

Before the
Pennsylvania Public Utility Commission

**REPLACEMENT OF THE HAUTO –
SIEGFRIED #1 & #4 69 kV LINE &
SIEGFRIED – EAST PALMERTON #1 &
#2 69 kV LINE WITH THE SIEGFRIED –
HAUTO #1 & #2 138/69 KV
TRANSMISSION LINE AND
TREICHLERS 138/69 kV TAPS**

**ATTACHMENTS IN SUPPORT OF THE
Letter of Notification**

Application Docket No. _____

Submitted by: PPL Electric Utilities Corporation



SUMMARY

This filing is submitted by PPL Electric Utilities Corporation (PPL Electric) pursuant to the Pennsylvania Public Utility Commission's (PUC or the Commission) regulations at 52 Pa. Code §§ 57.71 through 57.77 for PUC approval to replace approximately 8.5 miles of two existing parallel double-circuit 69 kV transmission lines, the Hauto – Siegfried #1 & Siegfried – East Palmerton #2 lines and the Hauto – Siegfried #4 and Siegfried – East Palmerton #1 lines, with one high capacity double-circuit 138/69 kV transmission line. The new double-circuit line will be referred to as the “Siegfried – Hauto #1 & #2 138/69 kV Transmission Line.”

The replacement of the Hauto – Siegfried #1 & #4 69 kV Line & Siegfried – East Palmerton #1 & #2 69 kV Line with the Siegfried – Hauto #1 & #2 138/69 kV Transmission Line (the “Project”) is the first phase of a three phase plan to replace these aging transmission lines between the Siegfried Substation and the East Palmerton and Hauto substations. PPL Electric has divided the overall plan into three separate phases, each with a separate need, to reduce the complexity of project execution (see Attachment 1, Figure 2). Each phase of the project will be the subject of a separate filing. This Letter of Notification (Letter of Notification) seeks the PUC's approval of the first phase, the section between the Siegfried Substation and the point in Washington Township where the double-circuit structures diverge. PPL Electric is seeking PUC approval of the first phase in order to achieve optimal project execution and sequencing and to accommodate a construction start date of February 2014, and an in-service date of September 2014—a construction period of approximately 7 months, to provide more reliable electric service to this area.

Presently, all four 69 kV circuits described above exit the PPL Electric Siegfried Substation located in Allen Township, Northampton County, Pennsylvania, on two sets of double-circuit transmission structures and continue northwest for approximately 8.5 miles. The routes diverge near the intersection of Mountain Road and Brown Road in Washington Township, Lehigh County (the “Split”). From this point, the Hauto –

Siegfried #1 and Hauto – Siegfried #4 69 kV lines continue northwest for approximately 15.2 miles to the Hauto Substation in Nesquehoning Borough, Carbon County, Pennsylvania on separate transmission structures. From the Split, the Siegfried – East Palmerton #1 and Siegfried – East Palmerton #2 69 kV lines traverse northeast for approximately 6.9 miles to the East Palmerton Substation in Lower Towamensing Township, Carbon County, Pennsylvania on separate transmission structures.

In this Letter of Notification, PPL Electric seeks PUC approval of the rebuild 8.5 mile long Hauto – Siegfried #1 & #4 138/69 kV Line & Siegfried – East Palmerton #1 & #2 138/69 kV Line. The Project involves replacing the first 8.5-mile-long section of the existing Hauto – Siegfried #1 and #4 and Siegfried – East Palmerton #1 and #2 69 kV Transmission Lines. The activities for the Project will include the following: (1) installing a switchyard near the Split where the four lines presently diverge;¹ and (2) replacing the four 69 kV circuits on two sets of transmission structures with two 138/69 kV circuits on one set of transmission structures. This proposed transmission line rebuild will be located entirely within PPL Electric’s existing right-of-way. No additional right-of-way is required for the rebuild of the transmission lines.

In addition, PPL Electric seeks PUC approval for the reconstruction of approximately 800 feet of the Treichlers #1 69 kV Transmission Tap and the siting and construction of the new Treichlers #2 138/69 kV Transmission Tap. The first approximately 470 feet of Treichlers Tap #1 & #2 lines will be constructed on separate structures. The two circuits are then supported by a common switching structure and deadend double-circuit structure for approximately 330 feet to provide a double-circuit tap-single feed (DT/SF) configuration. Presently, the Treichlers Substation is served via a single-circuit tap (Treichlers Tap #1) off the existing Hauto – Siegfried #1 138/69 kV Transmission Line. The addition of the Treichlers Tap #2 as a DT/SF configuration will provide a second source of electricity to the Treichlers Substation. The rebuilt portion of Treichlers #1 Tap

¹ No PUC approval is required for construction of a switchyard.

and the new Treichlers #2 Tap will be constructed within PPL Electric's existing right-of-way, which was recently expanded in this area from 70 to 100 feet in width.

The existing Treichlers Tap #1 is approximately 1.1 miles in length. After the 800 feet of construction, switches and other equipment will be installed so that the remaining portion of the Treichlers Tap #1 can be supplied from either of the Hauto – Siegfried circuits. This portion of the Treichlers Tap #1 will continue into and supply the Treichlers Substation. It will not be modified.

All of the transmission lines in this Project are being constructed for 138/69 kV operation. The operating voltage will be increased to 138 kV in the future as part of a regional upgrade of the transmission system in this area when future customer load increases make it appropriate to do so. This filing also seeks PUC review of the future increase in the operating voltage for the portion of the Treichlers Tap #1 138/69 kV Line that will not be modified from 69 to 138 kV.² The existing tap can safely be operated at 138 kV without modification.

PPL Electric is seeking PUC approval of the construction of the new Treichlers #2 Tap and the reconstruction of a portion of the existing Treichlers Tap, as well as review of the future increase in the operating voltage of the remaining portion of the Treichlers #1 Tap to 138 kV.

The Hauto – Siegfried #1 & #4 138/69 kV Line & Siegfried – East Palmerton #1 & #2 138/69 kV Line Replacement Project and Treichlers Tap Project will traverse Allen Township in Northampton County, and North Whitehall and Washington townships in Lehigh County.

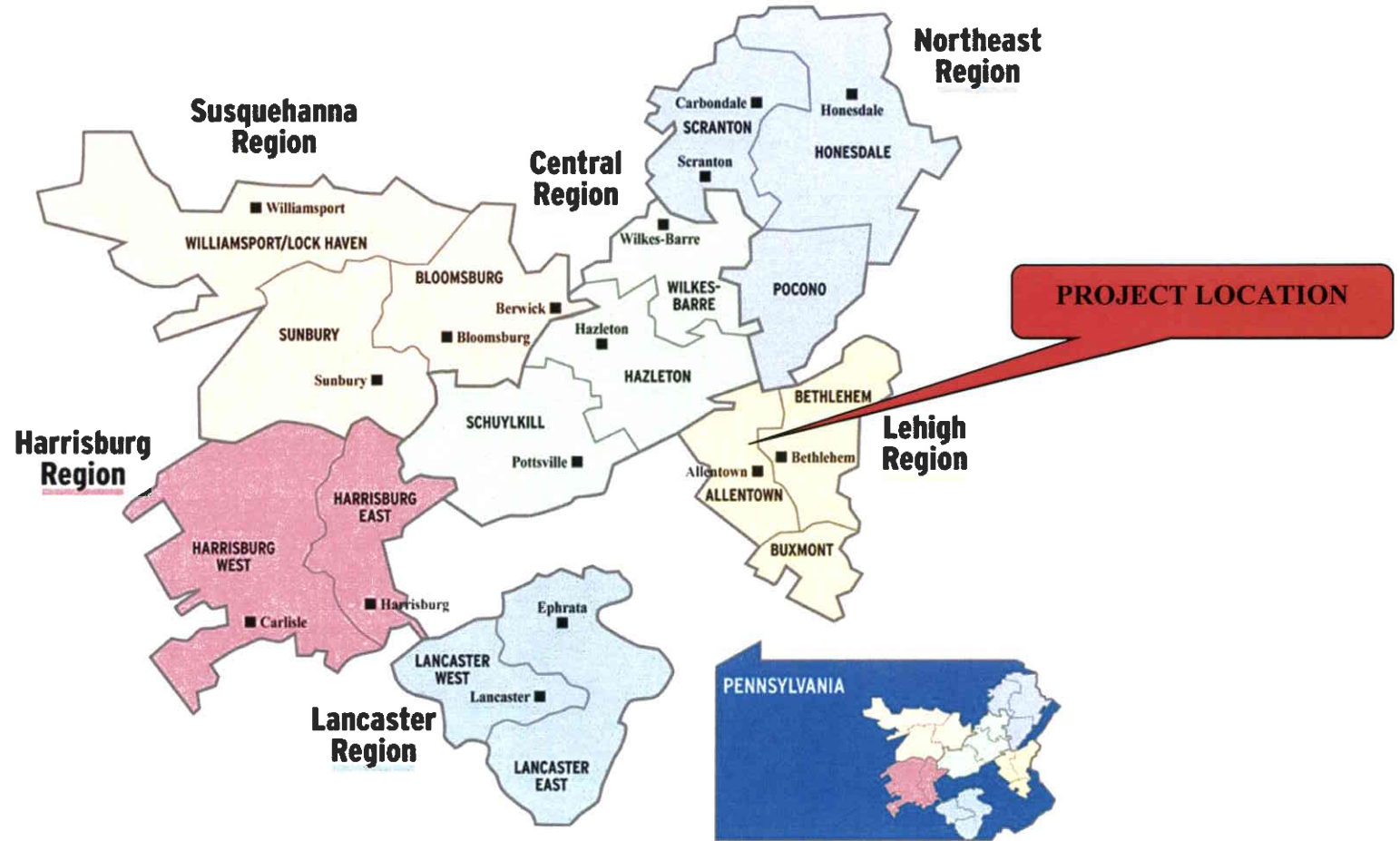
² PPL Electric is uncertain whether PUC approval for the increase in the operating voltage of the portion of the Treichlers Tap #1 that will not be modified is required. The Treichlers Tap #1 was constructed in 1976, before the PUC's regulations requiring prior approval of siting and construction of transmission lines with an operating voltage greater than greater than 100,000 volts were adopted. Therefore, its siting and construction were "grandfathered." 52 Pa. Code § 57.77. PPL Electric, however, is not certain whether the grandfather provisions of the regulation apply to the increase in operating voltage of the Treichlers Tap #1 contemplated in this Letter of Notification. 52 Pa. Code § 57.72(d)(iv). If the Commission determines that approval for the increase in the operating voltage is required, then PPL Electric requests such approval.

This Project was initiated as part of PPL Electric’s Asset Optimization Strategy (AOS) Program to improve deteriorated facilities across PPL Electric’s transmission system and to modernize those facilities to current standards. The Hauto – Siegfried #1 and #4 Lines have been in service since 1914 and 1923, respectively. The Siegfried – East Palmerton #1 and #2 lines have been in service since the 1950s. The lines have reached the end of their useful lives.

After analysis of the long term plan for the transmission system in this area, it was determined that one high capacity 138 kV double-circuit will suffice to replace two 138 kV double-circuit transmission lines. In order to more effectively address future load growth projections and prepare for the ultimate transmission system plan for this area, PPL Electric proposes to construct this new double-circuit line for future 138 kV operation but will initially operate it as a double-circuit 69 kV line until the load growth in the area makes it appropriate to increase the operating voltage. The estimated cost of this Project is \$11.8 million. Subject to Commission approval, construction of this Phase will begin in February 2014 to support the Project’s in-service date of September 2014. This document, which describes the need for the Project and discusses the engineering and environmental analysis for the proposed construction, consists of the following attachments:

Attachment 1	Necessity Statement
Attachment 2	Engineering Description
Attachment 3	Environmental Assessment
Attachment 4	PPL Design Criteria and Safety Practices
Attachment 5	PPL Electric Magnetic Field Management Program
Attachment 6	List of Owners of Property Within the Right-of-Way
Attachment 7	List of Involved Governmental Agencies, Municipalities and Other Public Entities

PPL ELECTRIC UTILITIES SERVICE TERRITORY



Attachment

1

ATTACHMENT 1

**REPLACEMENT OF THE HAUTO – SIEGFRIED #1 & #4 69 kV LINE &
SIEGFRIED – EAST PALMERTON #1 & #2 69 kV LINE WITH THE
SIEGFRIED – HAUTO #1 & #2 138/69 KV TRANSMISSION LINE AND
TREICHLERS 138/69 kV TAPS**

NECESSITY STATEMENT

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	INTRODUCTION	1-1
B.	SYSTEM PLANNING PROCESS.....	1-3
C.	PJM ROLE IN THE PLANNING PROCESS.....	1-7
D.	EXISTING SYSTEM	1-10
E.	DEFINITION OF THE PROBLEM.....	1-11
F.	PROPOSED SOLUTION.....	1-13
G.	FUNCTIONAL ALTERNATIVE.....	1-14

LIST OF FIGURES

FIGURE 1 FUNCTIONAL ONE-LINE DIAGRAM OF EXISTING AND
PROPOSED TRANSMISSION FACILITIES.....1-15

FIGURE 2 FUNCTIONAL ONE-LINE DIAGRAM OF PHASE
DEMARCATIION.....1-16

MAP 1 PPL ELECTRIC TRANSMISSION FACILITY MAP ATTACHMENT
1 MAP POCKET

ATTACHMENT 1

REPLACEMENT OF THE HAUTO – SIEGFRIED #1 & #4 69 kV LINE & SIEGFRIED – EAST PALMERTON #1 & #2 69 kV LINE WITH THE SIEGFRIED – HAUTO #1 & #2 138/69 KV TRANSMISSION LINE AND TREICHLERS 138/69 kV TAPS

NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric is requesting Commission approval to replace approximately 8.5 miles of two existing aging double-circuit 69 kV lines with one new high capacity double-circuit 138/69 kV transmission line. The 8.5-mile-long corridor presently hosts two double-circuit tower lines. The first tower line supports the Hauto – Siegfried #1 and Siegfried – East Palmerton #2 69 kV circuits, and the second tower line supports the Hauto – Siegfried #4 and Siegfried – East Palmerton #1 69 kV circuits. These lines serve 11,000 customers in Lehigh County with a 2012 summer peak loading of 40 MW. The new line will be referred to as the Siegfried – Hauto #1 and #2 138/69 kV Transmission Line (Siegfried – Hauto Line). It will be designed for 138 kV standards for higher capacity operation and will provide better reliability to the area it serves.

