness group which develops and maintains comprehensive emergency response plans and supports the effective execution of these plans. PPL EU’s recent experience in major storms, particularly Hurricane Sandy, Hurricane Isaac, a major snow in October of 2012, and extremely high winds in May 2012 have improved our emergency response processes. We have demonstrated the ability to quickly restore our

own assets under various scenarios. PPL EU’s award recognition in emergency response can be found in Figure B.4.1.

Figure B.4.1: Summary of Major Award Recognition

| PPL EU’s Award Recognition |
|---|
| 2013 Electric Light and Power Magazine’s Utility of the Year Award. Also, won in 2008. |
| 2013 North East PA Manufactures and Employers Association Process Improvement Award for improvements related to storm response processes |
| J.D. Powers and Associates conducted a national survey of consumers to rate performance of utilities and local, state and federal government actions prior to and following Hurricane Sandy. In February, 2013 J.D. Power recognized PPL EU as one of only three utilities that performed “Particularly well” |
| 2012 EEI Emergency Recovery Award for Hurricane Sandy |
| 2012 EEI Emergency Assistance Award, for tremendous support in the recovery from Hurricanes Isaac and Sandy |

As owners of the proposed Catawissa 500-230kV substation, PPL EU will maintain responsibility for executing the emergency response plan. PPL EU is confident that it can successfully execute the response plan as the substation is entirely within its traditional operating area and proximate to its wide resource network of local contractors, crews, and additional resources gained through participation in mutual assistance groups.

PPL EU is a member of two regional mutual assistance groups, the North Atlantic Mutual Assistance Group (NAMAG) and the Southeastern Electric Exchange (S.E.E.). PPL EU also has access to additional resources through the Contractors of Choice working on PPL EU’s transmission and distribution systems and Louisville Gas & Electric and Kentucky Utilities.

Overall, PPL EU has developed a unique network of third party support that will allow it to successfully execute against the emergency response plan. Further detail into PPL’s emergency preparedness organization and processes can be found in the pre-qualification document for Designated Entity status.

B.5 Cost / Schedule Adherence

PPL EU has implemented processes, governance, and project management tools to ensure projects are delivered on-time and on-budget.

The Project Controls Department is responsible for monitoring project progress to compare actual versus baseline resource usage and analyze project variances utilizing statistical techniques such as Earned Value Metrics and Reporting to identify trends,

develop forecasts, and expose potential problems. The Project Controls Department also implements process controls, monitors and audits projects to control project risks, ensures adherence to Generally Accepted Accounting Principles (GAAP), and compliance to Federal Energy Regulatory Commission (FERC) and Sarbanes Oxley Act (SOX) regulations.

B.6 Proposed Project Financing

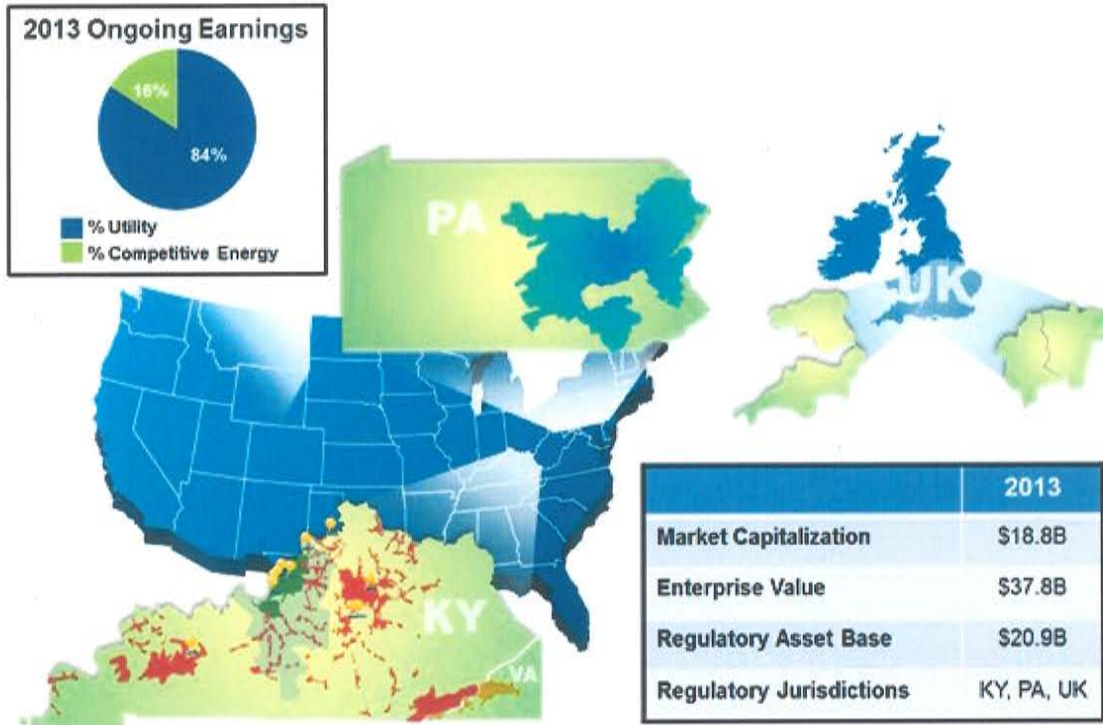
PPL and PPL EU propose to finance the project across its capital structure using approximately 50% debt and equity, including cash from operations. We expect to utilize the commercial bank lending and debt capital markets, using a variety of short-term and long-term securities.

Financial Strength

PPL is one of the largest public utility owners in the US with over \$1.5 billion in ongoing earnings and \$2.9 billion of cash from operations in 2013. The majority of PPL's ongoing earnings and cash flows stemmed from stable, regulated utility operations in the US and UK with over \$20 billion in regulated asset base. This diverse base of regulated cash flows supports PPL's strong balance sheet and enables it to maintain a credit profile that supports consistent access to the equity and debt capital markets and bank markets for additional financing needs at cost effective rates.

PPL EU had over \$500 million of cash flow generated from operations during 2013, and \$300 million of available liquidity, primarily through its commercial paper program and/or bank syndicated credit facilities. PPL EU also has consistent access to the commercial bank lending markets and debt capital markets. Through its parent, PPL, PPL EU has access to appropriate amounts of equity to provide efficient financing resulting in the lowest cost of capital for the ratepayers.

Figure B.6.1: PPL Financial Summary



Credit Metrics:

PPL Corporation and PPL EU have a strong financial foundation that enables the development, operation and maintenance of transmission facilities. To manage financing costs and access to credit markets, a key objective of PPL’s strategy is to maintain a strong investment grade credit profile and strong liquidity position. Additionally, PPL has put in place financial and operational risk management programs that, among other things, are designed to monitor and manage its exposure to earnings and cash flow volatility related to changes in energy and fuel prices, interest rates, counterparty credit quality and the operating performance of its generating units.

PPL EU is focused on timely recovery of costs, efficient operations, strong customer service and constructive regulatory relationships. PPL EU has a low-risk, fully regulated business profile with significant borrowing capacity and stable cash flows. Both PPL and PPL EU maintain investment grade credit ratings from the major credit rating agencies. PPL EU’s financing plan would be executed in a manner that does not negatively impact its current credit ratings.

Figure B.6.2: Credit Ratings

| Issuer | Rating | Moody's | S&P |
|------------------------------------|---------------------|---------|-----|
| PPL Corporation | LT Issuer Rating | Baa3 | BBB |
| PPL Electric Utilities Corporation | Senior Secured Debt | A2 | A- |
| PPL Electric Utilities Corporation | Commercial Paper | P-2 | A-2 |

Because of our strong investment-grade credit ratings and ability to finance a wide variety of funding sources, PPL Corporation and PPL EU expect the cost of financing to be extremely competitive.

C Proposed Project Constructability Information

C.1 Proposed Solution Scope

C.1.1 Project Summary: New Catawissa 500-230kV Substation

PPL EU proposes a new 500-230kV substation, to be named Catawissa Substation



Three single phase 500-230kV transformers totaling 750MVA (rated 858/1165 MVA for normal and emergency ratings respectively) will be connected to one of the two 230kV buses, and will have a low-side 230kV breaker.

PPL EU will be responsible for planning, siting, design, site acquisition, permitting, construction, operation, and maintenance of the entire project.

