Before the
Pennsylvania Public Utility Commission

SUSQUEHANNA – HARWOOD 230 kV TRANSMISSION LINE RECONDUCTOR PROJECT

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 reconductor the existing Susquehanna – Harwood #1 and #2 230 kV Transmission Line. Conductor splicing has periodically failed along the existing transmission line, resulting in line outages. PPL Electric intends to reconductor the line in order to resolve these issues.

The Susquehanna – Harwood 230 kV Reconductor Project described herein will require reconductoring approximately 12.8 miles of existing transmission line. This work will include replacing all conductor cable, splices, deadend assemblies and shield wire along the line. In addition, PPL Electric intends to replace or reinforce any deteriorated members of structures found along the length of the line or add members to meet current structural design criteria. Also as part of this Project, one structure of the existing 78 structures will be replaced with a structure of similar height adjacent to the existing structure. The transmission line begins at the PPL Electric Susquehanna 230 kV Switchyard in Conyngham Township, Luzerne County, Pennsylvania and terminates at the Harwood Substation located in Hazle Township, Luzerne County, Pennsylvania. The Project will be contained within the existing PPL Electric right-of-way that traverses portions of Conyngham, Hollenback, Sugarloaf and Hazle Townships, Pennsylvania.

The estimated cost to reconductor the existing Susquehanna – Harwood 230 kV Transmission Line is $8,090,000. Subject to Commission approval, construction is scheduled to begin in May 2012 to support the Project's in-service date of May 2013.

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 Electric Design Criteria and Safety Practices
Attachment 5	Magnetic Field Management at PPL Electric
Attachment 6	List of Owners of Property Within the Proposed Right-of-Way
Attachment 7	List of Involved Governmental Agencies, Municipalities, and Other Public Entities

PPL ELECTRIC UTILITIES SERVICE TERRITORY

ATTACHMENT "1"

SUSQUEHANNA – HARWOOD 230 kV LINE RECONDUCTOR PROJECT

NECESSITY STATEMENT

TABLE OF CONTENTS

LIST OF FIGURES

MAP

ATTACHMENT “1”

SUSQUEHANNA – HARWOOD 230 kV LINE RECONDUCTOR PROJECT

NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric is requesting PUC approval to reconductor the double-circuit Susquehanna – Harwood #1 and #2 230 kV Transmission Line. In conjunction with this Project, PPL Electric will also replace one of the existing shield wires with an Optical Ground Wire (OPGW). One of the 78 structures on this transmission line will require replacement. The new structure will be similar in height to the existing structure and will be constructed adjacent to the existing structure. In addition, PPL Electric will replace any deteriorated members of existing structures, and PPL Electric will add members to existing towers as needed to meet current structural standards.

This transmission line begins at the Susquehanna 230 kV Switchyard located in Conyngham Township and crosses through Hollenback and Sugarloaf Townships before ending at the Harwood 230 – 69 kV Substation in Hazle Township, all within Luzerne County. As explained in detail below, reconductoring of this transmission line is required to maintain system reliability.

The estimated cost of this Project is $8,090,000. Subject to Commission approval, construction is scheduled to begin in August 2012 to support the in-service date of May 2013.

A PPL Electric system map showing the existing transmission facilities with design voltages of 35 kV or greater is included in the Attachment “1” map pocket. This filing addresses only the existing 230 kV system in western Luzerne County.

B. EXISTING SYSTEM

Four 230 kV lines extend from the Harwood 230 - 69 kV Substation—two to the Susquehanna 230 kV Switchyard, one to the East Palmerton 230 - 69 kV Substation, and one to the Siegfried 230 - 69 kV Substation (see Figure 1 below). Electrical power typically flows from the Susquehanna switchyard through the Susquehanna – Harwood #1 and #2 Line to the Harwood Substation, and then to the East Palmerton and Siegfried Substations. All three substations serve local customer load by way of 69 kV lines. The load forecast for summer 2012 indicates that 180 MW of peak load will be served from the Harwood 69 kV Bus, and 96 MW of peak load will be served from the East Palmerton 69 kV Bus.

C. NEED FOR THE SUSQUEHANNA – HARWOOD TRANSMISSION LINE

If the Susquehanna – Harwood #1 and #2 230 kV Line was removed from the system, the Harwood 230 – 69 kV Substation would be supplied by only two 230 kV lines sourced from the East Palmerton and Siegfried 230 – 69 kV Substations. These three substations would form a loop, connected by the Harwood – East Palmerton 230 kV Line, the Siegfried – East Palmerton 230 kV Line, and the Siegfried – Harwood 230 kV Line (see Figure 2 below). Heading northward out of the East Palmerton Substation, the Harwood – East Palmerton Line and the Siegfried – Harwood Line were built using double-circuit construction, as were the Siegfried – East Palmerton and Siegfried – Harwood Lines to the south of the East Palmerton substation. Under normal system conditions, no overloads were seen on PPL Electric's system while using this configuration.