As explained in the Summary, this is the first of three filings planned to accommodate the proposed system reinforcement by PPL Electric to its transmission system in this vicinity. In this Phase (Phase 1) of this project PPL Electric proposes to replace, approximately 8.5 miles of two existing double-circuit 69 kV lines, to one double-circuit 138/69 kV line. This line will operate as a double-circuit 69 kV line until future load growth makes it appropriate to operate the Line at 138 kV. The Siegfried – Hauto Line will be constructed entirely within existing PPL Electric right-of-way.

The Letter of Notification for Phase 1 is being filed first because this phase is the first portion to be rebuilt in the construction sequence. The entire rebuild project is divided into three phases to reduce the complexity involved in project execution. In the remaining phases of the project PPL Electric will rebuild approximately 6.9 miles of the Siegfried – East Palmerton #1 & #2 69 kV double-circuit line (Phase 2) and 15.2 miles of Hauto – Siegfried #1 and #2 69 kV double-circuit line (Phase 3). Figure 2 shows a schematic diagram of the Siegfried – East Palmerton #1 & #2 69 kV double-circuit line and the Hauto – Siegfried #1 and #4 69 kV double-circuit lines with phases of demarcation. The new lines in Phases 2 and 3 will also operate as double-circuit 69 kV lines until future load growth makes it appropriate to operate the lines at 138 kV. These lines will be reconstructed entirely within PPL Electric existing right-of-way.

Based on PPL Electric's system planning studies, replacing the existing two double-circuit 69 kV lines in Phase 1 with one double-circuit 138 kV line will enable better utilization of assets, will accommodate the future transmission plan for this area, and will reduce maintenance costs. This Project will also allow for a more efficient use of the existing right-of-way by removing two double-circuit lines that are off-center and replacing them with one double-circuit line centered in the right-of-way.

Presently, the Treichlers Substation is supplied from a single source of supply. In addition, incidental to the construction of the Siegfried – Hauto Line, PPL Electric will add a second source of supply for the Treichlers Substation so that PPL Electric will be able to supply the Treichlers Substation from either the circuit of the Siegfried – Hauto Line. When the project is complete, the Treichlers Substation will be able to continue to provide reliable service even in the event of an outage of one of the circuits of the Siegfried – Hauto Line.

The estimated cost to design and construct Phase 1 of this project is \$11.8 million. Subject to the Commission's approval, construction is scheduled to begin in February 2014, and the lines should be in service by September 2014.

B. SYSTEM PLANNING PROCESS

System Planning is the process which assures that the transmission system can supply electricity to all customer loads in a manner that is reliable and economic. This System Planning process assures that both the Bulk Electric System (BES)³ and non-Bulk Electric System⁴ (non-BES) are planned and constructed so that:

- They are able to accommodate forecasted system flows during summer and winter peak load;
- They can adequately serve each customer's needs with regard to capacity, voltage and reliability for all load levels throughout the daily load cycle;
- They can sustain probable contingencies and disturbances with minimal customer service interruptions;
- They are in conformance with PPL Electric's transmission planning reliability principles, practices and standards for all normal and emergency operating conditions.

The process of planning the transmission system requires PPL Electric to look into the future to develop a reinforcement plan far enough in advance to be able to complete a project when it is needed. Ideally, transmission facility upgrades are planned such that the in-service date corresponds with the time frame that the facility is required to meet the planning criteria established by PPL Electric's Reliability Principles and Practices (RP&P). Significant lead times are needed to

³ Bulk Electric System (BES) includes transmission facilities operated at voltages of 100 kV or higher.

⁴ Non-Bulk Electrical System (non-BES) includes transmission facilities operated at voltages less than 100 kV.

design and install new line and substation facilities where new sites and/or rights-of-way and regulatory approvals must be acquired.

The reliable and economical operation of PPL Electric's transmission system requires planning standards for system expansion and reinforcement. The principles upon which these planning practices are based recognize that:

- The system expansion should be coordinated to achieve the most economical balance of construction and operating expenditures;
- The system should maintain a proper balance between the degree of risk, amount and type of load interrupted, and the cost of providing the needed expansion; and
- The system reliability should be maintained to prevent large scale, long term, or frequent service interruptions to avoid adverse effects and hazards to the public.

PPL Electric undertakes an independent analysis of both its BES transmission facilities and its non-BES electric transmission system facilities. The PPL Electric planning practices are outlined in the RP&P, which was developed to ensure adequate and appropriate levels of electric service to its customers consistent with good utility practice. The fundamental purpose of the RP&P is to provide PPL Electric planning engineers with a comprehensive set of planning practices and criteria that enable them to plan for a reliable transmission and distribution system for PPL Electric's customers. The RP&P is reviewed periodically by PPL Electric engineers and planners. The document is updated to reflect current standards and practices. Updates to the document are approved by PPL Electric's senior management. PPL Electric's RP&P is consistent with good utility practices and with the reliability criteria and standards used by similarly situated distribution and transmission utilities.

In accordance with these practices and PPL Electric's Reliability Criteria, the PPL Electric transmission system is planned so that it can be operated at all projected

load levels and during normal scheduled outages and withstand specific unscheduled contingencies without exceeding the equipment capability, causing system instability or cascade tripping, or exceeding voltage tolerances. The transmission system is required to have adequate capability so that it can be operated normally and can withstand the following unscheduled contingencies and other system conditions:

1. Normal operation of the system will not load any electric facility beyond its normal continuous rating.
2. The loss of any single transmission line, generating unit, power transformer, substation bus, circuit breaker, or double-circuit line due to the outage of a single tower or pole, does not result in any system electric facility being operated beyond its applicable emergency rating.
3. No customer load should remain interrupted for routine maintenance of non-BES transmission facilities.
4. The loss of any single facility should not result in a voltage drop of more than 5% on the non-BES transmission system.
5. Stability of the electric system should be maintained from a permanent three-phase transmission line fault cleared by normal primary relay action. In addition, system stability should be maintained for a permanent single phase to ground line fault and the failure of the protective devices to operate properly resulting in a failed circuit breaker.
6. No large-scale, long-term or frequent interruptions may cause excessive load losses due to their adverse effects on, and hazard to, the public.
7. Excessive load is not interrupted for the loss of a single-circuit 69 kV line or double-circuit 69 kV line, and the lost load is within the specified limits as defined in the RP&P.

These principles are incorporated in the PPL Electric's Transmission Planning RP&P.

The transmission planning process begins with the development of a computer model of the future system. A specific study year is chosen, and the future system model is developed using the existing system plus any planned modifications to the transmission system scheduled to be completed prior to the study year. Load levels used in the system model are based on the latest forecast prepared annually by PJM Interconnection, LLC (PJM).

Once the system model is complete, comprehensive power flow simulations are performed to determine the ability of the system to comply with the PPL Electric transmission planning reliability criteria. Compliance is determined by simulating the contingency conditions outlined above. All conditions where the system is not in conformance with the reliability criteria are identified, and system reinforcements are added to bring the system into compliance. Also identified are estimated costs and lead-times to implement the required reinforcements. Computer simulations of the system with the identified reinforcement alternatives are completed to identify the best overall reinforcement that will meet the needs of the region in a reliable and economic manner.

In addition to the above planning approach, PPL has also developed an Asset Optimization Strategy (AOS) that has been incorporated into the planning process. A significant portion of the system infrastructure is either approaching the end of or has exceeded its expected or useful life. The AOS program was developed to systematically identify and modernize these deteriorated facilities. The criteria used to identify and prioritize the equipment and lines that qualify for this work includes, but is not limited to: age, condition, operational issues, maintainability of the equipment, criticality of the equipment or line, line loading, and circuit performance. Once equipment has been identified and assessed under the above criteria, it will be put into the Capital Budget for replacement under the AOS program.

C. PJM'S ROLE IN THE PLANNING PROCESS

PJM is a Federal Energy Regulatory Commission (FERC)-approved Regional Transmission Organization charged with ensuring the reliability of the electric transmission system under its functional control and coordinating the movement of electricity in all or parts of thirteen states and the District of Columbia, including Pennsylvania. In order to ensure reliable transmission service, PJM prepares an annual Regional Transmission Expansion Plan (RTEP) to identify system reinforcements that are required to, among other things, meet the North American Electric Reliability Corporation (NERC) Reliability Standards,⁵ PJM reliability planning criteria, and transmission owner reliability criteria. The RTEP is a FERC-approved transmission planning process that results from a comprehensive analysis to identify existing and forecasted violations of the NERC, PJM and transmission owner reliability standards on the transmission systems within PJM's service territory.⁶

PJM's RTEP is an annual process that encompasses a comprehensive series of detailed analyses to ensure power continues to flow reliably to customers under stringent reliability criteria set by NERC. The NERC reliability standards, transmission owner criteria, and PJM reliability planning criteria are used by PJM and the transmission owners to analyze the system and to determine the specific transmission upgrade projects, as part of the overall reliability solution, that are

⁵ On February 3, 2006, FERC certified the North American Electric Reliability Corporation (NERC) as the organization required to establish and enforce reliability standards for the bulk electric system. Thereafter, NERC develops and enforces reliability standards, which define the reliability requirements for planning and operating transmission systems in North America. The NERC Reliability Standards apply to all users, owners, and operators of the nation's interconnected transmission grid, including PPL Electric.

⁶ PJM's RTEP process is currently set forth in Schedule 6 of PJM's Amended and Restated Operating Agreement (Schedule 6). Schedule 6 governs the process by which PJM's members rely on PJM to prepare an annual regional plan for the enhancement and expansion of the transmission facilities to ensure long-term, reliable electric service consistent with established reliability criteria. In addition, Schedule 6 addresses the procedures used to develop the RTEP, the review and approval process for the RTEP, the obligation of transmission owners to build transmission upgrades included in the RTEP, and the process by which interregional transmission upgrades will be developed.

needed to ensure long-term reliable electric service to customers and competitive power markets.

With respect to the BES, PJM conducts RTEP studies in conjunction with its transmission owners and applies NERC or PJM reliability criteria to specific conditions on the transmission system. When the studies show an inability of the transmission system to meet a specific reliability standard under these conditions, solutions such as construction of one or more new transmission lines or one or more upgrades to existing transmission facilities may be necessary. PPL Electric, an owner of transmission facilities in Pennsylvania, is a member of PJM and actively participates in the PJM transmission planning process.

As explained more fully below, the proposed rebuild of the existing Hauto – Siegfried #1 & Siegfried – East Palmerton #2 and Hauto – Siegfried #4 & Siegfried – East Palmerton #1 69 kV double-circuit lines to one new Hauto – Siegfried #1 & #2 138/69 kV double-circuit line will replace the existing aging transmission infrastructure. Replacement of aging infrastructure necessary to maintain electric system reliability is a practice set forth in PPL Electric’s RP&P, its local planning criteria on the 69 kV transmission system, the non-BES.

For non-BES system reliability violations, the local transmission operator, in this case PPL Electric is responsible for identifying the reliability violations and correcting any violations to meet its own local transmission planning criteria. PPL’s local transmission planning criteria for ensuring the reliability of the non-BES transmission system are based on the principles of the NERC and PJM reliability criteria for the BES. PJM relies on the local transmission owners to ensure the reliability of their non-BES system by meeting their own local transmission planning criteria. Projects that are necessary to resolve NERC criteria, PJM reliability criteria, or the transmission owners’ own local transmission planning criteria are included as baseline projects in PJM’s RTEP.

To achieve FERC Order 890's goal of a more open and transparent transmission planning process, PJM has taken a more active role in ensuring that the transmission owners communicate their plans for the development of their lower voltage transmission systems. In order to comply with FERC Order 890, transmission owners submit their lower voltage reliability projects to PJM so that they can be presented before the PJM stakeholders at the Sub-Regional RTEP Committee meetings.

The PJM Sub-Regional RTEP Committee review includes, but is not limited to, the review of the transmission owner criteria, assumptions and models used to identify reliability criteria violations and proposed solutions prior to finalizing the Local Plan. The Committee members are provided an opportunity to review and provide written comments to the transmission owners on the criteria, assumptions, and models used in local planning activities prior to finalizing the Local Plan. Once the Local Plan is finalized, the Committee is provided an opportunity to review and provide written comments to the transmission owners on the Local Plans as integrated into the RTEP. The final version of the RTEP, which includes the transmission owners' Local Plans that were reviewed and recommended by the Committee, is then sent to the PJM Board for approval. Once the PJM Board approves the RTEP that includes the transmission owners' Local Plans, the transmission owners then move forward to implement the RTEP BES transmission and the non-BES facility upgrades as they are obligated to do under the PJM Tariff and Operating Agreements. There are particular projects such as rebuilds of existing aging infrastructure that are categorized as PJM "supplemental" projects which do not need to be presented before the PJM Board for approval. This Project was presented in the 2013 RTEP.