Figure C.1.1 - Proposed Catawissa 500-230kV Substation Aerial Map

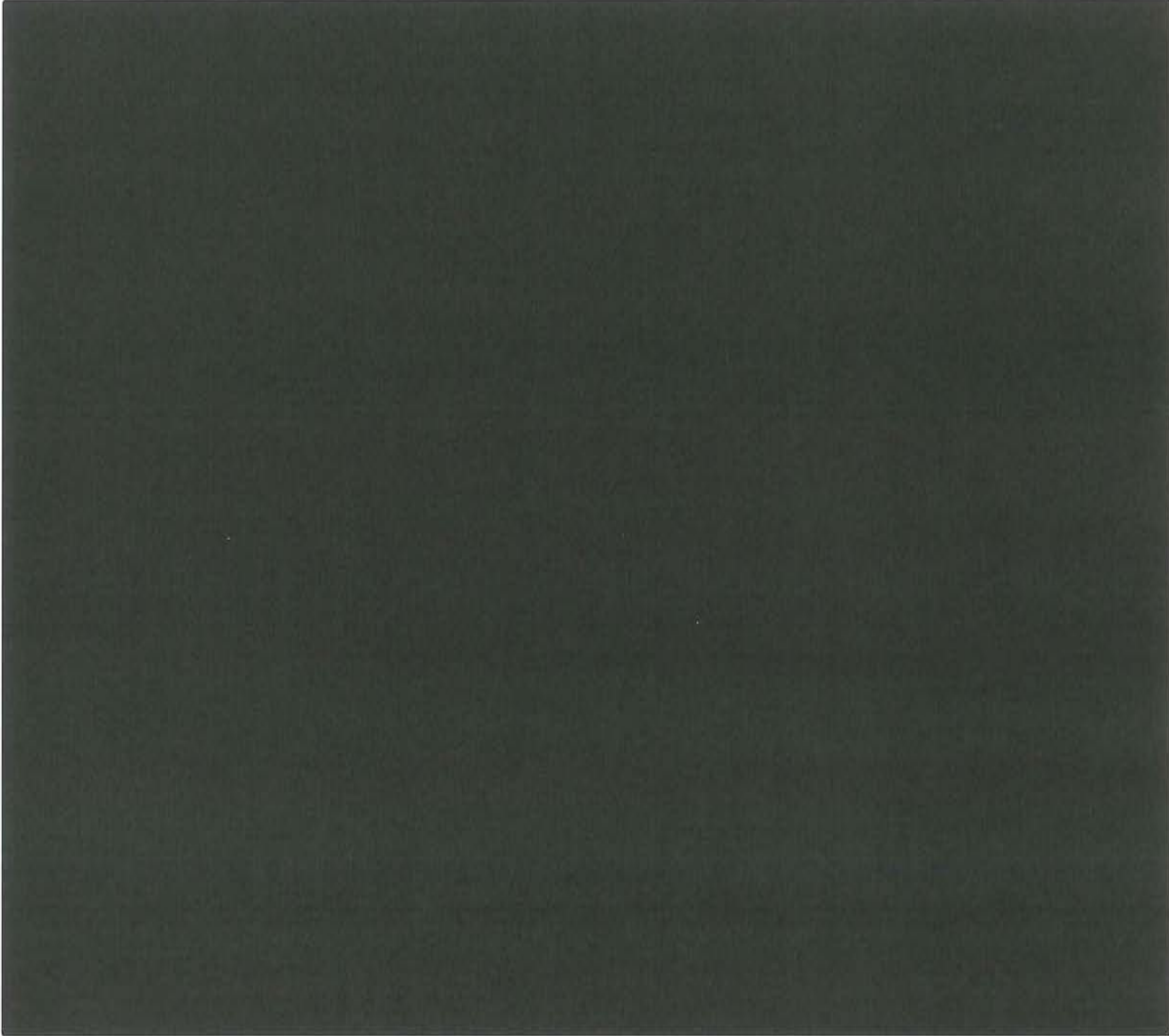
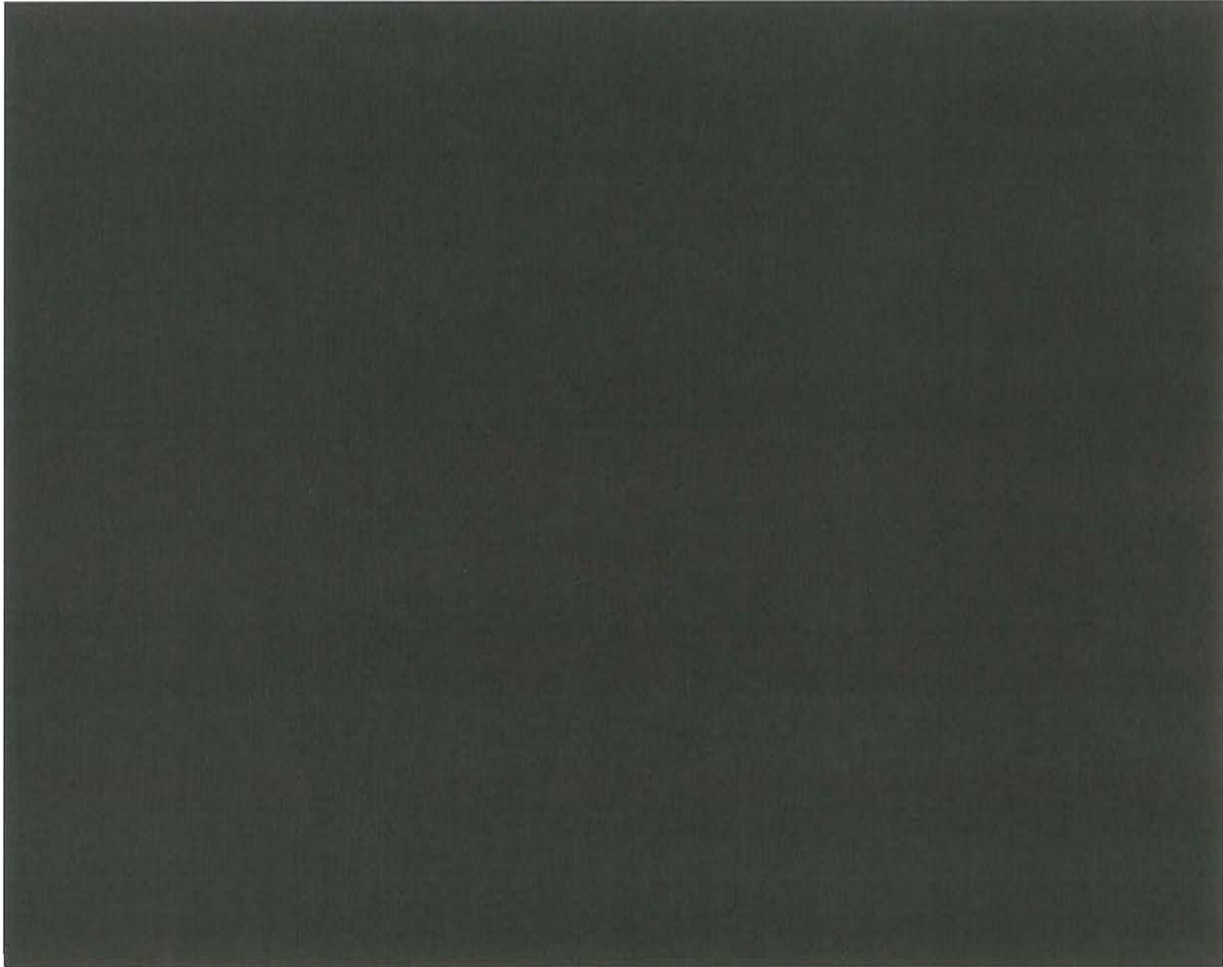


Figure C.1.2 below provides an overall one-line diagram that illustrates the system topology for the proposed solution.

Figure C.1.2 - Solution One-Line Diagram



Area Description and Reliability Concerns Being Addressed:

The PPL EU transmission system in the area of concern consists of 230kV and 500kV networked lines that transmit power across the PPL EU system from generation resources in the west to load pockets in the east. The Montour – Milton – Sunbury 230kV line is one of several 230kV lines that transmit power from Sunbury to Susquehanna. In 2014 RTEP study results, PJM has identified that the Montour – Milton – Sunbury 230kV line could load up to as high as 109% of its summer emergency MVA rating for loss of the Montour – Susquehanna 230kV double-circuit (DCT) line under certain Generation Deliverability dispatches.

A new Catawissa 500-230kV Substation will mitigate this thermal overload concern by redirecting west to east power flow onto the 500kV system and other, less-loaded 230kV lines, thus reducing the west to east transfer flows picked up by the Montour – Milton – Sunbury 230kV line. The addition of this project reduces the thermal loading on the

existing Montour – Milton – Sunbury 230kV line to approximately [REDACTED] emergency MVA rating.

C.1.2 Transmission Line Component(s)

Detailed description:

Transmission lines modifications will accommodate the installation of the Catawissa 500-230 Substation by terminating one (1) 500kV line and two (2) 230kV lines into Catawissa Substation. [REDACTED]

Section 1: [REDACTED]

Construct 1.5 miles of high-ampacity 230kV transmission line from [REDACTED] [REDACTED] The line will be constructed on self-supporting steel poles on concrete foundations, built for single-circuit 230kV utilizing (3) 1590 ACSR conductors per phase and (2) .752" 48F OPGWs. [REDACTED]

Section 2: [REDACTED]

Construct .25 miles of high-ampacity 230kV transmission line utilizing (3) 1590 ACSR conductors per phase from the [REDACTED]

Section 3: [REDACTED]

Construct .25 miles of high-ampacity 230kV transmission line utilizing (3) 1590 ACSR conductors per phase from the [REDACTED]

Section 4: [REDACTED]

[REDACTED] Construct approximately .75 miles of new 500kV line and 3.00 miles of new 230kV line. [REDACTED]

[REDACTED]

Preliminary list of materials and typical Structure Drawings

The transmission line major materials will include the following:

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



Figure C.1.3: Typical 230kV Structure Types

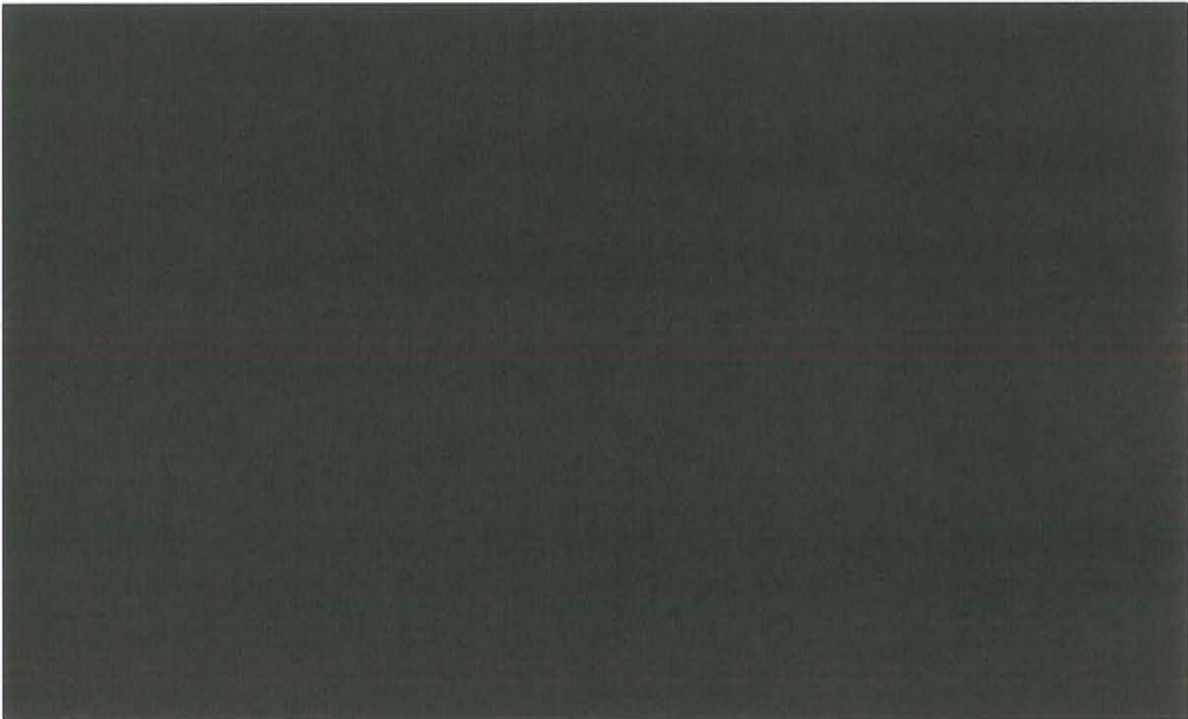


Figure C.1.4: Typical 500kV Structure Types

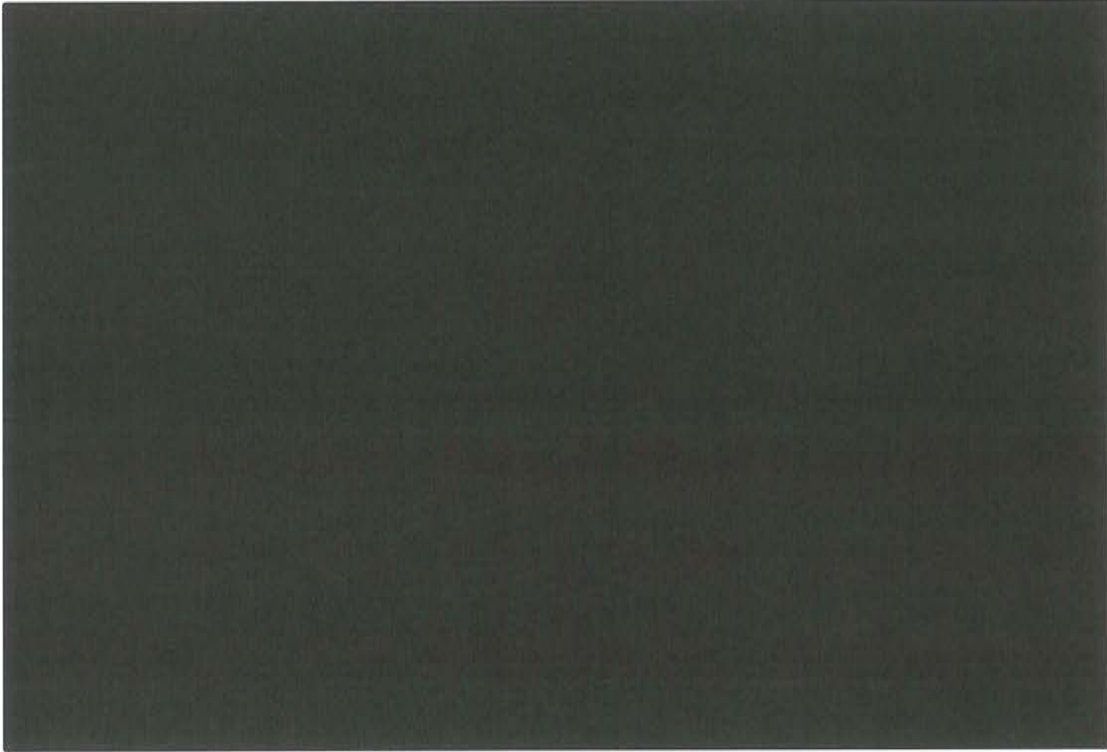
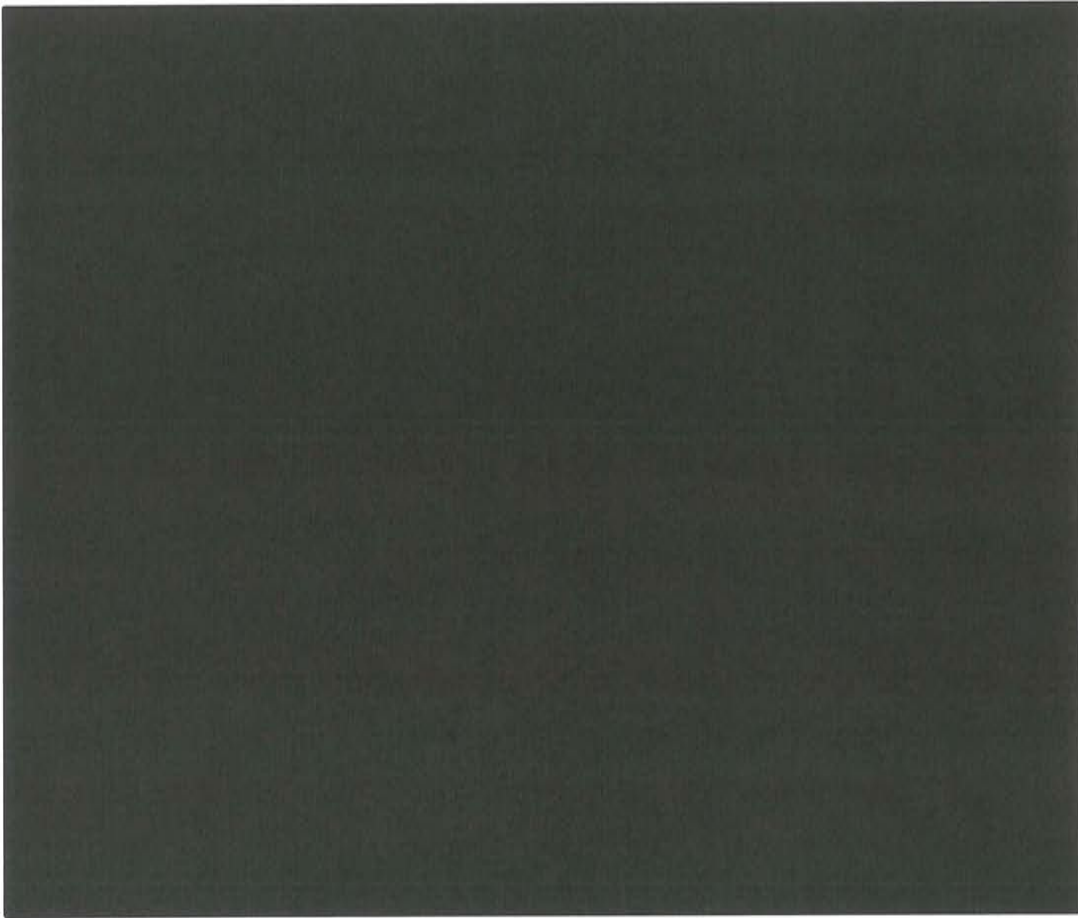


Figure C.1.5: Typical High Capacity 230kV Structure Types



C.1.3 Substation Component(s)

New Catawissa 500-230kV Substation

Detailed description

PPL EU proposes a new 500-230kV substation, to be named Catawissa Substation



[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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[REDACTED]

C.1.4 Transmission Facilities to be Constructed by Others

Transmission line relocation

This section is not applicable, as no transmission line relocations are anticipated to be constructed by others.

Substation Expansion or Modification

This section is not applicable, as no substation expansions or modifications are anticipated to be constructed by others.

C.2 Environmental, Permitting and Land Acquisition

C.2.1 Siting, Permitting, and Land Acquisition Overview

As described in Section B, the Siting, Right-of-Way, and Permitting group has built a strong set of capabilities to support the proposed project. The Siting and Right-of-Way department has established relationships with five external right-of-way contractors and four siting contractors to support the full right-of-way and siting processes. The PPL EU Permitting department has a track record of successfully obtaining the necessary local, state and federal government permits and licenses for proposed transmission projects. PPL EU understands the importance of engaging stakeholders and developing

relationships and will engage local consultants as needed to augment the company's existing network of relationships with federal, state, and local stakeholders.

C.2.2 Route Alternative Assessment

[Redacted]

[Redacted]

[Redacted]

C.2.3 Environmental Impact Review Methodology and Preliminary Results

[Redacted]

[Redacted]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

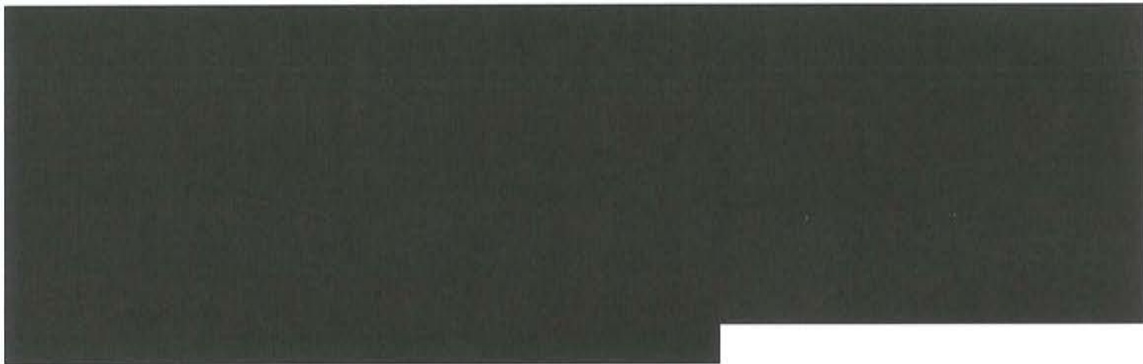
C.2.4 Right of Way & Land Acquisition Plan & Approach (public & private)

As part of securing the required right of way to accommodate the new line, PPL EU will work with the affected private landowners to acquire permanent irrevocable easements. As indicated in section C2 (Permitting), the project will also be crossing some state land. In this case, PPL EU will work with the affected state agency to obtain licenses to locate our facilities within its land.

PPL EU plans to build its substation expansion within the fence area of the existing substation and therefore the boundary of the current property line, and does not anticipate the need to acquire any additional land.

C.2.5 Permitting Plan and Approach

Project Configuration Preliminary Review



Permitting Support Activities

Wetland and Waterway/Stream Delineation

PPL EU will be required to evaluate the project area for the presence of wetlands and streams utilizing the methodology identified in the *U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (1987 Manual)* (Environmental Laboratory, 1987), and the newly adopted U.S. Army Corps of Engineers *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont (Version 2.0)*. The resulting Wetland and Stream Identification and Delineation Report will be submitted as part of the federal or state permitting process

Threatened and Endangered Species

The results of the PNDI review will assist in detailing the potential need for additional T&E surveys at the project site. Based on the February 2014 United States Fish and Wildlife Service (USFWS) list of federally listed species, the endangered Indiana bat (*Myotis sodalis*), the proposed-endangered northern long-eared bat (*Myotis septentrionalis*), and the endangered northeastern bulrush (*Scirpus ancistrochaetus*) may be located within the project area. As a new substation and new 230kV sections are not anticipated to affect significant forest areas, it is unlikely that bat surveys for federally-listed species will be required.

With the presence of several National Wetland Inventory emergent wetlands in the project area, botanical studies for the northeastern bulrush are also considered likely. The permitting plan will include coordination with the USFWS to determine if impacts to this plant species can be avoided through modifications in the work procedures. There is also a timing consideration to this study as the plant can only be positively identified at specific times of the year (summer).

A review of Pennsylvania Natural Heritage Program's Species List (January 2014) indicates that there are over 400 T&E plant and animal species listed in the state. PPL EU will coordinate with the Pennsylvania Department of Conservation and Natural Resources (DCNR), the Pennsylvania Fish and Boat Commission (PFBC), and the Pennsylvania Game Commission (PGC) to determine the need to conduct species-specific surveys. Modifications in construction practices and seasonal restrictions could minimize the need for potential presence/absence surveys. Additional T&E studies for building the new Catawissa Substation and 230kV lines include timber rattlesnake (*Crotalus horridus*) and various plant surveys.