However, under the above scenario, if a double-circuit outage were to occur on the 230 kV lines north of the East Palmerton Substation, the Harwood Substation would lose all of its 230 kV sources. A double-circuit outage between the East Palmerton and Siegfried substations would isolate both the Harwood and East Palmerton Substations from the rest of the 230 kV system. The resulting loss of load from either of these contingencies would be unacceptable, as PPL Electric's Reliability Principles & Practices (RP&P) states that "[it] is a general PPL EU (Electric) practice to avoid load loss for a single event on the 230 and 500 kV systems."

Retaining the Susquehanna – Harwood #1 and #2 Line alleviates this potential RP&P violation. If a double-circuit outage was to occur between the East Palmerton and Harwood Substations, the Harwood Substation would remain in-service because it would still be supplied by the Susquehanna – Harwood #1 and #2 230 kV Line. Similarly, if a double-circuit outage were to occur between the East Palmerton and Siegfried Substations, the Harwood and East Palmerton Substations would remain in-service because they would still be supplied from the Susquehanna Substation. The proposed solution (reconductor each circuit) will not alter the existing functionality of the Susquehanna – Harwood #1 and #2 Line.

In addition, the Susquehanna – Harwood #1 and #2 Line is one segment of an electrical path that connects the generation facilities at the Susquehanna Steam Electric Station and Montour Steam Electric Station with the regional load in the Lehigh Valley and western New Jersey areas. The Line also provides an alternate path for electric power delivery into western New Jersey should the Susquehanna – Stanton – Lackawanna – Blooming Grove – Bushkill 230 kV path be interrupted. Removing the Susquehanna – Harwood #1 and #2 Line would break both of the above mentioned paths and greatly compromise the ability of the 230 kV transmission system to deliver power where it is needed.

Finally, overloads would occur on some PPL Electric 69 kV lines under certain contingencies if the Susquehanna – Harwood #1 and #2 Lines were removed from the system. As modeled in a summer 2012 peak load case, the loss of the

Columbia and Elimsport 230 kV Circuit Breakers at the Montour Switchyard would cause the Berwick – Koons Air Break section of the Hunlock – Berwick 69 kV Line to load to 110.6% of its emergency rating. The loss of the 230 kV circuit breaker at the Columbia 230 – 69 kV Substation would cause the following overloads: the Berwick – Koons Air Break section of the Hunlock – Berwick Line would load to 129.5 % of its emergency rating; the Allied Chemical Tap – Geisinger Tap section of the Sunbury – Columbia 69 kV Line would load to 115.9% of its emergency rating; the Allied Chemical Tap – Point Tap section of the Sunbury – Columbia 69 kV Line would load to 118.5% of its emergency rating; and the Sunbury – Point Tap section of the Sunbury – Columbia line would load to 139.1% of its emergency rating.

Figure 1 illustrates the current electrical system layout while Figure 2 illustrates the electrical system should the Susquehanna – Harwood #1 and #2 Lines be removed from service.