The purpose of the proposed project to replace the Hauto – Siegfried #1 & Siegfried – East Palmerton #2 and Hauto – Siegfried #4 & Siegfried – East Palmerton #1 69 kV double-circuit lines to one new Hauto – Siegfried #1 & #2 69 kV double-circuit line is to replace aging transmission infrastructure on the non-

BES (69 kV) system serving a portions of the Lehigh and Central Regions of PPL Electric's service territory. PPL Electric submitted the proposed Project to PJM for review and inclusion in the RTEP as a supplemental project. The Project was presented before stakeholders at the Mid-Atlantic Sub-Regional RTEP meeting on February 28, 2013 and was assigned supplemental project number S0524.

D. EXISTING SYSTEM

Figure 1 identifies the functional arrangement of the existing and future transmission facilities. This schematic diagram also displays the number of customers and peak load served from each distribution substation off the Siegfried – East Palmerton #1 & #2 and Hauto – Siegfried #1 & #4 69 kV Lines.

Currently the Hauto – Siegfried #1 and Siegfried – East Palmerton #2 double-circuit 69 kV line extends from the Siegfried 230-69 kV Substation for approximately 8.5 miles west to the “Split.” Similarly, the Hauto – Siegfried #4 and Siegfried – East Palmerton #1 double-circuit 69 kV line extends from the Siegfried 230-69 kV Substation for approximately 8.5 miles west to the “Split.” From the “Split” the lines continue in two different directions. The Siegfried – Hauto #1 & #4 69 kV circuits continue as a double-circuit line west towards the Hauto 69-12 kV Substation. The Siegfried – East Palmerton #1 & #2 69 kV circuits continue as a double-circuit line north toward the East Palmerton 230-69 kV Substation.

The Treichlers Substation is presently fed from the Hauto – Siegfried #1 Line via the Treichlers Tap. The Treichlers Tap is approximately 1.1 mile in length and traverses northeasterly from the tap point to the Treichlers Substation.

E. DEFINITION OF THE PROBLEM

The Hauto – Siegfried #1 and #4 circuits have been in service since 1914 and 1923, respectively. The Siegfried – East Palmerton #1 & #2 circuits have been in service since the 1950s. The Hauto – Siegfried line operates with the original 4/0 copper conductor and the Siegfried – East Palmerton line carries the original 250 MCM copper conductor. The conductors of both lines have reached the end of their useful lives.

Based upon the age of the circuits and lines, a more detailed examination of the facilities was needed. PPL Electric hired an outside engineering consultant, DiGioia Gray and Associates (DGA)⁷ to perform an independent field investigation and assessment of the line components. This assessment found significant deterioration of the structural components, foundations, insulators, line hardware, shield wire, grounding, signage, paint and galvanizing as well as an outdated structure design. DGA completed its study in September 2011. Based on an inspection of 10 percent of the structures with known problems on the line, DGA concluded that the Phase 1 Hauto – Siegfried and Siegfried – East Palmerton lines have reached the end of their useful life. Given the age of the structures, foundation conditions, conductor age, and right-of-way constraints, DGA recommended that PPL Electric rebuild the existing lines with a more reliable and robust circuit constructed on steel monopoles. Rebuilding the existing double-circuit lines as one double-circuit line allows PPL Electric to construct the new line on the center line of the existing right-of-way to increase safety and reliability by increasing the distance between the conductors and the edge of the right-of-way.

⁷ DiGioia Gray & Associates of Monroeville, PA 15146

PPL Electric requested that DGA also compare the relative costs of rehabilitating and replacing the aging lines. DGA indicated that the following would be necessary in order to rehabilitate the existing lines:

- Conduct a complete engineering assessment of each structure, including computer modeling to ensure proper safety factors and clearances
- Replace existing conductors
- Replace existing shield wire
- Replace all hardware and insulators
- Install new grounding system at each structure location.
- Repaint all steel structures
- Have all wood poles tested for strength and repair/replace as necessary
- Repair or replace all bent, missing or corroded structural members
- Repair all corroded steel below ground
- Install cathodic protection at each structure
- Evaluate lightning strike and other fault history for the existing line to determine the cause for the extensive conductor damage. Improve lightning resistance by bonding shield wires to the structures. This work associated with improving tower ground resistance.
- Strengthen, reinforce or replace structures based on results of the engineering assessment mentioned above
- Repair any other issues found during engineering assessment or construction.

Based on DGA's assessment, rehabilitating the existing lines would not be economical. Replacing the existing line will allow PPL Electric to upgrade the lines to current standards, as well as to install 138 kV circuits and improved conductors to allow for future load growth.

PPL Electric performed an independent cost analysis to evaluate the cost difference between rebuilding and rehabilitating the lines. Typically, if the cost to rehabilitate the line is 50% or greater of the cost to rebuild the entire line, the option to rebuild should be considered. Based on PPL Electric's cost analysis, the total cost to rehabilitate the line would be greater than the cost to rebuild. Therefore, replacing the two existing aging double-circuit lines with one new high capacity double-circuit 138/69 kV transmission line was identified as the most prudent option.

F. PROPOSED SOLUTION

After evaluation of the alternatives, it was identified that the best overall solution to the problem is to replace the Hauto – Siegfried #1 & Siegfried – East Palmerton #2 double-circuit 69 kV line and the Hauto – Siegfried #4 & Siegfried – East Palmerton #1 double-circuit 69 kV line with one new double-circuit Siegfried – Hauto #1 and #2 138/69 kV line. The double-circuit line will be designed to new 138 kV standards, but it will initially operate at 69 kV. The Siegfried – Hauto #1 and #2 double circuit 138/69 kV line will be converted to 138 kV operation in the future as part of the long-term plan to reinforce the existing line corridor between the regional substations at Siegfried and East Palmerton. These requirements for rebuilding 69 kV lines for future double-circuit 138 kV operation are in accordance with the PPL Electric RP&P. In this filing,

PPL Electric also seeks PUC approval for the rebuild of an 800-foot section of the approximately 1.1-mile-long Treichlers Tap into a double-circuit tap, single feed configuration so that the Treichlers Substation can be supplied from either circuit of the Siegfried – Hauto 138/69 kV transmission line. As mentioned in the summary section, the Treichlers Tap will be designed for a double tap/single feed arrangement to provide more reliable service.

Figure 1 shows the current and proposed future configuration of the line. The proposed future configuration will use higher ampacity conductors, improved sectionalizing devices and meet new lightning protection standards of PJM. After completion of this Project, the customers served from these lines will experience improved service reliability. The improved line design and increased line sectionalizing capability will allow quicker load restoration after a system interruption and will contribute to the higher level of reliability for the customers served from these lines.

In addition, PPL Electric is seeking review of the future increase in operating voltage for the Treichlers #1 Tap. PPL Electric is uncertain whether PUC approval for the increase in the operating voltage of the portion of the Treichlers Tap #1 that will not be modified is required. The Treichlers Tap #1 was constructed in 1976, before the PUC's regulations requiring prior approval of siting and construction of transmission lines with an operating voltage greater than greater than 100,000 volts were adopted. Therefore, its siting and construction were "grandfathered" (52 Pa. Code § 57.77). PPL Electric, however, is not certain whether the grandfather provisions of the regulation, 52 Pa. Code § 57.72(d)(iv), apply to the future increase in operating voltage of the Treichlers Tap #1 contemplated in this Letter of Notification. If the Commission determines that approval for the increase in the operating voltage is required, then PPL Electric requests such approval.

For all of the foregoing reasons, this Project is necessary to enable PPL Electric to continue to provide reliable service now and into the future and therefore requests approval of the PUC to complete this Project.

G. FUNCTIONAL ALTERNATIVE

No other reasonably economical functional alternatives were identified that would resolve the problem as outlined above.

Attachment

3

ATTACHMENT 3

**REPLACEMENT OF THE HAUTO – SIEGFRIED #1 & #4 69 kV LINE &
SIEGFRIED – EAST PALMERTON #1 & #2 69 kV LINE WITH THE
SIEGFRIED – HAUTO #1 & #2 138/69 KV TRANSMISSION LINE AND
TREICHLERS 138/69 kV TAPS**

ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	INTRODUCTION	3-1
B.	LAND USE.....	3-3
C.	CULTURAL RESOURCES	3-4
D.	NATURAL FEATURES	3-6
E.	THREATENED AND ENDANGERED SPECIES.....	3-10

LIST OF TABLES

TABLE 1	MUNICIPALITIES CROSSED BY THE PROJECT.....	3-2
TABLE 2	WETLANDS AND WATERS CHARACTERISTICS.....	3-9
TABLE 3	PLANT SPECIES OF CONCERN.....	3-11

ATTACHMENT 3

REPLACEMENT OF THE HAUTO – SIEGFRIED #1 & #4 69 kV LINE & SIEGFRIED – EAST PALMERTON #1 & #2 69 kV LINE WITH THE SIEGFRIED – HAUTO #1 & #2 138/69 KV TRANSMISSION LINE AND TREICHLERS 138/69 kV TAPS

ENVIRONMENTAL ASSESSMENT

A. INTRODUCTION

PPL Electric is requesting PUC approval to rebuild approximately 8.5 miles of four existing 69 kV transmission lines: Hauto – Siegfried #1, Hauto – Siegfried #4, Siegfried – East Palmerton #1, and Siegfried – East Palmerton #2. These four circuits are presently installed on two sets of parallel double-circuit transmission structures located within the existing right-of-way. PPL Electric’s existing right-of-way varies in width, but is generally 100 feet wide. One set of double-circuit structures is located within the approximate right-of-way centerline while the other set of double-circuit structures is located on the western edge of the right-of-way. PPL Electric proposes to rebuild these four 69 kV circuits as two 138/69 kV circuits on a single set of transmission structures. Therefore, this Project will reduce the total number of transmission structures currently present within the right-of-way.

As part of this Project, PPL Electric intends to site and construct a new switchyard station in the vicinity of the “Split” in Washington Township where the lines presently diverge. In addition, the Project also includes the construction of the Treichlers Tap #1 & #2 138/69 kV Transmission Line. Presently, the Treichlers Substation is served via a single-circuit 69 kV tap (Treichlers Tap #1) off the existing Hauto – Siegfried #1 138/69 kV Transmission Line. Approximately 800 feet of this single-circuit tap will be rebuilt as a double-circuit tap-single feed (DT/SF) configuration, which will provide a second source of

electricity to the Treichlers Substation. The new tap line will be constructed within PPL Electric’s existing right-of-way, which was recently expanded in this area from 70 to 100 feet in width.

The proposed Project begins at the Siegfried Substation located adjacent to West 27th Street in Allen Township, Northampton County and continues northwest for approximately 8.5 miles through North Whitehall and Washington townships in Lehigh County, before terminating at the proposed switching station located directly west of Brown Street in Washington Township. Treichlers Tap originates from the existing Hauto – Siegfried #1 138/69 kV Transmission Line approximately 1,500 feet west of Rising Sun Road. The first approximately 800 feet of the tap will be rebuilt as the Treichlers Tap #1 & #2 138/69 kV Lines. The remaining portion of the tap (approximately 5,024 feet, or 0.95 mile), which will not be reconstructed, continues north through North Whitehall Township, crosses the Lehigh River, and continues north through Lehigh Township, Northampton County into the Treichlers Substation. Table 1 identifies the portion of the Project located within each township.

TABLE 1. MUNICIPALITIES CROSSED BY THE PROJECT		
Municipality	Siegfried – Hauto Length (miles)¹	Treichlers Tap Length (miles)
Northampton County		
Allen Township	0.2	0.0
Lehigh Township	0.0	0.8
Lehigh County		
North Whitehall Township	3.6	0.3
Washington Township	4.7	0.0

¹Rounded to the nearest tenth

The proposed Project was reviewed with representatives of Lehigh and Northampton counties and Allen, North Whitehall, Washington, and Lehigh townships, and neither the townships nor the counties had any objection. A list of involved governmental agencies, municipalities, and other public entities is presented in Attachment 7.

B. LAND USE

The entire Project will be rebuilt on a single set of new double-circuit transmission structures within PPL Electric's existing right-of-way. The Project begins in Allen Township in Northampton County at the existing Siegfried Substation located adjacent to West 27th Street and east of the Lehigh River. The proposed route exits the Siegfried Substation to the west and crosses the Lehigh River. After crossing the river, the route continues northwest for approximately 3.6 miles through a mix of forested and agricultural areas within North Whitehall Township, Lehigh County. From here, the route continues northwest through agricultural, forested and rural residential areas in Washington Township for approximately 4.7 miles, crossing Interstate 476 (I-476, the Northeast Extension of the Pennsylvania Turnpike) and terminating at the proposed switchyard station located on a vacant parcel near the intersection of Mountain Road and Brown Street in Washington Township.

The Treichlers Tap #1 138/69 kV Line right-of-way varies between 70 and 100 feet in width. PPL Electric acquired 30 feet of additional right-of-way to the east of the existing right-of-way in order to accommodate the proposed Treichler Tap #1 rebuild and Treichler Tap #2 construction, which is approximately 800 feet in length. The existing right-of-way is located within an agricultural field and is presently cleared of trees. The additional 30 feet of right-of-way acquired by PPL is also within an agricultural field. Therefore, limited or no vegetation clearing is anticipated as part of the Treichlers Tap rebuild. No work will be conducted on the remaining portion of the Treichlers Tap #1 69 kV Line. The portion between the rebuild and the Treichlers Substation is included in this filing in order to assure that PPL Electric is authorized to operate this portion of the line at 138 kV in the future.