Cultural Resources Phase I

Building a the new Catawissa Substation and [REDACTED] of new 230kV line will involve some earth disturbance. Due to these impacts, PPL EU will likely be required by the Pennsylvania Historic and Museum Commission (PHMC) to conduct a Phase I Archaeological Survey of these areas. The Phase I archaeological field reconnaissance will involve both visual pedestrian inspection of the ground surface and set-interval (15-meter, or 50-foot) shovel-testing within the limits of ground disturbance, in accordance with PHMC guidelines. Any archaeological resources identified by the archaeological field reconnaissance will be submitted to the PHMC for inventory, and preliminarily assessed for National Registry of Historic Places (NRHP) eligibility.

Migratory Birds

Based on review of the project, limited forested areas are present that will be impacted by the proposed project. The potential for bird species protected under the Migratory Bird

Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act does not appear relevant. The project will not span over any major rivers, which are considered important migratory corridors for raptors including the bald eagle (*Haliaeetus leucocephalus*). PPL EU does not anticipate having to coordinate with the USFWS.

Public Lands

The project will result in some impacts to State Game Lands (SGL 115) but will avoid impacts to other public lands (e.g., State Parks and State Forests). PPL EU will coordinate with Pennsylvania Game Commission (PGC) for a license to traverse these lands. PPL EU can review the Public Areas Database of the United States (PADUS) to identify areas of concern as they pertain to other public lands, such as open space or private conserved lands. Additional information on potential public lands in the area will be identified during the permitting process.

State Permitting

Pennsylvania Department of Environmental Protection (PADEP) Chapter 105 Water Obstructions and Encroachments Permits: PPL EU will need to coordinate with PADEP to determine the level of state permitting required for the project. According to Chapter 105 (Dam Safety and Waterway Management), Title 25 (Environmental Protection) of the Pennsylvania Code (25 Pa. Code §105), a permit is needed for all activities along or across, or projecting into a watercourse, floodway or body of water (including wetlands), whether temporary or permanent, including aerial crossings. As defined in Chapter 105, PADEP provides for a series of Waivers and General Permits (GP) that address projects that involve no (waivers) or minimal (general permits) impacts to regulated streams and wetlands.

Depending on the extent of the natural resources encountered within the project area and the ability of the engineering group to avoid or minimize impacts to the resources, there may be the opportunity that the project would be eligible for a series of PADEP issued General Permits. Specific GPs that may be used in this scenario include the following:

GP-5 (Utility Line Stream Crossing):

- Authorizes the installation, operation, and maintenance of utility line stream crossings of the regulated waters of the commonwealth (including wetlands).
- This GP would be used to permit the aerial crossing of the regulated resources, but does not apply to the crossing of wetlands greater than 10-acres or waters classified as Exceptional Value (EV) by the PADEP Chapter 93 Water Quality Standards (EV streams) or under §105.17, which refers to wetlands associated with T&E species (EV wetlands).
- Acquisition of a GP-5 does not require a wetland delineation report.

- Issuance of a GP-5 authorization requires that an Erosion and Sediment (E&S) Control Plan be reviewed and approved by the local CCD.

GP-7 (Minor Road Crossing)

- Authorizes the construction, operation, and maintenance of a minor road crossing that disturbs less than 0.1 acre of wetlands and is less than 100 feet in length. The cumulative wetland impact on an individual property cannot exceed 0.25 acre.
- Authorizes the construction, operation, and maintenance of a minor road crossing over a stream where the watershed drainage area is 1.0 square miles or less.
- This permit cannot be used to cross Exceptional Value (EV) streams, as classified by the PADEP Chapter 93 Water Quality Standards.
- This permit cannot be used to cross a stream channel and adjoining floodplain which is delineated as a floodway on Flood Insurance Maps prepared by the Federal Emergency Management Agency (FEMA).
- This permit cannot be used to cross sites which serve a habitat for flora or fauna listed as threatened or endangered by federal or state regulatory agencies.
- Mitigation of the impacted wetlands will be required.

GP-8 (Temporary Road Crossing)

- Authorizes the construction of a temporary road crossing (e.g., bridge, culvert, or ford) across regulated waters of the Commonwealth, including wetlands.
- Wetland crossings are limited to 200 feet in length and fords are not permitted in EV or High Quality (HQ) streams, as classified by the PADEP Chapter 93 Water Quality Standards, or within 2,000 feet upstream of reservoirs used for public water supply users.
- The temporary road must cross all watercourses at right angles, not be in place for more than one year, and be restored to original topography and stabilized within five (5) days of termination.
- This permit cannot be used to cross submerged lands of the Commonwealth (i.e., navigable rivers) until a Submerged Lands License Agreement (SLLA) is obtained from PADEP.
- This permit cannot be used to cross sites which serve a habitat for flora or fauna listed as threatened or endangered by federal or state regulatory agencies.
- Acquisition of a GP-8 will require an approved E&S Control Plan, a wetland delineation report, and additional engineering input to create drawings of the crossing technique or structure.

PPL EU will coordinate a pre-application conference with PADEP to confirm the GP's that are applicable for the project. Due to the relatively limited impacts associated with any of these GP's no direct USACE coordination is anticipated. Note also that a Section 401 Water Quality Certification will be issued in conjunction with the PADEP permits.

The use of these GPs does also involve potential seasonal restrictions based on specific Pennsylvania Fish and Boat Commission (PFBC) stream classifications. No work is permitted in streams classified as "Stocked Trout Streams" from March 1 through June 15 without prior approval from the PFBC. Similarly, no work is permitted in "Wild Trout Streams" from October 1 through December 31.

PADEP Chapter 102 Erosion and Sediment Control Design and Permitting: PPL EU will coordinate with local County Conservation Districts (CCD) and PADEP to obtain permits regarding erosion and sediment (E&S) control for activities during construction (E&S Control Plan) and as part of the post-construction site condition (Post-Construction Stormwater Management Plan (PCSM Plan)). The E&S Control and PCSM Plan will be required to comply with the PADEP regulations contained in Chapter 102, Title 25 (Pennsylvania Clean Streams Law) of the PA Administrative Code and CCD requirements, and will reflect the use of Best Management Practices (BMPs) and be consistent with guidance presented in PADEP's 'Erosion and Sediment Pollution Control Program Manual' (dated March 2012).

For this project, earth disturbance activities will occur to construct the new Catawissa Substation and where new access roads and poles will be installed for the 1.5 mile of new 230kV line. It is anticipated that the new substation will require the design of a new onsite stormwater management basin will be required. As total earth disturbance is anticipated to be greater than one acre, an approved E&S Control Plan and a National Pollutant Discharge Elimination System (NPDES) permit are anticipated to be required. The process involves review of the E&S Control Plans by the local CCDs and PADEP with the NPDES permit being issued by PADEP after approval of the plans. Note that one CCD may assume the role of lead reviewer but the other CCDs will review the alignments within their county boundaries. As the project is not located in any High Quality (HQ) or Exceptional Value (EV) watersheds, it is anticipated that an Application for General NPDES Permit for Stormwater Discharges Associated with Construction

Activities would need to be prepared for the project. It is also anticipated that the limits of disturbance (LOD) will be greater than ten acres, which will require consultation with the PHMC to address the potential for cultural resources within the anticipated LOD.

Pennsylvania Department of Transportation (PennDOT) Permits: As portions of the project parallel existing transmission line right-of-way, PPL EU will need to coordinate with PennDOT to determine the existence and status of permits for temporary and permanent construction entrances at these locations. For other portions of the proposed

line, PPL EU will need to identify potential access road or utility line crossing locations and collect the appropriate information required by PennDOT to permit the new location. These permits may include:

- Highway Occupancy Permit (HOP) - Utility Crossing: There are several locations where the utility line will span over a state highway, which will require acquisition of a PennDOT Highway Occupancy Permit (HOP).
- HOP - Minimum Use Driveway (MUD) Permits: PennDOT Minimum Use Driveway (MUD) Permits will be required for any construction access roads that connect onto a state road.

Federal Permitting

United States Army Corps of Engineers (USACE) – Section 404 Clean Water Act/Section 10 Rivers and Harbors Act: In Pennsylvania, the federal permit process is typically covered under the Pennsylvania State Programmatic General Permit (PASPGP-4) process. Due to the minimal permanent or temporary resource impacts associated with the Waivers and the GP-5, GP-7, and GP-8, no direct USACE coordination is anticipated. A PASPGP-4 would be issued under the delegated authority of PADEP in conjunction with the issuance of these GPs. Note also that a Section 401 Water Quality Certification will be issued in conjunction with the PADEP permits.

The assumption that the project will only require the state permits discussed above is based on the probability that developing the new Catawissa Substation and 1.5 miles of new 230kV line will not result in extensive impacts to natural resources. If the cumulative impacts do exceed specific thresholds, the project may be elevated to require a Joint Permit Application (JPA), which will involve PADEP and USACE coordination.

- Category I - these activities have minimal impacts to natural resources and are associated with the Waivers and General Permits offered by PADEP. Category I projects involve submission of a GP registration package to PADEP and do not involve a JPA. These activities also do not require USACE notification and PADEP can issue the federal permit (PASPGP-4) on behalf of the USACE.
- Category II - these activities result in direct or indirect impacts to 1.0 acre (accumulation of temporary and permanent impacts) or less of waters of the United States, including wetlands or 250 linear feet or less of streams, watercourses, or open waters. For linear projects, the sum of all impacts for all crossings of waters and/or wetlands associated with the overall linear project is used for these calculations. Category II projects involve the submission of a JPA. A PASPGP-4 may be issued by PADEP after an opportunity for review by the USACE and the general public through the publication of the project activities in the Pennsylvania Bulletin.

- Category III – these activities exceed the limitations of the Category II impact thresholds to wetlands (over 1.0 acre) or streams (over 250 linear feet). Other factors that may elevate the project to Category III include potential conflicts with federally listed species as identified during the Pennsylvania Natural Diversity Inventory (PNDI) review process or that may adversely affect cultural resources that are listed or are eligible for listing in the National Register of Historic Places pursuant to the requirements of Section 106 of the National Historic Preservation Act. This includes projects where the Pennsylvania Historical and Museum Commission (PHMC) have determined that archaeological or other cultural resources are believed to exist within the permit area. Category III projects involve the submission of a JPA. Depending on the review by USACE, PADEP may issue the PASPGP-4 or the project may require another type of federal authorization.