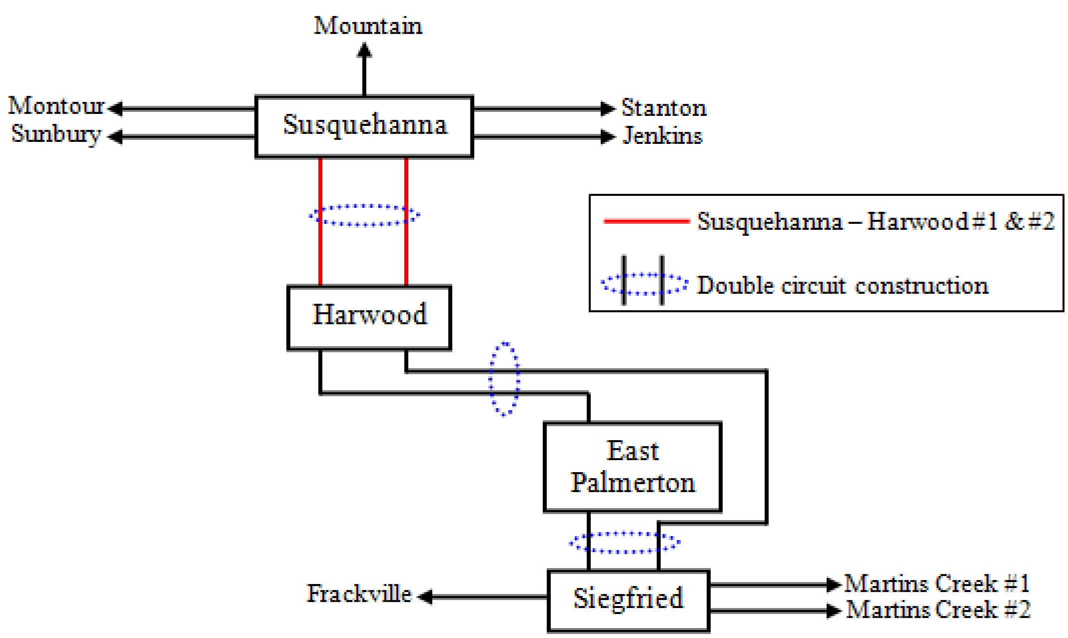


Figure 1 - Current PPL EU 230 kV System Surrounding Harwood Substation

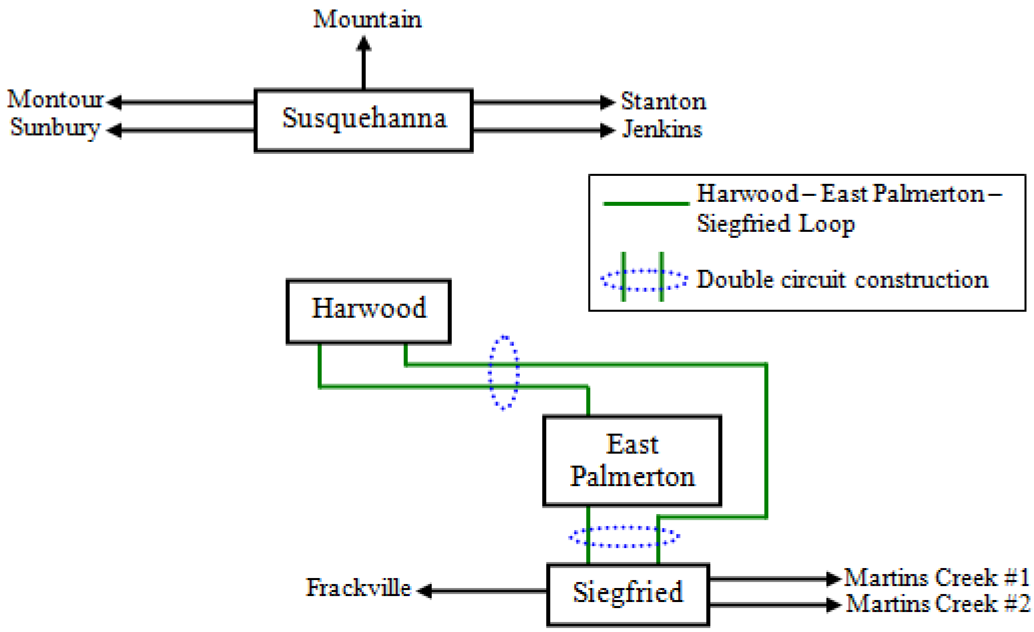


Figure 2 - PPL EU 230 kV System Surrounding Harwood Substation; Susquehanna – Harwood #1 & #2 Lines Removed

D. DEFINITION OF THE PROBLEM

This Project will resolve operational problems PPL Electric has been having with the Susquehanna – Harwood #1 and #2 230 kV Line. The Susquehanna-Harwood Line is equipped with a first generation 1113 kcmil 54/19 stranding Steel Supported Aluminum Conductor (currently referred to as ACSS) that was installed in 1976. This conductor was designed to operate at elevated temperatures, beyond the capabilities of typical Aluminum Conductor Steel Reinforced (ACSR) Cables. The installation of this cable allowed PPL to transfer power at a loading level that normally would have required the use of a larger-sized ACSR cable.

Recently, PPL Electric has been experiencing failures of the compression dead-end connectors and splices on this line. PPL Electric initiated a Root Cause Analysis (RCA) to determine the reason these components were failing. Throughout this process, PPL Electric gathered a significant amount of information on the history of this line, including detailed information on this first generation conductor and hardware used for original installation. To aid in this investigation, PPL Electric sent samples of failed splices and connectors to an independent lab for testing and analysis.

After a complete evaluation of all test results and data; PPL Electric has determined the root cause of the failures on this line to be overheating of dead-end connectors and splices. The overheating was caused by a higher than acceptable resistance between the ACSS conductor (aluminum) and the body of the dead-end or splice (aluminum). The high resistance reading between aluminum components creates heat. As the body of the dead-end gets hotter, the filler compound used breaks down creating a black residue that further increases resistance. As aluminum resistance increases, line current is diverted to flow through the steel supporting core of the ACSS. The steel core is not designed to carry electrical load which causes further heating and leads to failure. This mechanism causes the steel supporting strands of ACSS to neck down and fail, causing the phase conductor to pull out of dead-end or splice and fall to the ground. After this discovery was made, PPL Electric took immediate action to de-rate the Susquehanna-Harwood 230 kV Lines to prevent a reoccurrence of the failures noted above[1].

Several contributing factors were linked to the overheating of these components. The sheer age of the conductor and components, coupled with the installation techniques and component technology available at the time of installation all played a part. It was industry practice to use ACSR components on first generation ACSS conductor. This also included the filler compound that was used for all compression connections. These factors, coupled with the operation of this line as designed, have contributed to high resistance connections that were found between failed components and conductor on this line. The high resistance

[1] It should be noted that due to system loading conditions and reliability concerns it is not acceptable to have the Susquehanna-Harwood #1 & #2 lines de-rated on a permanent basis. Refer to Section "C" of this Attachment for additional details.

between aluminum components creates a hot spot and the beginning stages of component fitting failure.

As part of this Project, PPL Electric proposes to replace the existing shield wire over the Susquehanna-Harwood #2 circuit with OPGW. This existing shield wire dates back to 1967 when this line was originally constructed. PPL Electric plans to replace this shield wire in conjunction with this Project due to its age and years of service. Retaining this wire would leave new 1113 ACSS conductor underneath vintage shield wire. The aged shield wire could fail and drop down into the new ACSS conductor, potentially causing the line to short-circuit and trip out of service. To increase the future reliability of this line, PPL Electric intends to replace this shield wire during the proposed reconductoring. Replacing this wire with OPGW will ensure that the new phase conductors underneath the new OPGW are adequately protected.