Four cemeteries and one church are located within 1,000 feet of the Project. The existing right-of-way crosses the southwest corner of Union Cemetery in

Washington Township. The remaining cemeteries/churches are not crossed, but are located within 1,000 feet and include: Freidens Church and Cemetery located just south of Union Cemetery and south of the right-of-way; Welsh Baptist Congregation Cemetery located west of Union; and Slatedale Cemetery located south of the “Split.” No schools are crossed by or located within 1,000 feet of the right-of-way.

No communication towers, pipelines, or other utilities will be affected by the proposed Project. The closest airport is a privately owned heliport located approximately 800 feet north of the Project off of Ranch Road in North Whitehall Township. In addition, a privately owned airport identified as HI-VU, is located approximately 1 mile south of the Project in North Whitehall Township, and the Slatington airport is located approximately 1.8 miles north of the Project in Slatington Borough. The proposed transmission line rebuild is not expected to impact airport operations or flight patterns. Nevertheless, PPL Electric will file the appropriate documentation with both the Federal Aviation Administration (FAA) and the PennDOT Bureau of Aviation to ensure that the proposed construction will not be a hazard to the airports’ flight operations.

C. CULTURAL RESOURCES

PPL Electric reviewed the Pennsylvania Historical and Museum Commission’s (PHMC’s) Bureau for Historic Preservation (BHP) Cultural Resources Geographic Information System (CRGIS) to identify previously recorded historic resources located in the vicinity of the Project. Based on this review, the Project does not cross any recorded historic architectural or archeological resources. The CRGIS search identified two bridges and one unidentified structure within 0.5 mile of the Project. Two are considered ineligible for inclusion on the National Register of Historic Places (NRHP), and one is undetermined. Impacts of the Project on these resources are expected to be minimal because the Project involves removing two

existing double-circuit lattice towers and replacing them with a single double-circuit line supported by single shaft steel poles within the existing right-of-way. Eight Historic Linear Resources (five railroads, the Pennsylvania Turnpike and one canal) are crossed by the existing line. Three of the railroads are listed as “aggregates”¹⁴ and two are considered eligible for listing on the NRHP. The CRGIS indicates that the Pennsylvania Turnpike Northeast Extension is considered ineligible whereas the Walnutport to Allentown and the Lehigh Gap to Walnutport Sections of the Lehigh Canal are listed on the NRHP. Impacts on these resources are expected to be minimal because these resources are presently crossed by the existing double-circuit lines. This Project will reduce the number of transmission circuits crossing these features.

Five archaeological sites that have “insufficient data available to make a decision” are located within 0.5 mile of the existing line. There are also five historic districts within 0.5 mile of the existing line, three of which are considered ineligible and two of which (Slatington Historic District and Vigilant Fire Company’s Firemen’s Monument) are listed on the NRHP. Impacts on the resources are expected to be minimal because none of the resources are crossed by the Project.

PPL Electric submitted a letter to the PHMC on April 24, 2013 to request information on any additional archaeological or historic architectural resources located in the Project vicinity. No response has been received to date.

A separate letter was sent to the PHMC on June 6, 2013 regarding the Treichlers Tap rebuild. A PHMC response¹⁵ dated June 12, 2013 indicated that no historic properties are located within the Project Area. PPL Electric will continue to

¹⁴ Aggregate files refer to a display of previously surveyed components (associated resources) of a particular railroad line. The aggregate file illustrates the historic path of the railroad line based on research, but is not considered to be definitive. Aggregate files do not represent a historic district survey and will not have a determination of eligibility.

¹⁵ PHMC Review No. 2013-1645-077-A.

consult with the PHMC to minimize the potential for any adverse impacts on cultural resources.

D. NATURAL FEATURES

The Project will not affect any recreational areas or natural landmarks. No recreational areas are traversed by the Project.

The right-of-way for both the proposed Siegfried – Hauto line and the Treichlers Tap line cross the Mantz Conservation Easement located adjacent to the Lehigh River. The Project involves rebuilding transmission infrastructure within the existing right-of-way through the conservation easement area. In fact, the Project is anticipated to reduce impacts through this area by reducing the number of transmission circuits from four to two and reducing the number of structures. The portion of the Treichlers Tap line that will be rebuilt as part of this Project does not cross the Mantz Conservation Easement.

A few local recreational areas are located within 1 mile of the Project. The closest recreational area is the Minnich Tract located approximately 0.2 mile north of the right-of-way. The Project crosses a portion of the Delaware and Lehigh (D&L) Trail a rails to trails project, which is a 165-mile trail network constructed in an inactive Conrail right-of-way adjacent to the Lehigh River.¹⁶ The Project also crosses the Slate Heritage Trail, which is another rails-to-trails project that connects to the D&L Trail in Washington Township.¹⁷ The existing transmission right-of-way presently crosses these recreational areas. The Project is not anticipated to impact either site, as it will reduce the number of circuits from four to two and reduce the number of structures.

¹⁶ Pennsylvania's Delaware, Lehigh & Wyoming Valleys. The D&L Trail. <http://www.delawareandlehigh.org/index.php/trail/>

¹⁷ The Northern Lehigh Historical Society. <http://www.nlhistoricalsociety.org/trails.html>

The Project is located approximately 0.7 mile from the Appalachian Trail. State Game Land 217A is located along the Appalachian Trail in this area. Based on this distance, the change in elevation, and heavy tree cover, the existing transmission line is not visually noticeable from the Appalachian Trail and no impacts to these areas are anticipated.

The Project will traverse approximately 0.3 mile of two natural area sites identified in the natural area inventory (NAI) for Lehigh and Northampton counties¹⁸: Road Riverbank Site located in the eastern portion of the Project Area in North Whitehall Township and Rextown Ponds located in the western portion of the Project Area in Washington Township. The Clearview Road Riverbank Site consists of a forested strip of riverbank along the shore of the Lehigh River. This stretch of riverbank is influenced by scouring from flooding and ice and includes varying segments of rock outcrops, stunted trees and shrubs, and mixed herbs growing on alluvial sediments. According to The Nature Conservancy, the site supports populations of two plant species of special concern, Virginia rose (*Rosa virginiana*), and Baltic rush (*Juncus arcticus var. littoralis*). Extensive suitable habitat for both of these species occurs along the river. Approximately 1 acre of this natural area is crossed by the Project. The proposed transmission line will cross this natural area aerially

The Project traverses approximately 0.4 acre of the Rextown Ponds natural area. This NAI site consists of several small, seasonally wet, shallow depressions or ponds in an otherwise well-drained, upland forest along the Lehigh River and supports a plant species of concern, Northeastern Bulrush (*Scirpus ancistrochaetus*). A rare plant survey was conducted within the right-of-way as part of the Project. None of the plant species of concern that may be located within these NAI areas were identified during the survey. Based on this information and the facts that the Project will be rebuilt within PPL Electric's

¹⁸ The Nature Conservancy. (2005). *A Natural Areas Inventory of Lehigh and Northampton Counties*.

existing right-of-way and will cross this natural area aerially, no impact to these NAI areas are expected. The Project will not traverse any other unique geological, scenic or natural areas.

In addition, although the following natural areas are not crossed by the Project, they are located within 1 mile of the right-of-way¹⁴:

- Rextown Quarry Site (Washington Township, Lehigh County) is located approximately 0.2 mile north of the right-of-way adjacent to I-476. This NAI area consists of an abandoned slate quarry that provides suitable habitat for a plant species of concern, Torrey's rush (*Juncus torreyi*). This plant species has been observed at the base of a large slag pile on muddy soil enriched by the limy slate. In this case, human disturbance has created a unique habitat utilized by the species of concern.
- Walnutport Canal (Washington and North Whitehall townships, Lehigh County) is located approximately 0.2 mile north of the right-of-way. This NAI area consists of a canal and adjacent banks and a strip of woods between towpath and river contains a plant species of concern, Virginia rose (*Rosa virginiana*). A second species of concern, autumn willow (*Salix serissima*), was reported but could not be confirmed.
- Rockdale Cliffs (North Whitehall Township, Lehigh County) is located directly south of the Lehigh River in North Whitehall Township approximately 0.2 mile north of the right-of-way. This NAI area includes several small, seasonally wet, shallow depressions in otherwise well-drained, upland forest. A plant species of concern, ebony sedge (*Carex eburnea*), is found at one of the ponds.

Because these sites are distant from the Project and because the Project is a rebuild on existing cleared right-of-way, no impacts to these NAI areas are anticipated.

PPL Electric conducted a wetland delineation of the line in March 2012. Field survey efforts identified 40 wetlands and other Waters of the United States (WOUS), as shown in Table 2.

TABLE 2. WETLAND AND WATERS CHARACTERISTICS		
Wetland or WOUS Type²	Number Delineated	Total Area (Acre)¹
PEM	5	0.74
PSS	6	1.94
PEM/PSS	3	0.28
PFO	2	0.04
POW	2	0.45
PEM/PSS/PFO	2	0.27
PEM/PFO	2	0.14
R2	2	1.12
R3	8	0.52
R4	7	0.12
R5	1	0.04
Total	40	5.65

¹Total calculated within the right-of-way and rounded to nearest 0.01 acre.

²PEM = palustrine emergent wetland; PSS = palustrine scrub-shrub wetland; PFO = palustrine forested wetland; POW = palustrine open water wetland; R2 = lower perennial stream; R3 = upper perennial stream; R4 and R5 = intermittent stream

Some minimal tree clearing may be required, and if so, PPL Electric will apply its “Specification for Initial Clearing and Control of Vegetation On or Adjacent to Electric Line Right-of-Way Through Use of Herbicides, Mechanical and Hand Clearing Techniques” to mitigate any impacts.

PPL Electric will obtain any required soil erosion and sedimentation control approvals and associated National Pollutant Discharge Elimination System (NPDES) construction permits from the applicable County Conservation Districts and/or the Pennsylvania Department of Environmental Protection (DEP) and will comply with any conditions placed on those permits. PPL Electric will employ its “Specification for Soil Erosion and Sedimentation Control on Transmission Line Rights-of-Way” as appropriate.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric has coordinated with the relevant state and federal agencies to obtain information regarding endangered and threatened species that have been known to occur in the vicinity of the proposed Project. The Pennsylvania Game Commission (PGC), and Pennsylvania Fish and Boat Commission (PFBC)¹⁹ report that, except for occasional transient species of wildlife, no threatened or endangered plant or animal life is known to exist in the Project vicinity. However, PGC identified the following voluntary conservation measure for the Northern Myotis: *To the best extent practicable, removal of all trees and dead limbs greater than 5-inch diameter at breast height (DBH) should be cut between November 1 and March 31.* PPL Electric will comply with this recommendation.

The Pennsylvania Department of Conservation and Natural Resources (DCNR)²⁰ indicated that the Project is located within the vicinity of 10 plant species of concern, as identified in Table 3.

¹⁹ SIR No. 40577, update to #38581 and #33182, May 10, 2012

²⁰ DCNR PNDI No. 20530, February 1, 2010

TABLE 3. PLANT SPECIES OF CONCERN				
Scientific Name	Common Name	State Rank	Current Status	Habitat
<i>Carex longlii</i>	Long's sedge	S2S3	TU	Wet or seasonally wet sandy soils in swamps, thickets and meadows
<i>Cuscuta campestris</i>	Dodder	S2	N	Thickets and waste ground, parasitic on various wild and cultivated hosts including alfalfa and clover
<i>Juncus debilis</i>	Weak rush	S3	N	Stream banks, mudflats, shores and ditches
<i>Juncus filiformis</i>	Thread rush	S3	PR	Moist, sandy old fields, open woods and gravel pits
<i>Juncus torreyi</i>	Torrey's rush	S2S4	PT	Muddy or sandy shores, strip mine areas, swales or ditches
<i>Lathyrus venosus</i>	Veiny pea	S2	N	Sandy or rocky shores, wooded slopes and RR beds
<i>Polygonum careyi</i>	Carey's smartweed	S1	PE	Sandy, open woodlands and disturbed places, particularly after fire
<i>Scirpus ancistrochaetus</i>	Northeastern bulrush	S3	PE	Intermittently wet or inundated depressions
<i>Spiranthes lucida</i>	Singing ladies' tresses	S3	N	Moist banks, lake shores and wet meadows, usually on calcareous soils
<i>Trisetum spicatum</i>	Narrow false oats	S1	N	Open, shaley outcrops

N = No current legal status, but is under review for future listing; TU = Tentatively undetermined, which refers to a species believed to be in danger of population decline, but has insufficient data; PT = Pennsylvania threatened; PR = Pennsylvania rare; PE = Pennsylvania endangered; S1 = Critically imperiled; S2 = Imperiled; S3 = Vulnerable; S4 = Apparently secure

DCNR requested surveys for the species identified in Table 3 and Virginia rose (*Rosa virginiana*), which is currently unlisted in Pennsylvania. PPL Electric retained a qualified botanist to conduct plant surveys within the right-of-way in May and June 2012. Based on these surveys, none of the species identified by DCNR were identified within the right-of-way. However, one species of concern that was not identified by DCNR, Clinton's woodfern (*Dryopteris clintoniana*) (N), was identified within the Project right-of-way during these surveys. PPL Electric is currently finalizing the rare plant report for submission to DCNR.