The project will be located predominantly within the boundaries of the Baltimore District of the USACE. This distinction is made because there are differences between the districts as to how they view the use of timber matting for wetland crossings. The Philadelphia District does not view this activity as a disturbance, whereas the Baltimore District views it as a temporary impact. Temporary wetland impacts are used to assess the cumulative impact of the project and may elevate the area of wetland impacts to be reviewed.

Note also that the development of a JPA package is a major project schedule concern. The JPA process has a significantly longer planning and preparation time, requires development of more detailed design information, and typically involves additional evaluations, such as Hydraulics and Hydrology (H&H) Assessments and Environmental Assessments (EA). Development of the JPA document typically takes 6 months and review by PADEP and the USACE may take an additional 9-12 months.

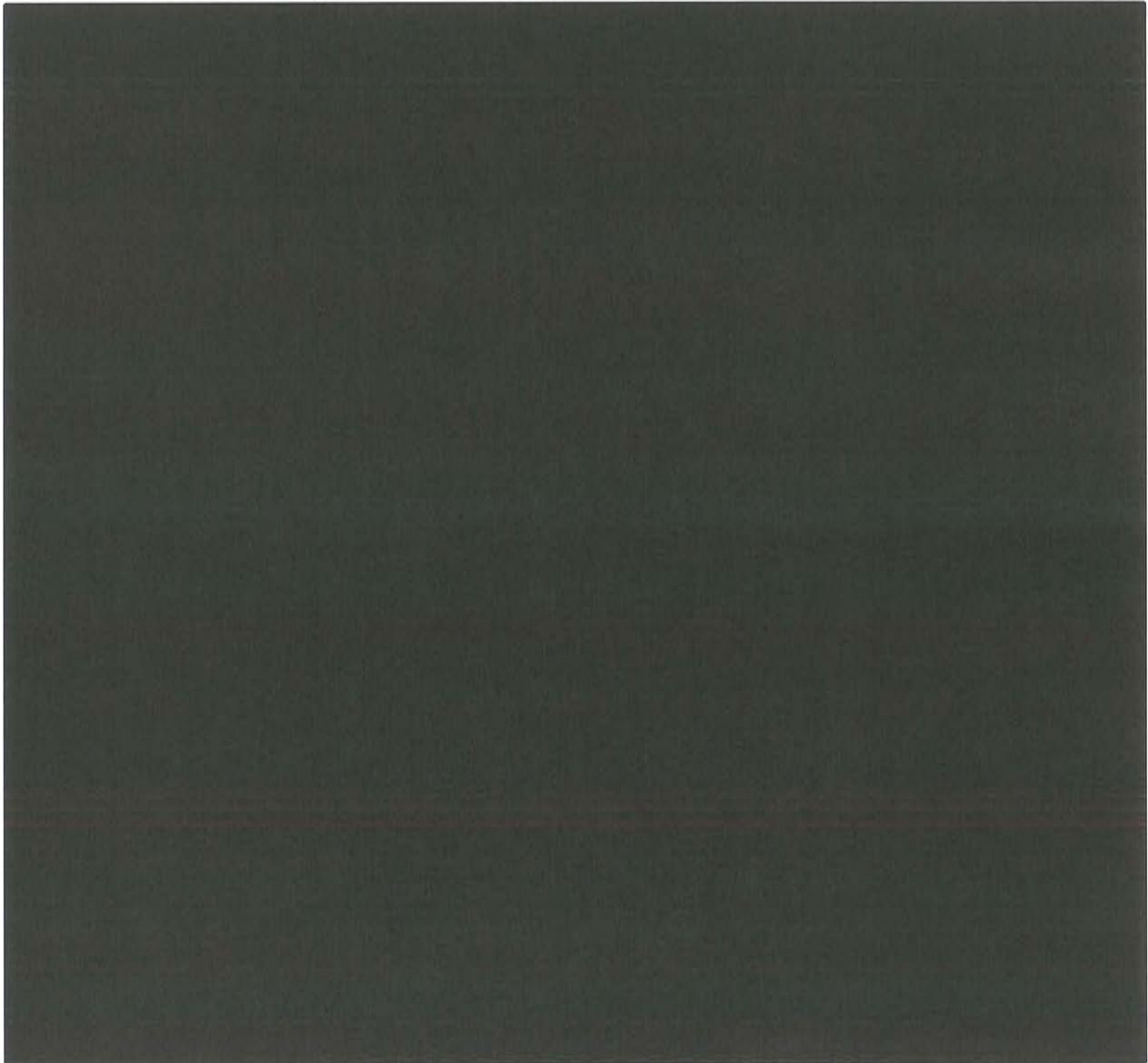
If the impacts for this solution exceed 1-acre, the presumption would be that the project would require submission of a JPA package that will be classified as a Category II project. As part of the pre-application process, PPL EU will need to coordinate with the USACE as well as PADEP to review the permitting options.

Federal Aviation Administration (FAA) – Obstruction Determination: As the project involves the installation of new poles, PPL EU will need to coordinate with the FAA regarding potential obstruction to air travel, which will involve completing online forms available on the FAA's Notice Criteria Tool website. This tool allows input of heights, elevations, and location of proposed structures to solicit the need to further coordinate with FAA.

Project Permitting Summary

The permits that may be required by environmental regulatory agencies on the federal, state, and county level for the proposed construction of the new Montour to Sunbury 230kV transmission line is listed in Figure C.2.1 below. It should be noted that building permits for utility corridors are often exempted by local municipalities. Local building permits requirements from specific municipalities will be reviewed when the project moves to its development phase.

Figure C.2.1: Potential Environmental Permits



Permitting of transmission line corridors is a complex process with many involved parties. Because of the potential complexity of the proposed project, it is difficult to quantify all the specific risks associated with the environmental permitting process. Some of the potential risks which will need to be addressed during the project development phase include:

[REDACTED]

While the general project area traverses mostly forested or agricultural lands, there will be wetland crossings and potential habitat for threatened and endangered species. Timing of threatened and endangered species surveys may be seasonally dependent and will need to be coordinated with the overall permitting schedule.

C.2.6 Public Opposition Review

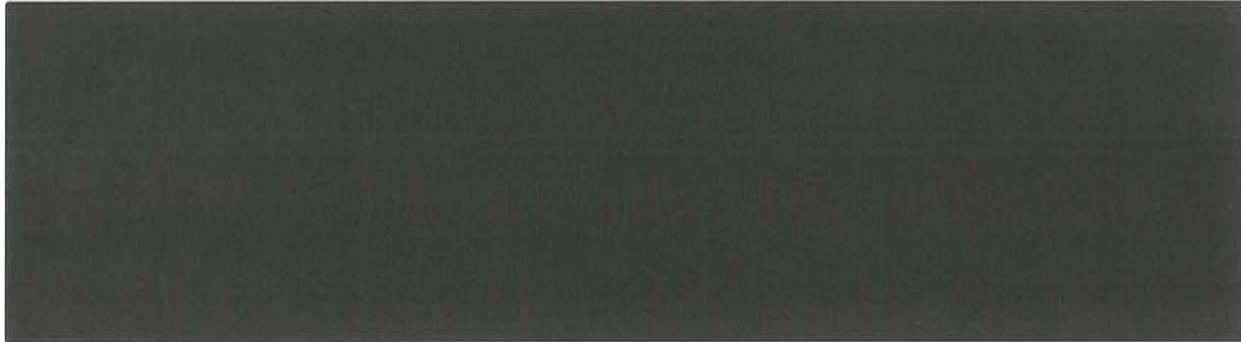
Public opposition to the construction of the Catawissa Substation and the associated 1.5 miles of realigned 230kV right-of-way is anticipated to be low. [REDACTED]

[REDACTED]

C.3 Project Component Cost Estimates

The estimated total project cost is \$102.9M and should be interpreted as a budget estimate. The bottom up development and top down verification provides an [REDACTED] confidence level in the project estimate, based on the baseline scope of work and assumptions

Figure C.3.1: Summary of Estimated Project Costs



Note 1: Cost in \$ Millions

Note 2: Numbers may not sum due to rounding

C.3.1 Engineering and Design Costs

In order to support the proposed project, engineering will request survey and core borings. These two elements, in addition to the labor required to support the design, will represent the majority of project costs for the proposed project are presented in Figure C.3.2 below.

Figure C.3.2: Summary of Estimated Engineering Costs



Note 1: Cost in \$ Millions

Note 2: Numbers may not sum due to rounding

C.3.2 Material and Equipment Costs

Material and equipment cost estimates are based on quantity take-off for both the transmission and substation scope of work. The pricing for these materials are based on average cost from suppliers utilized in previous PPL EU projects. Material and equipment costs for the proposed project are presented in Figure C.3.3 below.

Figure C.3.3: Summary of Material and Equipment Costs



Note 1: Cost in \$ Millions

Note 2: Numbers may not sum due to rounding

C.3.3 Construction and Commissioning Costs

Line construction cost estimates are based on quantity take-offs developed from past experience benchmarking of number of structures per mile multipliers for initial estimation, assuming standard construction designs and construction methods. The transmission line elements include

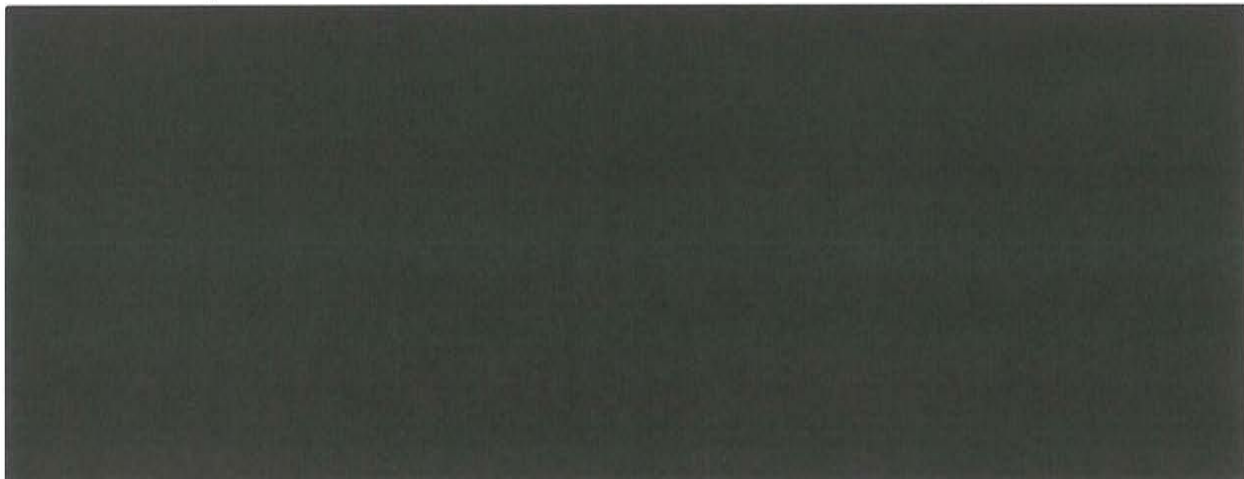
- Below Grade Line Construction: *Foundations for the steel structures including rebar and anchor bolts*
- Transmission Line Structures: *Erection of the steel structures with associated insulators and conductor attachments*
- Conductor Installation: *Stringing, Clipping and sagging the conductor*
- Fiber Optic Installation: *Stringing, sagging and installation of splice cans*
- Access and Crane Pads
- Mobilization, demobilization and Contractor Setup

Substation cost estimates are also based on past experience for similar type of equipment based on anticipated construction take-off commensurable of the current level of definition for the project. Substation construction costs include:

- Substation Steel Structure Construction: *Steel structures assemblies*
- High Voltage Equipment Construction: *Installation of the major substation elements including but not limited to power transformers, breakers, switches..*
- Bus Materials: *Installation of bus related materials including but not limited to bus, insulators, connectors, tap...*
- Conduit: *Installation of conduits in the substation yard*
- Control House: *Installation and dress up of the control house*
- Oil Containment Pit
- Testing and Commissioning
- Mobilization, demobilization and Contractor Setup

Construction and commissioning costs for the proposed project are presented in Figure C.3.4 below.