E. PROPOSED SOLUTION

In order to resolve the issues discussed above, PPL Electric seeks PUC approval to reconductor the Susquehanna – Harwood #1 and #2 230 kV Line and replace a vintage steel shield wire with OPGW. Replacement of these existing facilities will increase the safety, reliability, and operating flexibility of these lines.

PPL Electric proposes to reconductor the Susquehanna – Harwood Line with new 1113 kcmil 54/19 ACSS; the same conductor that currently exists on this line. PPL Electric has done research on each component it will use to reconductor this line. All appropriate high temperature hardware will be used to support the new 1113 ACSS conductor. The proper specification, application, and installation of each component and conductor will alleviate the operational problems on this line.

F. FUNCTIONAL ALTERNATIVE

Three alternate solutions were investigated for this Project. Each alternative solution included replacement of all the existing dead-end connectors and splices on the Susquehanna-Harwood 230 kV line with new high temperature equivalents.

1. PPL Electric currently stocks a replacement type high-temperature dead-end connector; this connector can be used in emergency situations to replace a dead-end without splicing in additional conductor length. This dead-end is significantly longer than the existing component, allowing it to take the place of the existing dead-end component, and leave enough cable for installation. This alternative was reviewed for use on the entire line.

2. PPL Electric investigated replacement of each component with new dead-end connectors and splices. This alternative would roughly double the number of connections on this line once complete. This alternative was reviewed for use on the entire line.

3. PPL Electric investigated the rebuild of the entire Susquehanna – Harwood 230 kV line. A condition assessment was done to accurately determine the condition of the structures on this line.

PPL Electric rejected all three alternatives and proposes to implement the solution described in Section E for the following reasons:

- Replacement type dead-ends and splices have not been used by industry in a “mass” replacement of an entire line. This option would be a high risk alternative and, in turn, a risk precursor for future problems.
- Replacement of dead-ends and splices with new standard high temperature equivalents would require splicing in new conductor for

each connection. This would roughly double the number of high temperature connections on this line, increasing the risk for future failure.

- The existing conductor on this line is a first generation product and has been in service on PPL Electric's system for 35 years. Since then, the industry has completed significant research and has improved the quality of this type of conductor and its associated components.
- Cleaning the existing conductor would be imperative for the integrity of a new compression connection. The existing conductor has been in service for 35 years and the individual strands are oxidized, which is normal for a conductor that has been exposed to the environment for many years. Each individual strand would need to be properly cleaned prior to installing the new connector. Cleaning the conductor properly would require de-stranding the cable to clean each individual strand, or the use of a new ultrasonic cleaning method that has not been tested or approved on PPL Electric's system. These cleaning methods could be another risk precursor for this line if not done properly.
- PPL had an independent condition assessment performed on the Susquehanna – Harwood 230 kV line. This inspection was initiated after the RCA investigation. The final report determined that the majority of the existing structures on this line are in acceptable condition and that they are not near the end of their useful life expectancy.

ATTACHMENT "2"

SUSQUEHANNA – HARWOOD 230 kV LINE RECONDUCTOR PROJECT

ENGINEERING DESCRIPTION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

MAP

ATTACHMENT "2"

SUSQUEHANNA – HARWOOD 230 kV RECONDUCTOR PROJECT

ENGINEERING DESCRIPTION

A. DESCRIPTION OF THE EXISTING LINE

PPL Electric is requesting PUC approval to reconductor and reinforce the double-circuit Susquehanna – Harwood #1 and #2 230 kV Transmission Line. This line is currently constructed for double-circuit 230 kV operation. Reconductoring the line will not change its operating voltage. The proposed Project begins at PPL's Susquehanna 230 kV Switchyard located in Conyngham Township, then crosses through Hollenback and Sugarloaf Townships before ending at PPL's Harwood 230 – 69 kV Substation in Hazle Township, all in Luzerne County, a distance of approximately 12.8 miles.

The Susquehanna – Harwood #1 & #2 230 kV Transmission Line is located almost entirely on double-circuit steel towers. At each termination point, this Line switches from steel tower construction to steel pole construction. In addition, there is one wood pole structure on this Line that was installed to cross under the Susquehanna – Wescosville 500 kV Line. There are 78 existing structures that form this 12.8 mile line. Of these, 72 structures are double-circuit lattice steel towers, five are double-circuit steel pole structures, and one is a double-circuit wood pole structure. The heights of the structures on this line average 150 feet. A photo of typical, existing Susquehanna – Harwood structures is presented as Figure 1.

The Susquehanna – Harwood 230 kV Line was originally built in 1967 as the single-circuit Harwood 230 kV Tap. When originally constructed, this line was equipped with 1033 kcmil, 54/7 stranding ACSR. In 1976, a second circuit was added to the existing towers utilizing 1113 kcmil, 54/19 stranding ACSS and the existing circuit was reconductored utilizing the same 1113 kcmil, 54/19 stranding ACSS.