The U.S. Fish and Wildlife Service (USFWS) ²¹ indicated that the federally threatened bog turtle (*Glyptemys muhlenbergii*) is known to exist within Lehigh County and requested Phase I bog turtle surveys. PPL Electric retained a qualified bog turtle surveyor to conduct Phase I bog turtle surveys along the right-of-way. No potential bog turtle habitat was identified during the Phase I surveys. PPL Electric is currently in the process of finalizing the Phase I report for submission to the USFWS.

An online PNDI review²² was conducted for the Treichlers Tap rebuild area. No impacts were identified by PGC, PFBC or USFWS. DCNR recommends the following conservation measure for the Ebony sedge:

Please avoid the introduction of invasive species in order to protect the integrity of nearby plant species of special concern. Voluntary cleaning of equipment/vehicles, using clean fill and mulch, and avoiding planting invasive species will help to conserve sensitive plant habitats.

PPL Electric will comply with this recommendation. PPL Electric will continue consultation with USFWS, DCNR and PGC to avoid impacts to species of concern and will obtain all required approvals, clearances, and permits prior to construction.

²¹ USFWS PNDI Project No. 2010-0356, February 4, 2010

²² PNDI Search No. 20130611407898, June 11, 2013

Attachment

4

ATTACHMENT 4

REPLACEMENT OF THE HAUTO – SIEGFRIED #1 & #4 69 kV LINE & SIEGFRIED – EAST PALMERTON #1 & #2 69 kV LINE WITH THE SIEGFRIED – HAUTO #1 & #2 138/69 KV TRANSMISSION LINE AND TREICHLERS 138/69 kV TAPS

PPL ELECTRIC DESIGN CRITERIA AND SAFETY PRACTICES

The National Electrical Safety Code (NESC) is a set of rules to safeguard people during the installation, operation, and maintenance of electric power lines. The NESC contains the basic provisions considered necessary for the safety of employees and the public. Although it is not intended as a design specification, its provisions establish minimum design requirements. PPL Electric Utilities Corp. (PPL Electric) has developed design specifications and safety rules which meet or surpass all requirements specified by the NESC.

Engineering Design Criteria and Parameters

The NESC includes loading requirements and clearances for the design, construction, and operation of power lines. The "loads" on conductors and supporting structures are the mechanical forces that develop from the weight of the conductors, the weight of ice on the conductors, plus wind pressure on the conductors and supporting structures. Loading requirements are the loads on the conductors and structures that are anticipated assuming certain ice and wind conditions. Loading requirements always contain "safety factors" to allow for unknown or unanticipated contingencies. The clearances and loading requirements contained in the NESC were developed to ensure public safety and welfare.

PPL Electric transmission line design standards meet or surpass the NESC standards. For example, the relative order of grades of construction for conductors and supporting structures is B, C, and N; Grade B being the highest. According to the NESC standards, construction Grades B, C, or N may be used for transmission lines (except at crossings of railroad tracks and limited access highways where Grade B construction is specified). However, PPL Electric designs all of its transmission lines for Grade B construction. The

use of Grade B design and construction specifies enhancements such as larger-minimum crossarm dimensions, larger-minimum conductor size, and increased safety factors.

Another example is the design parameters utilized to account for ice and wind loadings on the overhead ground wire (OHGW) and power conductors. The NESC standard ice and wind design magnitudes for the PPL Electric territory are 0.5 inch thickness of radial ice combined with four pounds per square foot horizontal wind pressure (equivalent to 40-mile per hour wind velocity). The conductor sags and tensions used in line designs are the result of various ice and wind combinations, depending on the elevation at the line location and line design voltage. The conductor sags and tensions used in the design of all PPL Electric transmission lines are at least 0.5-inch ice combined with eight pounds wind pressure (equivalent to 57 miles per hour wind velocity). This means that PPL Electric lines are designed to operate safely and reliably during inclement weather even more severe than assumed by the NESC. In addition, PPL Electric transmission lines are designed with more clearance to the ground than required by the NESC. The tables below compare PPL Electric and NESC ground clearances for lines of various voltages.

138 kV

Surface Underneath Conductors	Vertical Clearance to Ground	
	NESC Standard	PPL Electric Design
Roads, streets, alleys	21 feet	30 feet
Other land traversed by vehicles (such as cultivated field, forest, etc.)	21 feet	30 feet
Spaces accessible to pedestrians only	17 feet	30 feet
Railroad tracks	29 feet	35 feet

230 kV

Surface Underneath Conductors	Vertical Clearance to Ground	
	NESC Standard	PPL Electric Design
Roads, streets, alleys	23 feet	32 feet
Other land traversed by vehicles (such as cultivated field, forest, etc.)	23 feet	32 feet
Spaces accessible to pedestrians only	19 feet	32 feet
Railroad tracks	31 feet	36 feet

500 kV

Surface Underneath Conductors	Vertical Clearance to Ground	
	NESC Standard	PPL Electric Design
Roads, streets, alleys	28 feet	53 feet
Other land traversed by vehicles (such as cultivated field, forest, etc.)	28 feet	53 feet
Spaces accessible to pedestrians only	24 feet	53 feet
Railroad tracks	38 feet	53 feet

A relay protection system is used to protect the public safety and welfare as well as equipment and the transmission system. Relay protection is installed for all transmission lines to automatically de-energize the line in the unlikely event that the line or supporting structure fails and the line contacts the ground.

Periodic Maintenance Program on All Transmission Lines

To ensure continued public safety and integrity of service, a periodic maintenance and inspection program is implemented for every transmission line. The program is administered through the use of helicopter patrols, with supplemental foot and structure climbing patrols. A number of helicopter patrols are performed on all lines annually. The two-man helicopter crew flies parallel, to the left, and above the line so that the observer can look for signs of line damage or deterioration and observe clearances between vegetation and conductors. The observations are included in a report that is forwarded to the appropriate department for corrective action.

Foot and structure climbing patrol programs for a transmission line begin approximately three to five years after the line is energized, unless a helicopter patrol reports a need for earlier action. The frequency of foot patrols varies from once every year to once every several years depending on line type and age.

An assigned foot patroller checks right-of-way conditions, including access roads, bridges, pole washouts, tower footers, vegetation height and clearance to conductors, pole and tower deterioration and, with the use of binoculars, insulators, and condition of hardware. Identified problems are included in a report that is forwarded to the appropriate department for corrective action.

A scheduled line outage is required to perform an overhead patrol because of “hands-on” inspection of hardware. Overhead patrols are conducted on a schedule determined by line age, operating record, and observed general condition. The necessary repairs are also done during the inspection outage.

Personnel Safety Rules

The following are a few of the PPL Electric safety rules that demonstrate the Company's concern for employee safety:

- Work procedures have been developed to allow work to be performed on energized facilities in a safe manner. When lines or apparatus are removed from service to be worked on, the Energy Control Process system is applied. This system provides that a red tag must be physically placed on the control handle of the de-energized equipment. The red tag may be removed only after proper authorization to energize the equipment. Various other tags are used for limited operations and informational purposes. Employees will not apply or remove a tag or change the status of tagged equipment unless authorized.
- Temporary safety grounds are used on de-energized facilities for employee safety during maintenance, construction, or rebuild work. Safety grounds are wires connecting the de-energized facility to an electrical ground. If the facility should be energized, the safety grounds will divert the current directly to ground and reduce the likelihood of personal injury. The conductor size and attachment clamps of temporary safety grounds must be capable of conducting anticipated fault currents. Rubber gloves, rubber sleeves, and additional rubber protective equipment are used as required when applying or removing temporary safety grounds to or from the lines or apparatus to be grounded. An approved nonconductive working stick of sufficient length to allow workers to maintain the following required minimum clearances is used to test that the line has been de-energized and to apply temporary safety grounds:

<u>Voltage-kV</u>	<u>Minimum Clearance</u>
138	3'-7"
230	5'-3"
500	11'-3"

Before applying grounds, a test is done to confirm that the line is de-energized. The voltage test device is checked before and after use to assure reliability. When ground pins are used to establish proper ground points, they are driven to a depth of not less than four feet as near vertical as possible.

- Poles or structures are inspected and examined for structural integrity before climbing. If there is any reason to believe that a pole is unsafe, it is stabilized before work is performed. Appropriate safety gear in the form of body belts, safety straps, hard hats, gloves, etc., is worn by linemen during line work activity.

Attachment

5

ATTACHMENT 5

**REPLACEMENT OF THE HAUTO – SIEGFRIED #1 & #4 69 kV LINE &
SIEGFRIED – EAST PALMERTON #1 & #2 69 kV LINE WITH THE
SIEGFRIED – HAUTO #1 & #2 138/69 KV TRANSMISSION LINE AND
TREICHLERS 138/69 kV TAPS**

PPL ELECTRIC MAGNETIC FIELD MANAGEMENT PROGRAM



**MAGNETIC
FIELD
MANAGEMENT**
**PPL Electric Utilities
Corporation**

DECEMBER 2004

TABLE OF CONTENTS

INTRODUCTION	1
DEVELOPMENT OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM.....	6
VARIABLES THAT AFFECT MAGNETIC FIELDS	6
Effect of Phase Current on Magnetic Fields	6
Effect of Conductor Configuration on Magnetic Fields	7
Effect of Distance from the Magnetic Field Source	7
SUMMARY OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM.....	8
MAGNETIC FIELD MANAGEMENT PROGRAM GUIDELINES	9
Overhead Lines	9
New or Rebuilt Transmission Lines	9
Reconductoring or Adding Additional Circuits to Existing Transmission Lines	14
Distribution Lines	14
Underground Transmission Lines.....	15
CHARTS.....	16

INTRODUCTION

At PPL Electric Utilities Corp. (PPL EU), magnetic field management means investigating and implementing methods at low or no cost to reduce magnetic fields in new or rebuilt transmission and distribution lines. This document explains PPL EU's Magnetic Field Management Program, which is part of PPL EU's larger Electric and Magnetic Fields (EMF) policy.

PPL EU's View

Some people are worried that electric and magnetic fields are harming their health. Others think the scientific research does not show a problem at all, and still others believe there's just too much scientific uncertainty to draw any conclusions.

Here's what we do know now. Various panels of scientists that have reviewed the EMF research generally have drawn two main conclusions. First, the large body of evidence does not demonstrate that EMF are harmful. Second, additional research is recommended to explore questions raised in some studies.

Given these conclusions, PPL EU is taking a reasoned approach in responding to the EMF issue. PPL EU's approach to the EMF issue consists of five elements:

- Providing EMF information to customers and employees
- Providing magnetic field measurements
- Establishing and implementing a magnetic field management program to reduce magnetic fields in new or rebuilt facilities when it can be done at no, or low, cost
- Integrating EMF in the public involvement process that PPL EU undertakes in the siting of transmission lines
- Have supported additional research

EMF Are All Around Us

Electric and magnetic fields occur in nature and in all living things. The earth, for instance, has a magnetic field, which makes the needle on a compass point north.

Electric fields and magnetic fields of a different type also surround every wire that carries electricity. In everyday life, these EMF arise from several basic sources, including power lines, electrical appliances, home and building wiring, other utility lines and cables, and currents flowing on water pipes. Though they often occur together, EMF are made up of two separate components:

Electric Fields

Electric fields are produced by the voltage—or electrical pressure—on a wire. The higher the voltage, the higher the electric field. As long as a wire is energized—has voltage present—an electric field is present (see Figure 1). In other words, an appliance, or an electric power line, doesn't actually have to be turned on to create an electric field. It just has to be plugged in. Electric fields diminish with distance and can be blocked or partially shielded by objects such as trees and houses.

Magnetic Fields

Magnetic fields are created by the current or flow of electricity through a wire. Generally speaking, the higher the current, the higher the magnetic field. Because they only occur when current is flowing, magnetic fields are present only when the power is turned on (see Figure 1). Magnetic fields also diminish with distance, but—unlike electric fields—are not blocked by common objects. In recent years, public and scientific interest has turned toward the magnetic field component of EMF because of some scientific studies regarding these fields.