Figure C.3.4: Summary of Construction and Commissioning Costs



Note 1: Cost in \$ Millions

Note 2: Numbers may not sum due to rounding

C.3.4 Right of Way and Land Procurement Costs

PPL EU conducted a desktop cost analysis for the proposed Substation reinforcements and line modifications regarding the Right of Way and land procurement costs:

- Labor to Secure the Land Rights: *Survey Permissions, Title, Acquisition, Non-Env. Permitting, Const. Monitoring & Restoration, Access Roads, Recording, Field Office*
- Land Costs to Secure Easements: *Easement Costs for Right-of-Way, Damages for Crops, Access Roads, Staging Yards and Misc. & Temporary Workspace Agreements*

Figure C.3.5 outlines the estimated right-of-way and land procurement costs for the proposed project.

Figure C.3.5: Summary of Estimated Right-of-Way and Land Procurement Costs



Note 1: Cost in \$ Millions

Note 2: Numbers may not sum due to rounding

C.3.5 Siting and Permitting Costs

PPL EU conducted a desktop cost analysis for the proposed Substation reinforcements and line modifications siting and permitting costs including: Environmental Permitting, Non Environmental Permits, Siting (Public Outreach, Open House), Legal Costs and LiDAR. Figure C.3.6, outlines the siting and permitting costs for the proposed solution.

Figure C.3.6: Summary of /Siting/Permitting Costs



Note 1: Cost in \$ Millions

Note 2: Numbers may not sum due to rounding

C.3.6 Construction Management Costs

PPL EU conducted desktop cost analysis for the proposed Substation reinforcements and line modifications. Figure C.3.7 outlines the construction management estimated costs for the proposed project.

Figure C.3.7: Summary of Construction Management Costs



Note 1: Cost in \$ Millions
Note 2: Numbers may not sum due to rounding

C.3.7 Other Costs

The project includes A&G and Allowable Funds Used During Construction (AFUDC) at a rate of [redacted] for each year to account for the cost to borrow capital. Figure C.3.8 outlines the additional costs added for the proposed project for these categories.

Figure C.3.8: Summary of Other Costs Adders



Note 1: Cost in \$ Millions
Note 2: Numbers may not sum due to rounding

C.3.8 Contingency

As mentioned earlier in this section, PPL EU has developed a budget level estimate. As such, PPL EU recommends that a contingency be applied to cost estimates to account for the unforeseen costs required to support construction activities. Figure C.3.9 below presents the contingency costs for the proposed project.

Figure C.3.9: Summary of Contingency



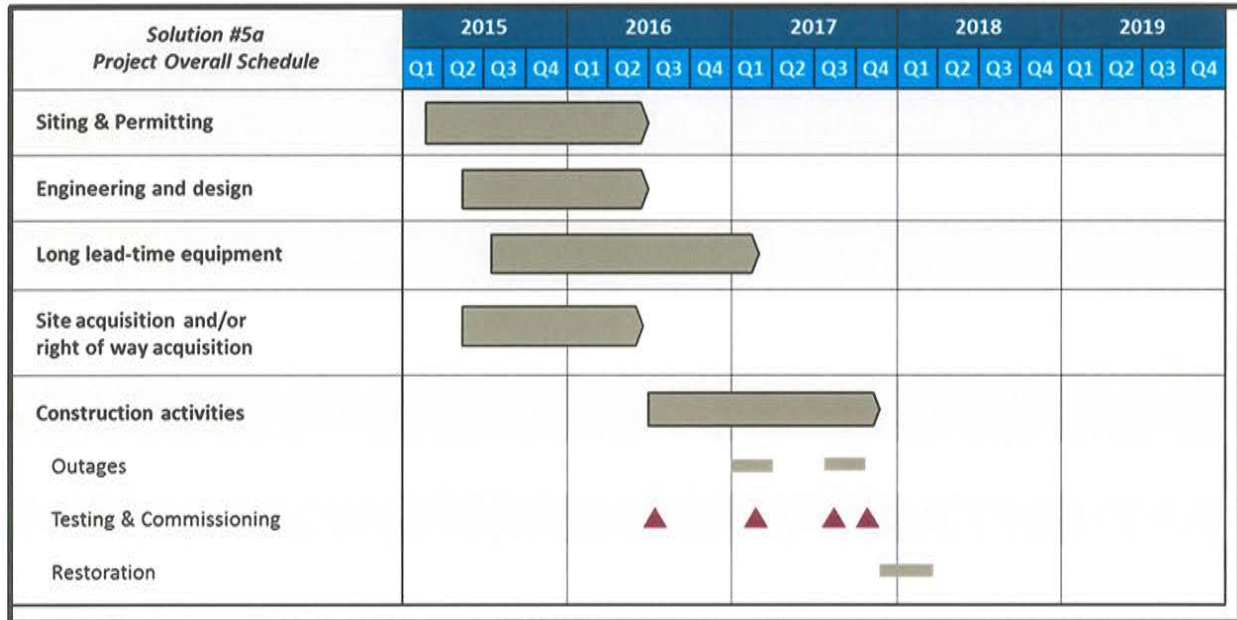
Note 1: Cost in \$ Millions
Note 2: Numbers may not sum due to rounding

C.4 Schedule

C.4.1 Overall Project Schedule

A 5-year project schedule is required for the proposed project: 24 months for planning & design, right-of-way, siting, & permitting activities and long lead time procurement, and another 27 months for construction and commissioning (with some overlap). An integrated project schedule is provided in Figure C.4.1.

Figure C.4.1: Substation Reinforcements and Line Reconfigurations Integrated Schedule



Permitting requirements

This schedule is based on a preliminary understanding of the topographical and ownership variances in the area. Limited permitting requirements are anticipated in this proposed project as the scope is focused on substation reconfiguration with limited line reconfigurations.

Site acquisition and/or Right of Way acquisition

PPL EU conducted a preliminary review of the transmission line siting considerations in order to develop a high level schedule estimate.

Engineering and design

The proposed solution would require an estimated 14 months of Engineering. Key activities include identifying pole locations, conducting core borings, finalizing steel pole orders, designing the foundation, and finally, completing the engineering release.

Engineering activities will span a variety of disciplines:

- Surveying: *Site selection and physical arrangement utilizing aerial (LiDAR) surveys*
- Civil: *Foundation, ground grid design, water and water retention designs*
- Environmental: *Environmental effects, access road design, spill response, SPCC plans in close conjunction with the Right-of-Way/Siting/Permitting team*
- Geo-Technical: *Soil investigation and earth resistivity*
- Structural: *Structural loading, component and hardware analysis including equipment standards, procurement, factory acceptance testing, equipment ratings, insulation ratings*
- Mechanical: *Conductor Sag/Tension design*
- Electrical: *Grounding, clearances analysis, insulation design, lightning performance*
- Telecommunication: *Fiber optics design (OPGW)*

Long lead time equipment

PPL EU expects the construction phase to last 18 months with several key long lead items requiring upfront procurement activities. Site clearing, preparation and delivery as well as site restoration, crop damage, and landscape work are performed in coordination with the Right-of-Way team.

The proposed project design requires several long lead time materials to be delivered prior to the construction phase. Average lead times range from 12 – 30 weeks for transmission line materials and 12 weeks to a year for substation equipment. The typical long lead time materials include 1590 kcmil ACSR, 0.752 OPGW, steel structures for transmission line construction and Breakers, Switches, Transformers, and Steel for substation work.

Construction activities, Outage plan to support construction and energization, Testing and commissioning

The substation and transmission line schedule includes standard construction activities:

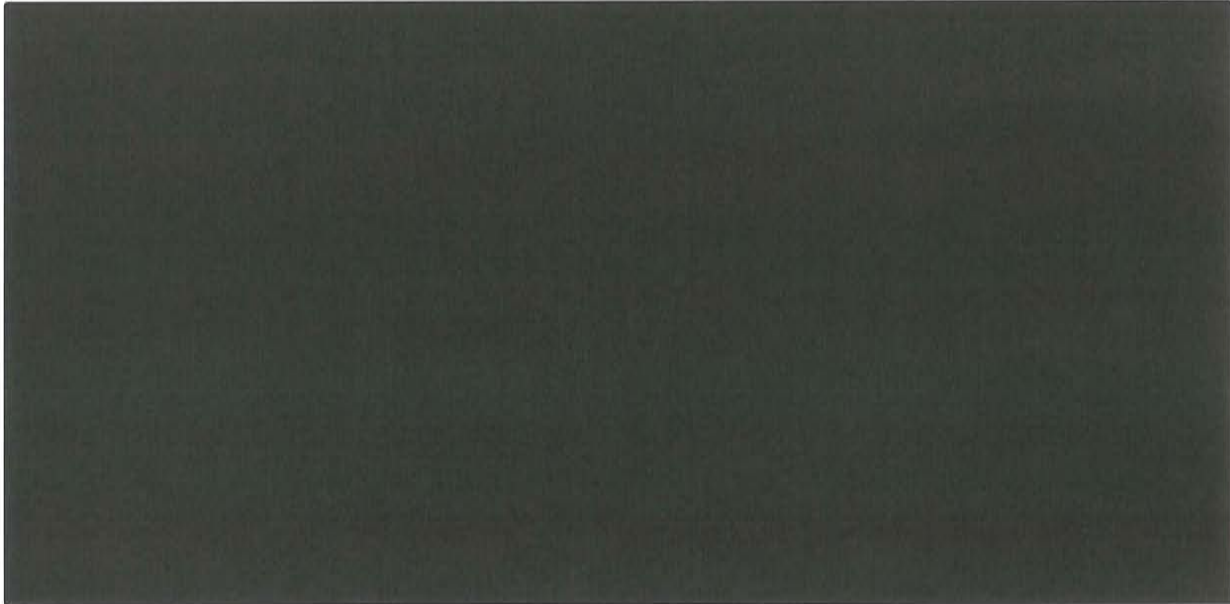
- Site Clearing/Prep/Delivery: *Clearing / grubbing preparation, access road completion, site delivery*