B. DESCRIPTION OF THE PROJECT

PPL Electric proposes to reconductor and reinforce the Susquehanna – Harwood #1 & #2 230 kV Transmission Line. The Project will include replacement of all conductor, insulator assemblies, and vintage shield wire on this Line. PPL Electric plans to replace the existing 1113 kcmil, 54/19 ACSS conductor, in kind, with new conductor of the same type, size, and stranding. The vintage shield wire will be replaced with an OPGW. In addition, structural changes, including lattice steel tower reinforcements and a structure replacement, will be completed to meet PPL Electric's structural design requirements for this Line. PPL Electric's structural design criteria for this Line will exceed current National Electric Safety Code ("NESC") standards. The current design criteria for this line has changed since this line was originally constructed. The structural modifications needed for this Project are outlined below.

Tower Modifications:

PPL Electric will be making structural modifications to reinforce select lattice steel towers. These structural modifications will consist of adding or replacing tower members to ensure each tower meets PPL Electric's structural design criteria for this Line. The modifications will be made after a structural loading study has been completed on each tower. These modifications will not affect the height or location of the existing towers. Nor will the modifications materially change the appearance of the towers.

Structure Replacements:

PPL will be replacing one of the existing structures on this line. This structure is being replaced to meet PPL's structural loading criteria for this Line.

Structure to be Replaced

The replacement structure will be composed of four weathering steel poles on concrete foundations. The existing six wood poles (see Figure 2) and associated guys will be removed. The new structure will be of similar height and installed adjacent to the existing structure. The replacement structure will not significantly alter the right-of-way because it will be a simpler structure with only four, instead of six, poles.

Clearances:

The proposed line will be designed to, and will generally exceed, NESC minimum standards. Design specifications and safety rules practiced by PPL Electric are included in Attachment 4. The minimum vertical conductor to ground clearance will be 25.2 feet. This clearance occurs at maximum thermal rating and at maximum ice loading without wind. This is not typical for all spans on this Line, because generally the maximum thermal rating will dictate minimum ground clearance. The 25.2 foot clearance value occurs on one of the longest spans on this Line; due to the length of the span ice loading plays an increased part on sag.

The designed minimum conductor clearances and conductor thermal ratings for the Line are as follow:

TABLE 1

DESIGN MINIMUM VERTICAL CONDUCTOR CLEARANCES FOR 1113 KCMIL, 54/19 STRANDING ACSS*

Condition	Double-Circuit Design Clearance to Ground
Normal load, average weather (60°F ambient & conductor temperature)	34.6 feet
Predicted extreme thermal load (356°F conductor temperature)	25.2 feet
Predicted extreme wind load (25 lbs. wind, 60°F conductor temperature)	43.3 feet
Predicted extreme ice & wind conditions (1-inch ice, 8 lbs. wind, 0°F)	25.3 feet
Predicted extreme ice conditions (1-inch ice, 0 lbs. wind, 0°F)	25.2 feet

*Clearances based on a maximum initial tension of 20,370 lbs. at 1 inch ice, 8 lbs. wind, 0°F and a ruling span of 1,689 feet.

TABLE 2

CONDUCTOR THERMAL RATING
1113 KCMIL 54/19 STRANDING ACSS
356°F (180°C) MAXIMUM CONDUCTOR TEMPERATURE

Condition	Ambient Temperature °C	Wind Speed Knots	Ampacity Amps
Summer Normal	35	0	1,742
Winter Normal	10	0	1,886
Summer Emergency	35	1.5	2,075
Winter Emergency	10	1.5	2,222

C. MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program is summarized in Attachment 5 and is applied to reconstruction and new line projects. In order to lower magnetic field exposures, the program generally prescribes the use of line designs that provide 5 feet higher ground clearances and reverse phasing of new double-circuit lines where it is feasible to do so at low or no cost. The implementation of additional modifications will be considered, provided those modifications can be made at low or no cost.

For this Project, reverse phasing is within the no cost/low cost threshold of the Program. The reconductored line will utilize reverse phasing to aid in minimizing magnetic fields. Since PPL will be utilizing the existing towers and structures on this line, it is not possible to provide additional ground clearance at minimal cost.

D. RIGHT-OF-WAY STATUS

All work will be completed on existing easements or land owned by PPL Electric in fee. No additional right-of-way or other property interest is required. All owners of land subject to rights of way and easements for the transmission line have been notified by letter of the proposed line Project.

Figure 1: Typical Susquehanna-Harwood #1 & #2 230 kV Towers

Figure 2: Structure to be Replaced

ATTACHMENT 3

SUSQUEHANNA – HARWOOD 230 kV RECONDUCTOR PROJECT

ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

LIST OF TABLES

ATTACHMENT 3

SUSQUEHANNA – HARWOOD 230 kV LINE RECONDUCTOR PROJECT

ENVIRONMENTAL ASSESSMENT

A. INTRODUCTION

PPL Electric proposes to reconductor the existing Susquehanna – Harwood 230 kV Transmission Line located in Luzerne County, Pennsylvania in order to prevent potential outages resulting from failed conductor splicing. The existing line is approximately 12.8 miles in length and traverses portions of Conyngham, Hollenback, Sugarloaf and Hazle Townships. The Project involves reconductoring the transmission line, replacing the existing steel shield wire with OPGW, replacing one structure and reinforcing select lattice steel structures within the existing PPL Electric right-of-way.