Figure 1

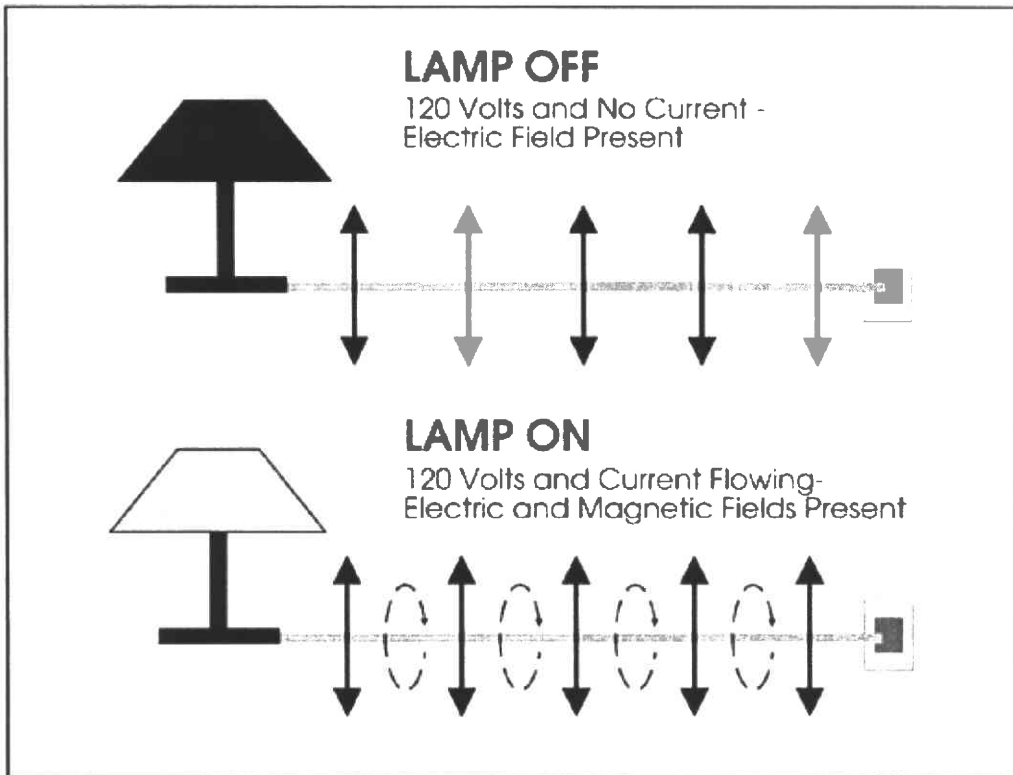


Figure 2









Magnetic field strengths decrease with distance Magnetic fields are measured in milligauss		Source: "EMF In Your Environment", U.S. Environmental Protection Agency 1992		
		At 6 inches	At 1 foot	At 2 feet
Clothes dryer		2 to 10	* to 3	*
Microwave oven		100 to 300	1 to 200	1 to 30
Toaster		5 to 20	* to 7	*
Power drill		100 to 200	20 to 40	3 to 6
Can opener		500 to 1500	40 to 300	3 to 30
Mixer		30 to 600	5 to 100	* to 10
Hair dryer		1 to 700	* to 70	* to 10
Color television		Data not available	* to 20	* to 8

FIGURE 2 * The magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

Measuring Magnetic Fields

Magnetic fields usually are measured in a unit called a milligauss. Magnetic field levels found in the living areas of homes typically range from less than 1 milligauss to about 4 milligauss according to the U.S. Environmental Protection Agency. They can be higher in some cases. The levels next to appliances can exceed 1,000 milligauss (1 gauss). Figures 2 and 3 show how the strength of the field falls off as you move away from the source, just as the heat of a campfire grows weaker as you walk away from it. For overhead power lines, the strength of the magnetic fields is dependent upon a number of factors that will be explained later. Those factors produce a magnetic field that drops off rapidly as you move away from the power line.

Figure 3

Sample Magnetic Field Levels in Milligauss				
Type of Overhead Power Line	Distance from the line			
	Under the line	50 ft.	100 ft.	200 ft.
220 kV and 500 kV	5-400	5-250	1-75	0.5-20
69 kV and 138 kV	3-80	0.5-2.5	0.1-10	0.1-3
12 kV and below	0.4-20	0.1-1	-	-

The magnetic field values provided in this table represent a general range of values associated with the types of overhead power lines listed and are provided for illustration. There will be circumstances in which there will be magnetic field levels above or below the range of values provided due to variations in such factors as height of the wires, current flow and so on.

DEVELOPMENT OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM

One element of our response to EMF concerns expressed by some of our customers is PPL EU's Magnetic Field Management Program. The program was initiated in March 1991 because PPL EU believes it makes good sense, as a matter of policy, to respond to the concerns expressed by some of our customers and to reduce magnetic fields in new and rebuilt facilities where it can be done with either no-cost or low-cost design changes.

This document updates the original program which has been revised several times since 1991. These guidelines were developed by PPL EU's EMF Working Group.

VARIABLES THAT AFFECT MAGNETIC FIELDS

Magnetic fields from transmission and distribution lines are a function of a number of design variables. The following parameters affect the magnetic field levels produced by transmission and distribution lines:

- Current
- Height of conductors above ground
- Configuration of conductors
- Distance from the line

EFFECT OF PHASE CURRENT ON MAGNETIC FIELDS

At power frequencies (i.e., 60 hertz), the magnetic field level is a function of the current or flow of electricity through a wire. Keeping all other parameters the same, the magnetic field is proportional to the current. Hence, if the current increases by 25 percent, the resulting magnetic field level will increase by 25 percent.

The overall load current on any line varies with the demand for power. It's usually highest during daytime hours and lowest at night. There also are weekly, monthly, seasonal and yearly variations.

The difference in the currents between each phase in a multiphase line also can affect the magnetic field. This difference is called phase unbalance. For a constant load, a statistical analysis of this phase unbalance can be made to determine its effect on the magnetic field. Close to the line, there is very little effect. However, the phase unbalance slows the rate at which the magnetic field decreases with distance from the line.

EFFECT OF CONDUCTOR CONFIGURATION ON MAGNETIC FIELDS

In the transmission and distribution of power, utilities like PPL EU presently use both three-phase and single-phase lines. Each phase on a three-phase power line has either a single conductor or a bundle of two or more conductors. In a three-phase system, the ground-level magnetic field is a result of the fields produced by the currents in each of the phases. Placing the three phases as close together as possible (compaction) creates some field cancellation, and the ground-level magnetic field is reduced. However, appropriate phase separation is required for the reliable operation of the line. In addition, the arrangement of the phases can create some; field cancellation and reduction of the ground-level magnetic field.

EFFECT OF DISTANCE FROM THE MAGNETIC FIELD SOURCE

Magnetic field strength diminishes with the vertical and lateral distances from the magnetic field source. Increasing the height of the conductors above ground is useful for magnetic field reduction at ground level, but may result in increased structure costs and increased aesthetic impact of the structures. Another possible method of increasing the distance to the magnetic field source is to increase the right-of-way requirements. By keeping buildings off increased rights of way, thereby requiring the public to live and work further away from lines, exposure to magnetic fields produced by the lines can be reduced. Increases in right of way are not always practical and may increase costs significantly, however.

SUMMARY OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM

Under its Magnetic Field Management Program, PPL EU has changed the way it builds and rebuilds some of its transmission and distribution lines. These design changes reduce magnetic field levels (assuming balanced circuit loadings and phase currents) by up to 69 percent in most of the company's new transmission lines. These guidelines now are being applied to new and reconstructed transmission facilities, based on this program.

The distribution component of the program focuses on 12 kV lines, the company's standard distribution voltage. It concentrates on the three-phase, primary 12 kV lines, since these are the most heavily loaded facilities and often are located in densely populated areas. The guidelines in this program are being applied to these three-phase, primary 12 kV lines.

A maximum 3-5 percent change in estimated cost was used as the limit for the guidelines since this value is consistent with low cost, is within estimating accuracy and is likely to have little impact on overall line costs.

The magnetic field calculations used in this document for the design of PPL EU's overall magnetic field management plan assume balanced load conditions among the phases and a fixed level of current, not necessarily representative of specific transmission or distribution lines. These levels were calculated using the Electric Power Research Institute's ENVIRO computer program. Under actual operating conditions, the magnetic field levels that result may vary due to such things as actual load per circuit, overall current on each phase conductor and the electrical configuration and operation of each line.

MAGNETIC FIELD MANAGEMENT PROGRAM GUIDELINES

The guidelines for magnetic field management are noted below, with discussion points for each.

OVERHEAD LINES

NEW OR REBUILT TRANSMISSION LINES

1. **Balance transmission circuit loads and phase currents as much as possible.**
 - PPL EU should continue to make every effort to balance loadings between the two circuits of a double circuit line when planning new or rebuilt facilities to maximize the effects of reverse phasing.
 - PPL EU should continue the practice of balancing single-phase loads across the three phases of the distribution system. (Unbalanced phase currents on the distribution system are reflected through to the transmission system.)
 - Unbalanced phase currents result in higher magnetic fields that do not drop off as quickly with distance as do the fields resulting from balanced phase currents.
 - For a 5 percent phase current unbalance, the magnetic field 50 feet from the centerline of a single circuit 138 kV line could be more than twice the value than if the same line had balanced phase circuits.
 - Balanced phase currents on each three-phase distribution circuit also reduce magnetic fields from the distribution circuits themselves. In addition, they reduce magnetic fields on the transmission system from which the distribution system circuits are supplied and connected through substations.
 - Apart from magnetic field considerations, balanced phase currents on each three-phase distribution circuit also reduce line losses and improve the system voltage.

2. Continue with the present practice of using long-span construction as the PPL EU 138/69 kV standard

- Structure designs for short-span and long-span construction are illustrated on Charts I and II, respectively.
 - Short-span design does not significantly reduce magnetic fields when compared to long-span design even though it is more compact than long-span design. Comparison of the magnetic field values from Chart III indicates essentially the same values. Therefore, short-span design should not be used solely to reduce magnetic fields.
 - PPL EU will continue to use long-span construction for 138/69 kV double-circuit lines and for single-circuit/future-double-circuit lines.
 - For single-circuit/future-double-circuit lines, PPL EU will continue to install two conductors on the top positions and one in the middle position as shown in Chart IV.
 - This arrangement minimizes magnetic fields as shown in Chart V by placing the three initial conductors higher on the structure, which increases the ground clearances, and by placing the conductors in a triangular configuration.

3. Compact design structures are not a low-cost alternative and should be used for magnetic field reduction only in special applications.

Chart VI illustrates the compact design structure.

- The compact design increases the initial installation costs by 79 percent when compared to the long-span design but reduces the magnetic field from 9 mG to 3 mG (about 67 percent) at the edge of the 100-foot-wide right of way as shown on Chart III.

4. Reverse phase new or rebuilt double-circuit transmission lines for all voltage levels.

- Reverse phasing was adopted by PPL EU in March 1991 for double-circuit 138/69 kV transmission lines and in April 1992 for all other double circuit transmission lines. Reverse phasing is shown in Chart VII. Reverse phasing will reduce the magnetic fields when the current flow on both circuits is in the same

direction. Calculated values contained here are based on balanced and equal phase currents on both circuits.

- Reverse phasing reduces the magnetic field of a double circuit 138 kV single pole transmission line from 29 mG to 9 mG (about 69 percent) at the edge of the 100-foot-wide right of way as shown on Chart III.
- Reverse phasing reduces the magnetic field of a double circuit 230 kV single pole transmission line from 49 mG to 16 mG (about 67 percent) at the edge of the 150-foot-wide right of way as shown on Chart VIII.
- Reverse phasing reduces the magnetic field of a double-circuit 500 kV single pole transmission line from 37 mG to 21 mG (about 43 percent) at the edge of the 200-foot-wide right of way as shown on Chart IX.
- When new or rebuilt double-circuit lines require tapping existing double-circuit lines, PPL EU will review the existing lines to determine if reverse phasing can be provided at low cost.
- Computer modeling is required to develop the optimum phasing and overall conductor arrangements for lines added to, or rebuilt in, multiple-line corridors.
 - Merely adding a reverse-phase double-circuit line to an existing transmission line corridor or reverse phasing a rebuilt line in the multiple-line corridor will not necessarily produce lower magnetic field levels at the edge of the corridor right of way.
 - The corridor must be computer modeled with all the lines, existing phase conductor locations and currents. Then, magnetic field calculations must be made varying the phase arrangements of the new or reconstructed line to determine the appropriate phasing arrangement.
 - Current flow direction on a line also must be considered. For example, a reverse-phased line should have the current flowing in the same direction on both circuits. If the current flow is in the opposite direction for one circuit, reverse phasing will not produce the lowest magnetic field and another phase arrangement that produces lower fields may need to be utilized.

5. Increase the minimum ground clearance for all new transmission lines.

138/69 kV Transmission Lines

- Increasing the minimum line design ground clearance from 25 feet to 30 feet may add up to about 5 percent to the installed cost of a new double-circuit single pole 138/69 kV line. For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. With long-span reverse-phase design, the magnetic field is reduced from 9 mG to 7 mG (about 22 percent) at the edge of a 100-foot-wide right of way as shown in Chart X.
 - In the actual design of transmission lines to include higher minimum ground clearances, there may be limited segments (such as highway crossings, severe slopes and transmission line crossing locations) where National Electrical Safety Code (NESC) minimum ground clearances may need to be used. The NESC minimum ground clearances are less than the increased ground clearance discussed previously.

230 kV Transmission Lines

- Increasing the minimum line design ground clearances from 27 feet to 32 feet may add up to about 5 percent to the cost of a single-circuit single-pole line (current standard). For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. By increasing the clearances, the magnetic field is reduced from 30 mG to 28 mG (about 7 percent) at the edge of a 150-foot-wide right of way.
- Increasing clearances from 27 feet to 32 feet could theoretically add up to about 2.8 percent to the cost of a double-circuit single-pole line (current standard) and reduce the magnetic field of a reverse-phase line from 16 mG to 15 mG (about 6 percent) at the edge of a 150-foot-wide right of way. Chart XI is a summary of this data.
- Studies are required for each new 230 kV line to determine optimum structure types, ground clearances, configurations and designs to reduce field levels. Such

studies could include analysis of reduction measures such as additional minimum ground clearances, increasing conductor tensions, using reduced phase spacing (a "Delta" configuration on a single-circuit line), installing the second circuit initially, and/or adding a second set of conductors that are reverse phased and operated in parallel with the first set (bundled/split phase).