- Mechanical: Site pad construction, mechanical work foundation, below grade work, conduit, ground grid
- Electrical: Pole and conductor construction, conductor/device removal, pole testing for ground resistance, structure removal, communication, splicing & testing, substation equipment installation, testing and commissioning
- Demobilization: Site restoration, crop damage, landscaping

C.4.2 Catawissa Substation Schedule

The Catawissa substation expansion will be developed constructed and commissioned as described in the schedule below:

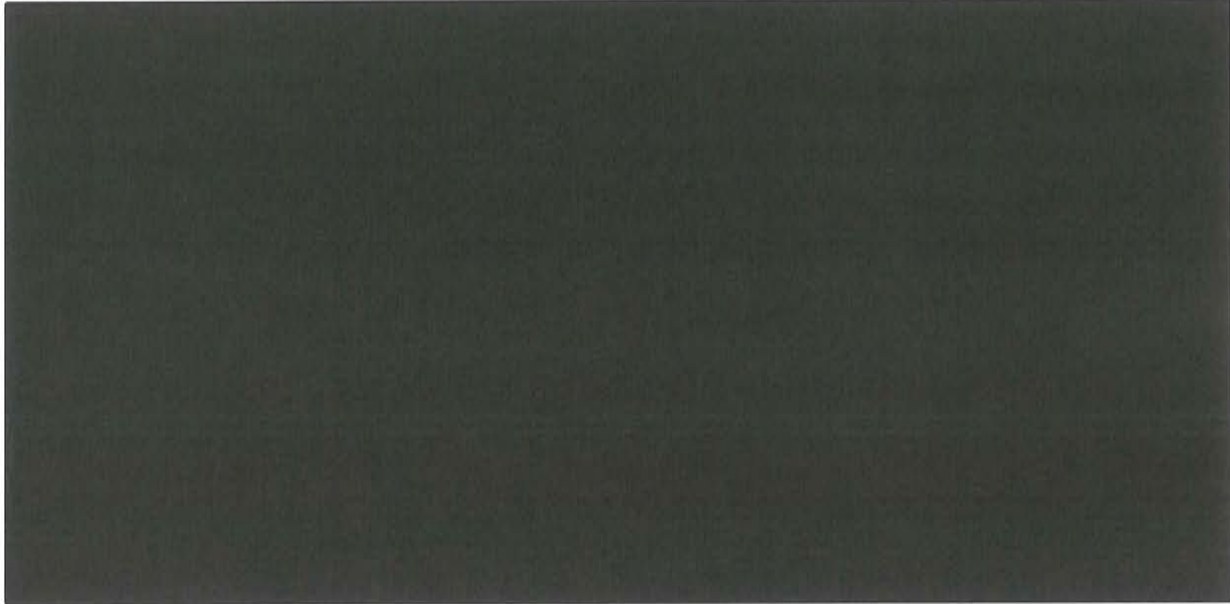
Figure C.4.2: Catawissa Substation Schedule



C.4.3 Sunbury-Susquehanna #1 230kV Transmission Line Reconfiguration

The 230kV line reconfiguration will be developed constructed and commissioned as described in the schedule below:

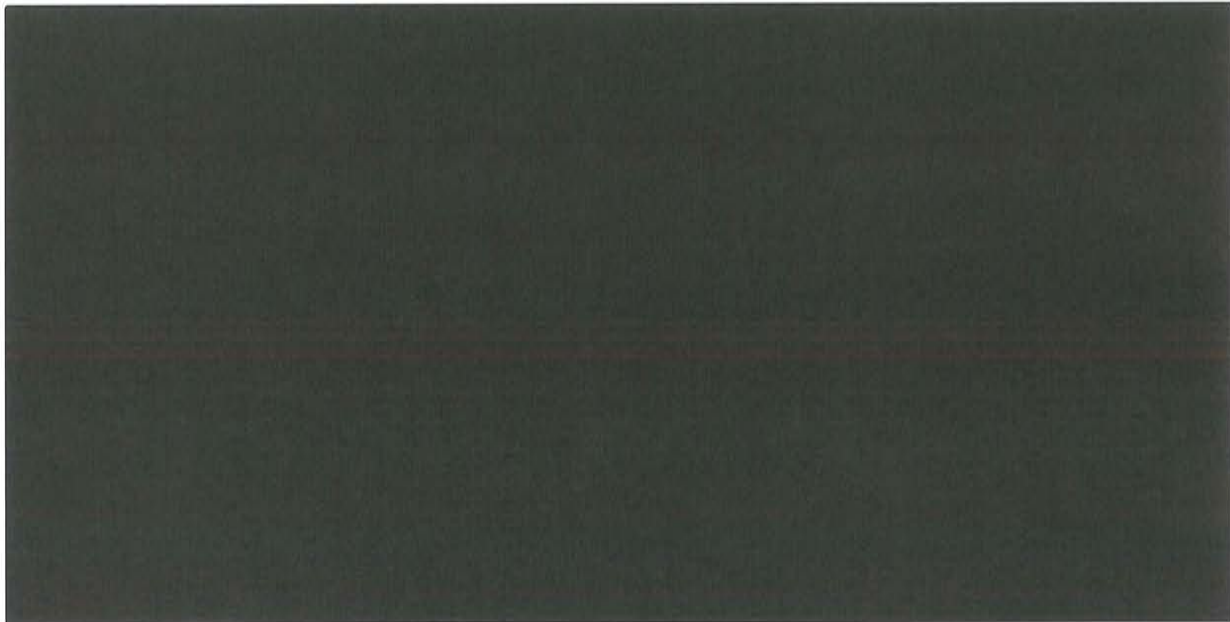
Figure C.4.3: Sunbury-Susquehanna #1 230kV Line Reconfiguration Schedule



C.4.4 Sunbury-Susquehanna #2 500kV Transmission Line Reconfiguration

The 230kV line reconfiguration will be developed constructed and commissioned as described in the schedule below.

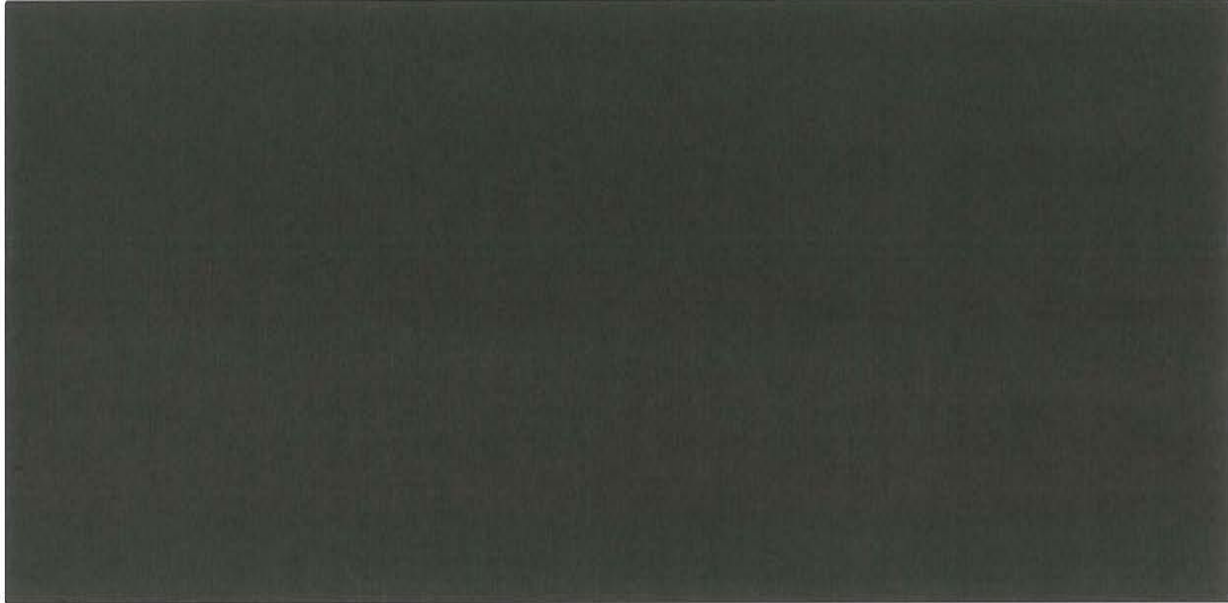
Figure C.4.4: Sunbury-Susquehanna #2 500kV Line Reconfiguration Schedule



C.4.5 Terminate Montour-Columbia 230kV Circuit into Catawissa

The 230kV line terminations will be constructed and commissioned as described in the schedule below:

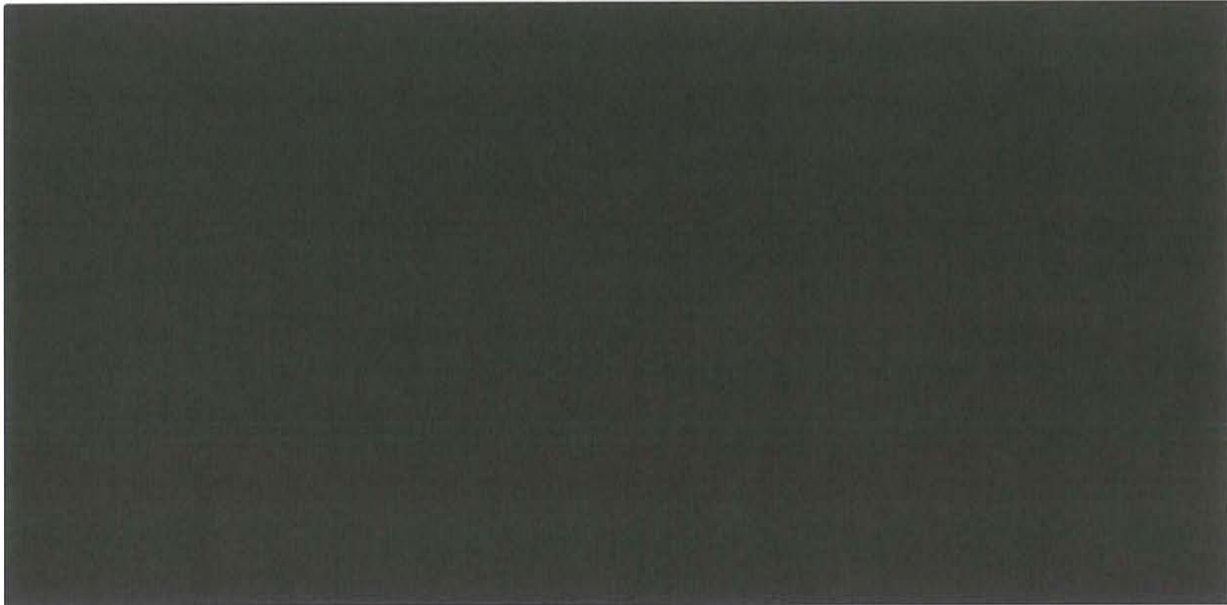
Figure C.4.5: Montour-Columbia 230kV Circuit into Catawissa



C.4.6 Montour-Columbia 230kV Bypass

The 230kV line bypass will be constructed and commissioned as described in the schedule below:

Figure C.4.6: Montour-Columbia 230kV Bypass



C.5 On-going 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. 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.