The proposed Project was reviewed with representatives of Conyngham, Hollenback, Sugarloaf and Hazle Townships and Luzerne County. Neither the townships nor the county has expressed any objection to the Project. A list of involved governmental agencies, municipalities and other public entities is presented in Attachment 7.

B. LAND USE

Because the Project involves primarily reconductoring of an existing transmission line, the proposed Project will not result in changes to existing land use. The Project runs in a northwest to southeast direction through southwestern Luzerne County (Figure 1). The northern terminus of the Project is the Susquehanna 230 kV Switchyard, located east of the Susquehanna River near the intersection of Route 239 and Rifle Range Road in Conyngham Township. The southern terminus is the Harwood Substation, located approximately 2.5 miles west of the City of Hazleton and near the intersection of Forest Road and Commerce Drive in Hazle Township. Townships where Project activities will occur include (from north to south) Conyngham, Hollenback, Sugarloaf and Hazle Townships.

Land use within the project area is dominated by forest land. According to the National Land Cover Dataset (NLCD 2001), approximately 68 percent of the route traverses forest land. The route also crosses areas of steep slopes and rugged terrain including portions of the Buck, Sugarloaf, Nescopeck and Hess Mountains. The southernmost portion of the route traverses several industrial areas, including industrial parks and active or reclaimed mines and mine tailing areas. Farmland is generally located in valleys between ridges along the central and northern portions of the route. According to the NLCD, approximately 22 percent of the route traverses pasture or cropland. Residential development within the Project area is limited and concentrated along major roadways. Industrial, residential and commercial developed areas constitute approximately 6 percent of land use along the route. The remaining percentage of land use (approximately 4 percent) consists of barren land or water.

The proposed Project is located within an existing transmission right-of-way that is currently maintained in accordance with PPL Electric's Vegetation Management Plan. Only minimal tree trimming is anticipated.

The route aerially spans Interstate 81, State Route 93 and State Route 924, as well as several other state or local roads. Other linear features located within the project area include the Norfolk Southern Railroad and other electric transmission lines. Aside from possible traffic controls employed during construction, the proposed Project is not anticipated to result in impacts to any of these linear features. PPL Electric will coordinate with PennDOT, Norfolk Southern and local municipalities regarding road and railroad crossings, as required.

Hazleton Municipal Airport is located approximately 4 miles northeast of the Line. Impacts to air traffic are not expected because, with one exception, PPL Electric is not adding new structures. The one structure being replaced is lower than the surrounding structures because it pulls the Susquehanna – Harwood Line beneath an existing 500 kV Line. PPL Electric will contact the PennDOT Bureau of Aviation and the Federal Aviation Administration to ensure that the proposed Project will not be a hazard to flight operations.

C. CULTURAL RESOURCES

Historic Architectural Assessment

A desktop survey of historic architectural resources within the Susquehanna – Harwood project area was completed. The survey consisted of accessing the Pennsylvania Historical and Museum Commission's (PHMC's) Bureau for Historic Preservation ("BHP") Cultural Resources Geographic Information System ("CRGIS") to review available information on previously recorded historic architectural sites along and in the vicinity of the transmission line alignment.

Six National Register of Historic Places ("NRHP")-eligible historic architectural resources are located within 1 mile of the proposed Project. None of the NRHP-eligible resources are found within the existing Susquehanna – Harwood 230 kV right-of-way. The Union Reformed and Lutheran Church (also known as the Old River Church or River Church) (key number 155049), is the closest NRHP-eligible property to the Susquehanna – Harwood right-of-way, located 0.3 mile west of the Susquehanna Switchyard in Conyngham Township. Other NRHP-eligible resources located between 0.5 and 1 mile of the transmission line corridor include the A.K. Harter Farm (also referred to as Woodcrest) (key number 155052) in Conyngham Township, and four unnamed bridges. Two of the bridge structures are located in Hollenback Township (key numbers 095049 and 135733) and two are in Sugarloaf Township (key numbers 095055 and 135828). In addition to the six properties mentioned above, the Lehigh Valley Railroad passes through the Susquehanna – Harwood right-of-way in Hazel Township and also runs adjacent to the ROW right-of-way near the Harwood Substation. This resource (key number 156109) is currently listed as an "aggregate file" and its NRHP-eligibility is undetermined. In addition, the Wapwallopen Historic District in Conyngham Township (key number 155070) and Foothills Farm in Sugarloaf Township (key number 086552) also have an undetermined NRHP-eligibility status. Because the Project involves mainly reconductoring of an existing transmission line and because even the one structure replacement will involve a simpler structure of approximately the same height as existing structures in approximately the same location, the Project will not have any material incremental impact on any architectural sites.

<u>Archaeological Assessment</u>

Review of the PHMC CRGIS reveals that eleven recorded archaeological sites are located within 1 mile of the proposed Project. None of these sites are located within the transmission corridor. The closest site to the Project area is recorded as a prehistoric open habitation site (site number 36LU0022), located approximately 0.45 mile from the right-of-way in Conyngham Township. Two of the eleven recorded sites located within 1 mile of the transmission line have been either "listed or determined eligible" according to the NRHP. Those sites, the SES-6 Site (36LU0016) and the SES-8 Site (36LU0049), are prehistoric open habitation sites located in Salem Township approximately 0.9 mile west of the right-of-way on the western bank of the Susquehanna River. The remaining resources identified have insufficient data for the PHMC to make a decision on their NRHP status.