500 kV Transmission Lines

- Increasing ground clearances from 33 feet to 53 feet may add up to about 4.5 percent to the cost of a single-circuit "H-frame" line (current standard). For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. By increasing the clearances, the magnetic field is reduced from 42 mG to 35 mG (about 17 percent) at the edge of a 200-foot-wide right of way.
- Increasing ground clearances from 33 feet to 53 feet could theoretically add up to 2.8 percent to the cost of a double-circuit "H-frame" line (current standard) and reduces the magnetic field of a reverse-phase line from 21 mG to 16 mG (about 24 percent) at the edge of a 200-foot-wide right of way. Chart XII is a summary of this data.
- Studies are required for each new 500 kV line to determine optimum structure types, ground clearances, configurations and designs to reduce field levels. Such studies could include analysis of reduction measures such as additional minimum ground clearances, increasing conductor tensions, using reduced-phase spacing (a "Delta" configuration on a single circuit line), installing the second circuit initially, and/or adding a second set of conductors that are reverse phased and operated in parallel with the first set (bundled/split phase).

RECONDUCTORING OR ADDING ADDITIONAL CIRCUITS TO EXISTING TRANSMISSION LINES

When reconductoring or adding additional circuits to existing transmission lines, PPL EU will evaluate low-cost or no-cost options for magnetic field management on a case-by-case basis.

When reconductoring existing transmission lines or adding additional circuits, low-cost alternatives may not exist; however, the following steps will be taken:

- For a single-circuit line, the use of a Delta arrangement or other modifications on the existing structure, with reduced-phase spacing, will be evaluated.
- For double-circuit lines, application of reverse phasing may reduce the magnetic field under the line and within the right of way and will be evaluated.
- For single- and double-circuit lines, evaluate using higher conductor tensions that can increase the minimum line design ground clearance.

DISTRIBUTION LINES

At the 12 kV distribution level, new main three-phase lines will continue to be constructed with five feet of additional ground clearance.

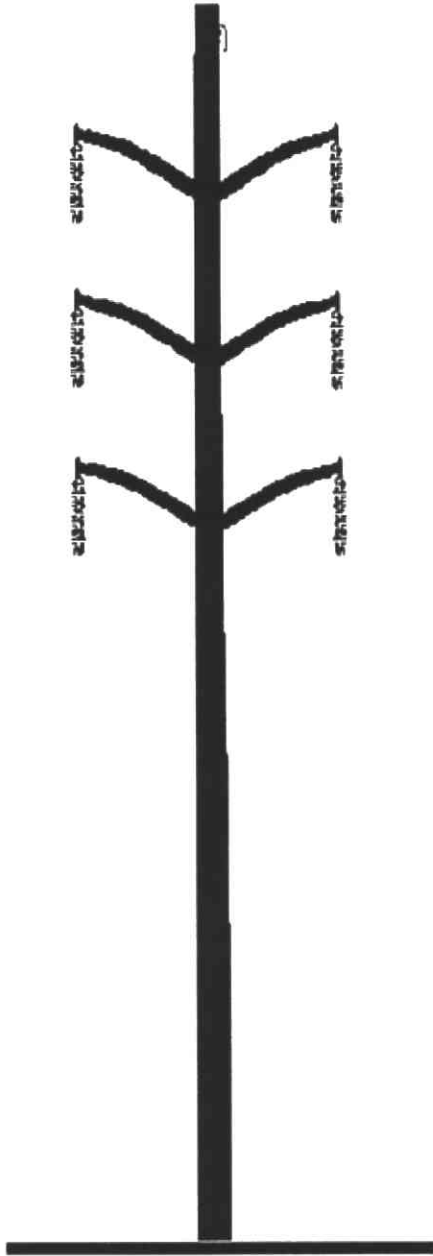
- Main lines are the most heavily loaded sections of a distribution line and therefore have the highest magnetic fields associated with them.
- Increasing the ground clearance by five feet reduces the magnetic field under the line from 14 mG to 11 mG using the standard eight-foot crossarm design. These values are based on increasing pole heights from 45 feet to 50 feet and a typical operating current of 300 amps per phase.
- Chart XIII is a summary of this data. Increasing ground clearance by five feet could theoretically add about 5 percent to the cost of a typical distribution line.

UNDERGROUND TRANSMISSION LINES

Underground transmission lines are required due to environmental or land use factors or restrictions on available clearances, PPL EU will evaluate options for magnetic field management techniques on a case-by-case basis.

- The phase arrangement that produces the lowest field will be determined.
- The depth of burial of the line will be determined considering the cost of excavation and the location of other buried utilities in the area.
- The use of steel pipe ferromagnetic shielding that reduces magnetic fields will be evaluated.

Short-Span Construction



- **More compact design**
- **Should not be used solely to reduce magnetic fields**
- **Typical conductor data:**
 - 1 3/8" HS steel overhead ground wire - 7.3 feet sag
 - 6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 10.0 feet sag
 - Average span - 400 feet

Long-Span Construction Remains PPL EU 138 kV Standard



- Lower cost alternative
- Reduces magnetic fields due to higher structures
- Typical conductor data:
 - 1 3/8" HS steel overhead ground wire - 17.3 feet sag
 - 6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 23.0 feet sag
 - Average span - 600 feet

**138/69 kV REVERSE-PHASE TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 400 AMPERES**

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SHORT SPAN (CHART I)	30
SHORT SPAN (REVERSE PHASE)	8
LONG SPAN (CHART II)	29
LONG SPAN (REVERSE PHASE)	9
COMPACT (CHART VI)	14
COMPACT (REVERSE PHASE)	3

The edge of right of way is 50 feet from the line centerline.
The 400 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 25 feet.
LONG SPAN, SHORT SPAN and COMPACT are double-circuit lines.

Typical Single-Circuit Structure Designs



Top/Middle



Vertical



Top/Middle/Bottom

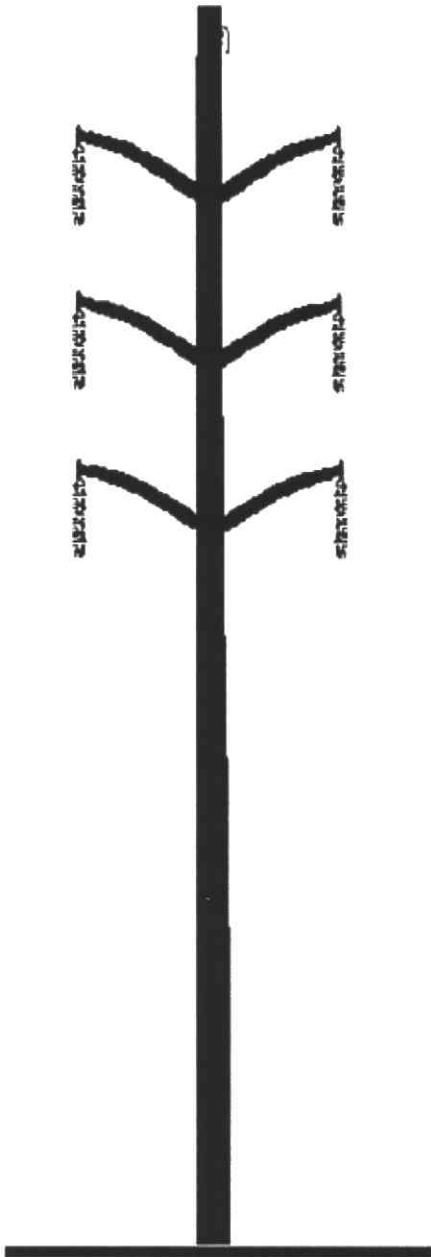
——— initial single circuit
- - - - - future second circuit

**138/69 kV SINGLE CIRCUIT TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 400 AMPERES**

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
TOP/MIDDLE/BOTTOM	20
VERTICAL	17
TOP/MIDDLE	12

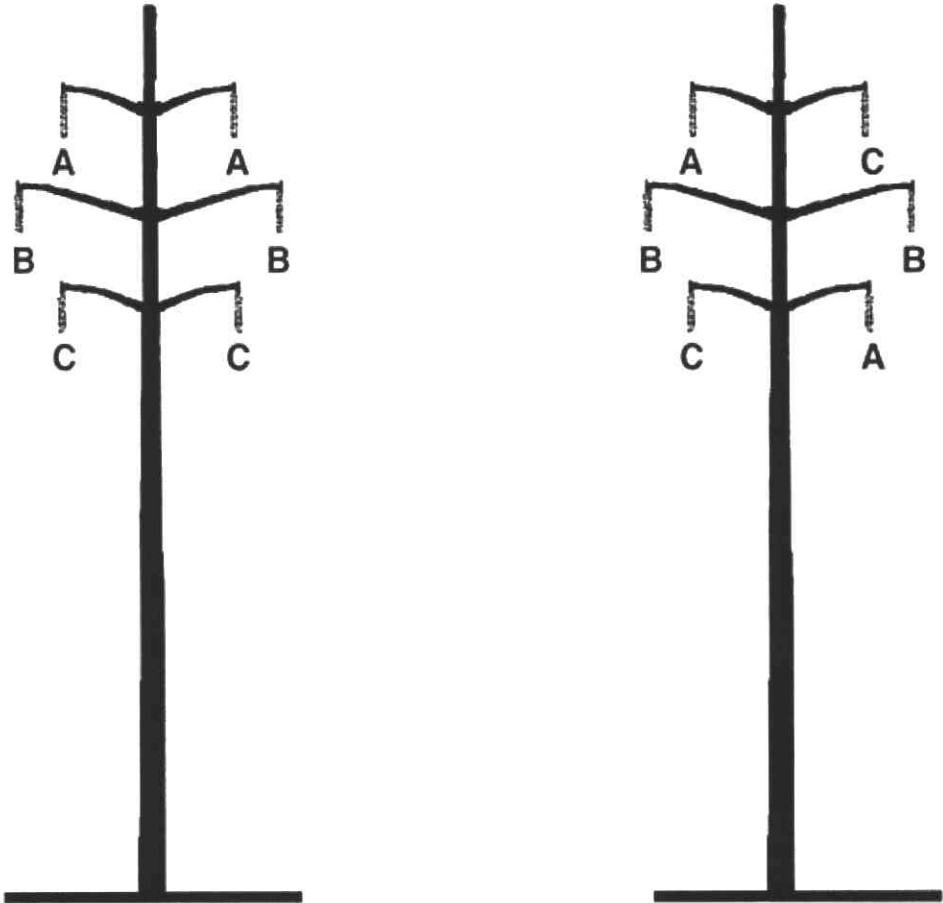
The edge of right of way is 50 feet from the line centerline.
The 400 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 25 feet.

Compact Design Structure



- **Minimize magnetic fields due to compact design**
- **Not a low-cost alternative**
- **Typical conductor data:**
 - 1 3/8" HS steel overhead ground wire - 9.0 feet sag
 - 6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 9.0 feet sag
 - Average span - 300 feet

Reverse Phasing of Double-Circuit Transmission Lines



From: → → → → To:

Reverse phasing also can be one of the following phase arrangements:

- | | | | | | | | | | | | | | |
|---|---|----|---|---|----|---|---|----|---|---|----|---|---|
| A | B | | B | A | | B | C | | C | A | | C | B |
| C | C | or | C | C | or | A | A | or | B | B | or | A | A |
| B | A | | A | B | | C | B | | A | C | | B | C |

**230 kV REVERSE-PHASE TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 800 AMPERES**

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
DOUBLE CIRCUIT POLE	49
DOUBLE CIRCUIT POLE (REVERSE-PHASE)	16

The edge of right of way is 75 feet from the line centerline.
The 800 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 27 feet.

**500 kV REVERSE-PHASE TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 1100 AMPERES**

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
DOUBLE CIRCUIT POLE	37
DOUBLE CIRCUIT POLE (REVERSE PHASE)	21

The edge of right of way is 100 feet from the line centerline.
The 1,100 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 33 feet.

**INCREASED 138/69 kV MINIMUM GROUND CLEARANCE
CALCULATED MAGNETIC FIELDS AT 400 AMPERES**

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT TOP/MIDDLE	25	12
SINGLE CIRCUIT TOP/MIDDLE	30	10
LONG SPAN	25	29
LONG SPAN	30	26
LONG SPAN (REVERSE PHASE)	25	9
LONG SPAN (REVERSE PHASE)	30	7

The edge of right of way is 50 feet from the line centerline.
The 400 ampere phase current is balanced between phases.

**INCREASED 230 kV MINIMUM GROUND CLEARANCE
CALCULATED MAGNETIC FIELDS AT 800 AMPERES**

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT TOP/MIDDLE	27	30
SINGLE CIRCUIT TOP/MIDDLE	32	28
DOUBLE CIRCUIT POLE	27	49
DOUBLE CIRCUIT POLE	32	46
DOUBLE CIRCUIT POLE (REVERSE PHASE)	27	16
DOUBLE CIRCUIT POLE (REVERSE PHASE)	32	15

The edge of right of way is 75 feet from the line centerline.
The 800 ampere phase current is balanced between phases.

**INCREASED 500 kV MINIMUM GROUND CLEARANCE
CALCULATED MAGNETIC FIELDS AT 1,100 AMPERES**

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT "H" STRUCTURE	33	42
SINGLE CIRCUIT "H" STRUCTURE	53	35
DOUBLE CIRCUIT POLE	33	37
DOUBLE CIRCUIT POLE	53	31
DOUBLE CIRCUIT POLE (REVERSE PHASE)	33	21
DOUBLE CIRCUIT POLE (REVERSE PHASE)	53	16

The edge of right of way is 100 feet from the line centerline.
The 1,100 ampere phase current is balanced between phases.

**12 kV DISTRIBUTION LINES
CALCULATED MAGNETIC FIELDS AT 300 AMPERES**

TYPE CONSTRUCTION	POLE HEIGHT FEET	MAGNETIC FIELD IN MILLIGAUSS*	
		AT CENTERLINE	AT 30 FEET FROM CENTERLINE
STANDARD CROSSARM	45	14	7
STANDARD CROSSARM	50	11	6

* Field level under the line at mid-span based on 300 amps, balanced loading, one meter above ground level.