Transmission Control Center

In order to operate and maintain the transmission grid reliably, PPL EU manages a Transmission Control Center (TCC) 365 days, 24 hours a day located in the [REDACTED]. PPL EU has operated a Transmission Control Center since its inception in 1926 and was an original PJM member.

Our current NERC/RF certified control center is a secure, state-of-the-art facility with redundant data and communication. The Disaster Recovery Site is an independent facility with similar capability and both sites meet all RFC and NERC criteria. The control center adheres to the guiding principles of safety, reliability and production in that order.

Transmission Control Center Operations

Core responsibilities of the TCC include monitoring and operating the Bulk Electric System and 69kV transmission systems in the PPL EU footprint, directing the application of the PPL EU Energy Control Process (Permit and Tag), and analyzing flow study, and contingency studies.

The Operations engineering section resolves operational discrepancies with PJM when load flow models provide inconsistent results and stability studies are required. A key differentiating attribute of the TCC that sets PPL EU apart from other utilities is its experience with nuclear generation and managing complex interfaces, safety, and reliability.

Outage Requests

In addition to real time operations, PPL EU develops a construction and maintenance outage plan. TCC Planning processes requests to upgrade transmission facilities and translates those to equipment outages using the PJM outage criteria time lines. The TCC effectively plans all outage requests, limits risks to the electric system and PPL EU customer base, and responds to any unplanned events. Transmission outage planning, including risk and conflict analysis, is crucial to promoting safety, preserving the reliability of the bulk and non-bulk transmission system, eliminating volatility in the work portfolio.

Employee Qualifications

TCC employees seek continuous improvement in technologies and processes, are trained in all operator tasks, and embrace compliance as a measure of our effectiveness. PPL EU TCC follows best-in-class training practices, which increases the effectiveness of the organization, and creates a distinct advantage when dealing with adverse conditions. All Transmission Control Center employees are trained within the TCC by NERC certified trainers and they receive NERC, PJM Transmission Operator, PJM Generation, and PPL EU training certifications. In addition, PPL EU owns an internal simulator that is used for training.

TCC operators have broad experiences across multiple areas of the control center and are well versed on the uses of security-analysis tools. As a result of the training, the operators are all able to take action when necessary and can perform basic trouble shooting on advanced systems. All team members at the TCC participate in system restoration drills, and act as liaisons between PPL EU and PJM for information dissemination. All operators are coached and trained in system restoration drill requirements.

Significant Operating Response Team

The Significant Operating Response Team (SORT) is a joint effort between the Transmission Operations, Transmission Planning, and Engineering departments, which includes Substation and Relay engineering, Protection analysis, Transmission Engineering, T&S Maintenance Engineering, and Relay Test. This group of engineers is on-call to address any electric system event that may occur. The team is also responsible for conducting root cause investigations. The SORT and subsequent root-cause analysis allows for PPL EU to successfully translate lessons learned into success for future transmission projects.

C.5.2 Maintenance Plan

PPL EU Transmission Maintenance Group is responsible for the transmission line preventative maintenance program for the PPL EU Transmission System. This includes periodic review and comment on the content of the program with ultimate responsibility for the program residing within the Asset & Strategy Policy Group of T&S Asset Management. The T&S Maintenance Engineering – Transmission Maintenance Group reports to the Manager – T&S Maintenance which reports directly to the Director – Engineering. 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.

Transmission Line Maintenance

- Comprehensive Helicopter Patrols: detect problems that can only be seen at the pole top, i.e. arm rot, loose or worn hardware, flashed insulators, overhead ground wire and ground lead connections and conductor damage. Detailed inspection reports are submitted by the inspection vendor, which include structure details, digital photos of the deficiency as well as repair accessibility recommendations. This information is entered via file transfer protocol directly into PPL EU's Transmission Maintenance Program (TMP).
- Routine Helicopter Patrols: detect imminent failures that are obvious that occur between comprehensive patrols. These imminent failures are typically caused by storms, through faults, and vandalism. These patrols are completed at a much faster pace allowing the entire PPL EU system to be patrolled annually. Inspection reports are submitted by the inspection vendor and are reviewed by Transmission Maintenance Staff.
- Ohmstick Inspections: PPL EU utilizes a process employing the Sensorlink Radio Ohmstick to determine health of compression connections. This live line micro-ohm measurement of connections and conductor is completed periodically via helicopter to

determine the health of this critical asset. Additional ohmstick measurements are conducted using hot line tool methods via ground crews as needed.

- Emergency Patrols: dictated by system conditions, the Transmission Control Center (TCC) can request an emergency patrol be completed. This is usually after an operation on the PPL EU Transmission System. These patrols are most often completed by helicopter, although they can also be conducted on foot. Information from Lightning Detection and Relay Data is used to determine areas for focused patrols. Inspection reports are submitted by the inspection vendor and are reviewed by Transmission Maintenance Staff.
- Special Patrols: also dictated by system conditions, but not typically initiated as a result of an operation. These patrols are typically completed by helicopter, but can also be foot patrols. The most typical special patrols completed are the result of Risk Mitigation Studies performed as part of abnormal sectionalizing due to new construction outages. Additional special patrols can be to inventory specific line hardware, assist line design, etc.
- Foot Patrols: detect failure modes that evolve over long periods of time at the base of the structure. At present, foot patrols are on an as needed basis, but in the past have been completed on regular intervals.
- Thermovision: annual inspection of the entire PPL EU transmission system with an infrared camera to detect poor or deteriorated electrical connections. Inspection includes, transmission lines, switches, and substations. Detailed inspection reports are provided by the inspection vendor to include Infrared image, digital image, and analysis of the infrared abnormality to include Deg C rise above reference and ambient temperature.
- Acceptance of Facilities: process for commissioning new facilities for service on the PPL EU system. Involves inspection of new construction to insure adherence to PPL EU design and specifications. Review includes receipt of acceptance testing (ductor, x-ray, ohm-stick, etc.), comprehensive inspection and receipt of necessary inventory information.
- Right-of-Way Encroachment Review: process for review PPL EU ability to operate and maintain transmission assets, as well as insure electrical clearances are maintained due to proposed projects within PPL EU right-of-ways.

Substation Maintenance

Nearly all substation maintenance within PPL EU is performed by internal forces (>95%). The field forces have been trained on the specific equipment and schemes and are capable of performing all levels of work from inspections to overhauls and rebuilds. The company also employs skilled workers in the forms of relay maintenance, insulation

testing and transformer maintenance. Contract forces may be used at times of heavy workload.

PPL EU's current maintenance program heavily employs time-based cycles. The equipment data is kept in a maintenance management system (MMS) that serves dual functions; inventory management and maintenance order generation. A piece of equipment can have one or more triggers assigned to it with the appropriate frequency for each. When the maintenance comes due, the MMS will generate a work order for a field crew to perform. When complete, the trigger automatically resets to reflect the next maintenance due date. Triggers can range from weeks to years. The substation maintenance department is responsible for the upkeep of both the maintenance program and the inventory data. Test data is reviewed by the maintenance department and corrective orders are issued as needed.

Most of the maintenance performed can be considered either visual or diagnostic. Invasive work, such as an overhaul is performed on an as-needed basis to correct issues found during diagnostic testing.

As technology improves, PPL EU is moving away from time-based maintenance to a condition-based program. Online monitoring of equipment results in less time required for a crew to perform diagnostic work and allows for some data to be telemetered back to the office for analysis.

Project Spare Equipment

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. If a piece of equipment were to fail, a cross-functional team evaluates the failure and determines if the system spare is needed. These spares are incorporated into our time-based maintenance program to assure that they are ready when called upon. The proposed project will have equipment specified to match the current standard equipment so that any existing spares would be compatible.

C.6 Assumptions

The project execution model relies upon a set of assumptions described in Figure C.6.1.

Figure C.6.1: Summary of Major Assumptions

| Key Assumptions | |
|------------------------------------|---|
| Transmission Design | <ul style="list-style-type: none"> • Steel structure count and line angles are based on preliminary line route • No Significant right-of-way or height restrictions which require alternate design • PPL EU designs transmission and substation facilities to meet or exceed PJM design standards. PPL EU designs transmission structures to have greater resistance to natural elements, e.g., wind loading, ground clearance, lightning protection |
| Substation Design | <ul style="list-style-type: none"> • Design based upon PPL EU’s bulk power Substation design standard • Yard and control room capacity sufficient to expand within existing footprint |
| Planning | <ul style="list-style-type: none"> • PJM 2019 RTEP base case is the basis for reliability results that determined drivers for potential upgrades |
| Schedule | <ul style="list-style-type: none"> • Outages based upon proposed construction sequence and system requirements • Long-lead time items: transformers 12-18 months, steel poles up to 30 weeks • PJM will award a proposal by January 1st, 2015 • Proposed outages will be granted to support construction execution |
| Siting / Right-of-Way | <ul style="list-style-type: none"> • PUC will approve selected route and allow PPL EU to exercise eminent domain, if needed • Right of way / land costs based on the scheduled time frame for acquisition |
| Permitting / Environmental | <ul style="list-style-type: none"> • Detailed studies of the existing land to confirm transmission line routes • Phase II and III archaeological studies and threatened and endangered (T&E) species studies may be required for the projects, time and costs to conduct studies not included • Impacts to environmentally sensitive lands such as state parks, state wildlife management areas may result from the projects |
| Financial | |
| Operation & Maintenance | <ul style="list-style-type: none"> • Assets to be operated and maintained consistent with PPL EU practices, e.g., through TCC and with Lifecycle Asset Management approach |

ALL APPENDICES ARE REDACTED