PPL Electric consulted with the PHMC to determine whether surveys are required given the limited earth disturbance involved. A response letter from the PHMC dated January 12, 2012[2] indicates that the activities associated with this Project should have no effect on potential historic buildings, structures, and/or archaeological resources located within the project area. PPL Electric will notify the PHMC should any unidentified historic buildings, structures or archaeological resources be discovered during the course of this project.

D. NATURAL FEATURES

Geology and Soils

The Project is located entirely within the Ridge and Valley Physiographic Province (Sevon 2000). Within this province, the Project traverses three sections: The Anthracite Upload Section, the Susquehanna Lowland Section and the Anthracite Valley Section. The Anthracite Upland Section is characterized as an upland with low, linear to rounded hills, strip mines and mining waste piles. The upland is surrounded by an escarpment (steep slope/cliff), valley, and a mountain rim. The dominant rock types include sandstone, siltstone, conglomerate and anthracite coal. The Susquehanna Lowland Section is characterized as low to moderately high, linear ridges and valleys. Rock types include soft shales, limestone and siltstones. The Anthracite Valley Section consists of a narrow to wide, canoe-shaped valley enclosed by a steep-sloped mountain rim. Dominant rock types include sandstone, siltstone, conglomerate and anthracite coal (DCNR 2000). Elevation along the transmission right-of-way ranges from 595 to 2,368 feet.

[2] PHMC File No. ER 2012-0421-079A

The route traverses the following six STATSGO soil associations:

- *Laidig-Hazleton-Dekalb-Buchanan*: very to moderately deep, somewhat poorly to excessively drained soils.
- *Wellsboro-Oquaga-Morris-Lackawanna*: very to moderately deep, somewhat poorly to somewhat excessively drained soils.
- *Wurtsboro-Oquaga-Morris-Mardin-Lackawanna-Arnot*: very deep to shallow, somewhat poorly to somewhat excessively drained soils.
- *Pope-Monongahela-Holly-Chenango*: very deep, very poorly to somewhat excessively drained soil.
- *Urban land-Udorthents*: well drained soils on uplands, fill material.
- *Meckesville-Leck Kill-Calvin*: very to moderately deep, well drained soils.

STATSGO is a general soil association map developed by the National Cooperative Soil Survey and distributed by the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture. Many of the soils along the route are extremely stony, especially those located along steep ridges.

Surface Water Resources

Wetland delineations were conducted within the Susquehanna – Harwood right-of-way in October 2011. Based on a review of the National Hydrology Dataset (NHD) and the results of the wetland delineation, the Susquehanna – Harwood line traverses 35 streams as it travels from the Susquehanna Switchyard in the north to the Harwood Substation in the south. Four of these streams (Black Creek, Stony Creek, Nescopeck Creek and Big Wapwallopen Creek) are named streams and the rest are unnamed tributaries of named streams. Based on a review of Pennsylvania Department of Environmental Protection (PADEP) Title 25 Chapter 93 classifications, 34 streams are classified as Cold Water Fisheries (CWF) (PADEP 2010a). One stream, Nescopeck Creek, is classified as Trout Stocked Fishes (TSF). None of the streams are classified as High Quality (HQ) or Exceptional Value (EV) streams. **Table 1** provides a summary of all streams found within the Project area and their classifications. Definitions for each of these classifications are located below the table. These stream crossings are also regulated by the U.S. Army Corps of Engineers (USACE).

TABLE 1: Surface Water Classification

STREAMS	
Name	**Designated Use**
Black Creek	CWF, MF
Unnamed Tributary of Big Wapwallopen Creek (Reach Code No. 02050107001133)	CWF, MF
Unnamed Tributary of Big Wapwallopen Creek (Reach Code No. 02050107001134)	CWF, MF
Unnamed Tributary of Nescopeck Creek (Reach Code No. 02050107001157)	CWF, MF
Unnamed Tributary of Little Nescopeck Creek (Reach Code No. 02050107001160)	CWF, MF
Stony Creek	CWF, MF
Nescopeck Creek	TSF, MF
Big Wapwallopen Creek	CWF, MF
4 Unnamed Tributaries of Stony Creek (No Reach Codes Identified)	CWF, MF
3 Unnamed Tributaries of Black Creek (No Reach Codes Identified)	CWF, MF
3 Unnamed Tributaries of Little Nescopeck Creek (No Reach Codes Identified)	CWF, MF
3 Unnamed Tributaries of Nescopeck Creek (No Reach Codes Identified)	CWF, MF
5 Unnamed Tributaries of Big Wapwallopen Creek (No Reach Codes Identified)	CWF, MF
9 Unnamed Tributaries of Little Wapwallopen Creek (No Reach Codes Identified)	CWF, MF

- CWF – *Cold Water Fishes* – Maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat.
- MF – *Migratory Fishes* – Passage, maintenance and propagation of anadromous and catadromous fishes and other fishes which move to or from flowing waters to complete their life cycle in other waters.
- TSF – *Trout Stocking Fishes* – Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.