Attachment

6

ATTACHMENT 6

**REPLACEMENT OF THE HAUTO – SIEGFRIED #1 & #4 69 kV LINE &
SIEGFRIED – EAST PALMERTON #1 & #2 69 kV LINE WITH THE
SIEGFRIED – HAUTO #1 & #2 138/69 KV TRANSMISSION LINE AND
TREICHLERS 138/69 kV TAPS**

LIST OF OWNERS OF PROPERTY WITHIN THE RIGHT-OF-WAY

<u>Property Owner/Address</u>	<u>Parcel Number</u>
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	1
Pennsylvania Lines LLC c/o Norfolk Southern Railway Com 110 Franklin Road SE Roanoke, VA 24042 0028	2
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	3
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	4
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	5
Lehigh County 17 S 7th Street Allentown, PA 18101-2400	6
Buy-N-Sell Houses Inc. 1513 Russett Road Orefield, PA 18069-9013	7
Timothy D & Debra K Beil PO Box 57 Laurys Station, PA 18059	8

Kenneth D & Marlene A Gilbert 5019 Egypt Road Coplay, PA 18037-2660	9
Kenneth D & Marlene A Gilbert 5019 Egypt Road Coplay, PA 18037-2660	10
Donald C Newhard et al 5124 Mulberry Street Coplay, PA 18037-2530	11
Lamar & Carolyn E Broadhead 5441 Ledge Road Slatington, PA 18080-4155	12
Barbara J Kintz 4827 N Cypress Road Walnutport, PA 18088	13
Alan R & Tammy Lee Danner 5424 Ledge Road Slatington, PA 18080-4154	14
Matthew D Fairchild 201 Cherry Street Slatington, PA 18080-2005	15
Charles David & Linda S Lynn 5448 Ledge Road Slatington, PA 18080-4154	16
Charles D & Linda S Lynn 5448 Ledge Road Slatington, PA 18080-4154	17
Janet Louise Engleman 1560 Rising Sun Road Slatington, PA 18080-4107	18
Dale E Remaley et al Shaw Landing Condos 1855 Rising Sun Road Slatington, PA 18080-4114	19
Dale E Remaley et al Shaw Landing Condos 1855 Rising Sun Road Slatington, PA 18080-4114	20

Dale E Remaley et al Shaw Landing Condos 1855 Rising Sun Road Slatington, PA 18080-4114	21
John J Jr & Dorothy E Horwith 1806 Rockdale Road Slatington, PA 18080-3943	22
Kevin M Remaley 1855 Rising Sun Road Slatington, PA 18080-4114	23
Don M & Maxine Krapf Yurconic c/o Mary Yurconic 5577 Riverview Road Slatington, PA 18080-4102	24
John J Jr & Dorothy E Horwith 1806 Rockdale Road Slatington, PA 18080-3943	25
Barry D & Rose C Miller 1975 Rockdale Road Slatington, PA 18080-3946	26
Reema, Inc. 6476 Overlook Road Orefield, PA 18069-8928	27
Reema, Inc. 6476 Overlook Road Orefield, PA 18069-8928	28
Joseph & Naziha Elias 6476 Overlook Road Orefield, PA 18069-8928	29
Joseph & Naziha Elias 6476 Overlook Road Orefield, PA 18069-8928	30
Spotlot Land Development Company Inc. 3312 7th Street Whitehall, PA 18052-3443	31
Jonathan & Lyndsie Hesener 4534 Springfield Drive Coplay, PA 18037-2400	32

Lawrence A & Ann T Mazziotta 6339 Riverview Road Slatington, PA 18080-3926	33
Thomas R & Maureen T Gyory 2075 Red Hill Road Slatington, PA 18080-3934	34
Thomas R & Maureen T Gyory 2075 Red Hill Road Slatington, PA 18080-3934	35
Thomas R & Maureen T Gyory 2075 Red Hill Road Slatington, PA 18080-3934	36
Kenneth O & Rosanna Y Deitrick 6178 Riverview Road Slatington, PA 18080-3921	37
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	38
Ralph G Juchheim 2132 Ranch Road Slatington, PA 18080-3929	39
Richard P & Elaine G Keim Trust Richard P & Elaine G Keim Trustee 735 Wayne Circle Emmaus, PA 18049-2132	40
Gene R & Sandra Badman 2234 Ranch Road Slatington, PA 18080-3931	41
Melissa L Neff 2246 Ranch Road Slatington, PA 18080-3931	42
Luvera Vincent L & Linda 2233 Ranch Road Slatington, PA 18080-3932	43
Beverly J Evans 2320 High Hill Road Slatington, PA 18080-3358	44

Bonnie L Yenser-Colver 2646 High Hill Road Slatington, PA 18080-3363	45
Bonnie L Yenser-Colver 2646 High Hill Road Slatington, PA 18080-3363	46
John P & Dixie D Gross 4140 Hilldale Road Slatington, PA 18080-3733	47
Sean C & Samantha M Handwerk 6597 Walnut Street Slatington, PA 18080	48
Howard E Jr & Margaret E Jessup 6550 Walnut Street Slatington, PA 18080-3315	49
Marcia & Dag Boyesen 35 Ruen Road Kempton, PA 19529	50
Michael G & E P Detweiler Mutarelli 2662 Shady Nook Road Slatington, PA 18080-3331	51
Michael B & Kimberly A Dalessandro 2830 Shady Nook Road Slatington, PA 18080-3333	52
Michael B & Kimberly A Dalessandro 2830 Shady Nook Road Slatington, PA 18080-3333	53
Allen T & Bonita L Foulk 2663 Avery Road Slatington, PA 18080-3340	54
Guy L & Ruth J Schmick 2917 Avery Road Slatington, PA 18080-3340	55
Robert J & Nina Harwi 7239 PA Route 873 Slatington, PA 18080-3401	56

Robert J & Nina Harwi 7239 PA Route 873 Slatington, PA 18080-3401	57
Robert J & Nina Harwi 7239 PA Route 873 Slatington, PA 18080-3401	58
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	59
Kevin S & Donna L Schmoyer 7264 PA Route 873 Slatington, PA 18080-3402	60
Union Cemetery Association c/o James Evans 813 Williams Avenue Walnutport, PA 18088-1145	61
Kevin S & Donna L Schmoyer 7264 PA Route 873 Slatington, PA 18080-3402	62
Kevin S & Donna L Schmoyer 7264 PA Route 873 Slatington, PA 18080-3402	63
Sunset Farm Development Group 3343 Friedens Road Slatington, PA 18080-3806	64
Jamie J & Lora A Steffie 3255 Friedens Road Slatington, PA 18080-3804	65
Allen C & Ruth L Gruber 3012 Beddall Street Slatington, PA 18080-1623	66
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	67

George S Jr & Jean Carrol Boyko 3888 S Main Street Slatington, PA 18080-3771	68
Joanne M Maher 7640 Williamstown Lane Slatington, PA 18080-3446	69
Lanny R & Suzanne D Lewis PO Box 184 Slatedale, PA 18079-0184	70
Ruthann E Stewart 3159 Main Street Slatington, PA 18080-3429	71
Sunset Farm Development Group 3343 Friedens Road Slatington, PA 18080-3806	72
Stephen Frano 2763 Cemetery Street Slatington, PA 18080-2110	73
Michael LaSalla 3250 Main Street Slatington, PA 18080-3428	74
Thomas Paul Jr & Denise R Papay 4145 Friedens Road Slatington, PA 18080-3810	75
Thomas Paul Jr & Denise R Papay 4145 Friedens Road Slatington, PA 18080-3810	76
Thomas Paul Jr & Denise R Papay 4145 Friedens Road Slatington, PA 18080-3810	77
Washington Township 7951 Center Street Emerald, PA 18080	78
Edwin L Ziegler 138 N Walnut Street Slatington, PA 18080-1548	79

Edwin L Ziegler 138 N Walnut Street Slatington, PA 18080-1548	80
Washington Township 7951 Center Street Emerald, PA 18080	81
Garrett R & Karen B Kreglow 8126 Center Street Slatington, PA 18080-3436	82
Marion I Redline Irrevocable Trust Gary E Redline & Linda A Rex Trustee 3251 E Grant Street Slatington, PA 18080-3439	83
Terry Lee & Sherri L Bowman 8125 Rextown Road Slatington, PA 18080-3465	84
Jeffrey A & Jane L Kunkle 8523 Rextown Road Slatington, PA 18080-3504	85
Larry J & Tammy L Zangari 8216 Rextown Road Slatington, PA 18080-3462	86
Dustin W & Earlene S Bosga Smyth 3435 E Grant Street Slatington, PA 18080-3417	87
Charles S & Maureen P Fleischmann 8362 Rextown Road Slatington, PA 18080-3462	88
Tina M & Thomas R Sargent 3447 E Grant Street Slatington, PA 18080-3417	89
Carl P Fritchey PO Box 55 Slatedale, PA 18079-0055	90
Carl P Fritchey PO Box 55 Slatedale, PA 18079-0055	91

PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	92
Linda K Blose PO Box 7 Slatedale, PA 18079-0007	93
Ronald S & Annette F Diehl 8459 Deer Road Slatington, PA 18080-3555	94
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	95
Linda K Blose PO Box 7 Slatedale, PA 18079-0007	96
Robert & Denise Pierce 8733 Brown Street Slatington, PA 18080-3565	97
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	98
Keith A Horn 8761 Brown Street Slatington, PA 18080-3565	99
David F & Kathleen J Wanamaker 8951 Deerview Lane Slatington, PA 18080-3559	100
Lehigh County 17 S 7th Street Allentown, PA 18101-2400	101
Pennsylvania Lines LLC c/o Norfolk Southern Railway Company 110 Franklin Rd SE Roanoke, VA 24042-0028	102

Pennsylvania Lines LLC c/o Norfolk Southern Railway Company 110 Franklin Rd SE Roanoke, VA 24042-0028	103
Three Mile Boating Association Inc. c/o William Whymeyer 4587 Three Mile Lane Walnutport, PA 18088	104
Pennsylvania Lines LLC c/o Norfolk Southern Railway Company 110 Franklin Rd SE Roanoke, VA 24042-0028	105
Nancy Ann & Frank Geseck 157 Riverview Drive Walnutport, PA 18088 9658	106
Glenn L Williams Revocable Trust et al 166 Riverview Drive Walnutport, PA 18088 9658	107
Stanley & Grace Knappenberger 217 New Street Walnutport, PA 18088	108
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	109
PPL Electric Utilities c/o PPL Real Estate Taxes Gentw2 2 North 9th Street Allentown, PA 18101	110

Attachment

7

ATTACHMENT 7

**REPLACEMENT OF THE HAUTO – SIEGFRIED #1 & #4 69 kV LINE &
SIEGFRIED – EAST PALMERTON #1 & #2 69 kV LINE WITH THE
SIEGFRIED – HAUTO #1 & #2 138/69 KV TRANSMISSION LINE AND
TREICHLERS 138/69 kV TAPS**

**LIST OF INVOLVED GOVERNMENTAL AGENCIES, MUNICIPALITIES AND
OTHER PUBLIC ENTITIES RECEIVING APPLICATIONS**

1. Pennsylvania Historical and Museum Commission
Bureau for Historic Preservation
Commonwealth Keystone Building, Second Floor
400 North Street
Harrisburg, PA 17120-0053
Attn: Mr. Douglas C. McLearn, Chief

2. Pennsylvania Department of Transportation
Honorable Barry Schoch, P.E., Secretary
c/o Office of Chief Counsel
Commonwealth Keystone Building
400 North Street, 9th Floor
Harrisburg, PA 17120
Attn: William J. Cressler

3. Department of Environmental Protection
P.O. Box 2063
Market Street State Office Building
Harrisburg, PA 17105-2063
Attn: Office of Field Operations

4. Lehigh Valley Planning Commission
961 Marcon Boulevard - Suite 310
Allentown, PA 18109
Attn: Mr. Michael Kaiser, AICP

5. Lehigh County Board of Commissioners
17 South Seventh Street
Allentown, PA 18101-2400
Attn: Mr. Brad Osborne, Chairman

6. North Whitehall Township Planning Commission
3256 Levans Road
Coplay, PA 18037
Attn: Mr. Jerry J. Joseph, Board Representative

7. North Whitehall Township
3256 Levans Road
Coplay, PA 18037
Attn: Mr. Jeff Bartlett, Township Manager
8. Washington Township Planning Commission
7951 Center Street
Slatington, PA 18080
Attn: Mr. Peter Papay, Chairman
9. Washington Township
7951 Center Street
Slatington, PA 18080
Attn: Mr. Josh Friebolin, Township Supervisor Chairman
10. Northampton County Council
Northampton County Courthouse
669 Washington Street
Easton, PA 18042
Attn: Mr. John Cusick, President
12. Allen Township Planning Commission
4714 Indian Trail Road
Northampton, PA 18067
Attn: Mr. William Holmes, Chairman
13. Allen Township
4714 Indian Trail Road
Northampton, PA 18067
Attn: Ms. Ilene Eckhart, Township Manager
14. Lehigh Township
1069 Municipal Road
Walnutport, PA 18088
Attn: Alice Rehrig, Township Manager
15. Lehigh Township Planning Commission
1069 Municipal Road
Walnutport, PA 18088
Attn: David Shulman, Chairman