No impacts to streams are expected because the line will aerially span streams along the route. Any culverts that need to be placed for temporary access roads or work near streams will be conducted in accordance with approved plans and permits and using best management practices to the extent practicable.

Wetlands

Based on a review of the U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI), the Susquehanna – Harwood line intersects two NWI wetland systems for a total of approximately 0.1 mile (rounded to the nearest 0.1 mile). As mentioned in the previous section, wetland delineations were conducted within the Susquehanna – Harwood right-of-way in October 2011. Based on the wetland delineations, the Susquehanna – Harwood Line Reconductor Project intersects fifteen wetlands, not including the stream crossings discussed in the previous section. The line traverses approximately 6.63 acres of wetlands. These wetland systems are located throughout the Project area. Most of these wetlands are palustrine emergent wetland systems (PEM). **Table 2** provides a summary of the type and acreage of all wetlands found within the project area.

TABLE 2: Wetlands Crossed by the Proposed Project

WETLANDS	
Wetland Type	**Acres Crossed***
PEM	1.09
POW	<0.01
PEM/POW	0.55
PEM/PFO	2.22
POW/PFO	0.01
PEM/PSS	2.77
Total	**6.63**

*Rounded to the nearest 0.1 acre.

PEM – palustrine emergent
POW – palustrine open water
PFO – palustrine forested
PSS – palustrine scrub-shrub

PPL Electric will avoid staging construction equipment and placing any new replacement structures in wetlands to the maximum extent practical. Where impacts cannot be avoided, PPL Electric will obtain and adhere to the terms and conditions of all required and approved plans and permits.

Floodplains

The route traverses floodplains associated with Black Creek, Nescopeck Creek, Stony Creek and Big Wapwallopen Creek. Only one structure will be replaced as part of this Project and this structure is not in a floodplains. No impacts to floodplains are anticipated.

Vegetation

The southernmost portion of the route traverses industrial areas, including active or former anthracite coal mining areas located within the Anthracite Subregion Ecoregion. Areas disturbed by mining activities are generally sparsely vegetated or consist of early successional habitats or second-growth forest. The natural forest was Appalachian Oak Forest; however, black cherry (*Prunus serotina*), gray and black birches (*Betula populifolia* and *B. Lenta*), white pine (*Pinus strobus*), and pitch pine (*Pinus rigida*) are more common species today that are recolonizing mined areas (Woods, Omenik and Brown 1999). Less frequent communities within this region include Pitch Pine-Scrub Oak communities found on isolated, dry and exposed ridgetops (Nature Conservancy 2006). An example of this community type is Humboldt Barren, which is a special natural area described in the subsequent section.

The central and northern portions of the route generally consist of steep, forested ridges or farmed valleys within the Northern Shale Valleys Ecoregion and, to a lesser extent, the Northern Sandstone Ridges Ecoregion (Woods, Omenik and Brown 1999). Upland forested or shrub-scrub areas noted within the right-of-way consist of gray birch, bear oak (*Quercus ilicifolia*), lowbush blueberry (*Vaccinium angustifolium*), sphagnum moss and sweet fern (*Comptonia peregrina*). The Susquehanna – Harwood transmission line will be reconductored within an existing right-of-way that is currently maintained in accordance with PPL Electric's Vegetation Management Plan. Minimal land disturbance and tree clearing is expected, as only a handful of structures will be replaced or refurbished. Therefore, this Project will not result in noticeable changes or significant impacts to the existing vegetation within the right-of-way. PPL Electric will apply its "Specification for Initial Clearing and Control of Vegetation On or Adjacent to Electric Line Right-of-way Through the Use of Herbicides, Mechanical and Hand Clearing Techniques" to mitigate an impacts.

<u>Special Natural Areas</u>

The Project traverses one special natural area (NAI): the Humboldt Barren, which is located in Hazle Township. This NAI is characterized as a ridgetop dwarf tree forest natural community on a broad, high-elevation (1,500 to 1,700 feet). According to the Luzerne County NAI (2006 Update):

> "[the site] is unusual among Luzerne County ridgetop barrens in having pitch pine (*Pinus rigida*) that is at least as abundant as scrub oak (*Quercus ilicifolia*) over much of the site. Portions of the site are pitch-pine oak woodland with openings dominated by large conglomerate rock slabs."

The existing transmission line currently bisects the site. In addition, gravel roads and mine tailings are also present within this NAI area. The Project is not anticipated to result in additional impacts to this NAI area. No other NAI areas are located within 0.1 mile of the existing line.

The Project will not affect any recreational areas or natural landmarks. The closest recreational area is State Game Land No. 260, located 2.7 miles northwest of the route.

E. PLANT AND ANIMAL SPECIES OF CONCERN

Pennsylvania Natural Diversity Inventory Review

A large-project review of the Pennsylvania Natural Diversity Inventory (PNDI) database was conducted for the project area. The Pennsylvania Fish and Boat Commission (FBC) determined that the Project is not expected to result in any impacts to state listed fish, reptiles, amphibians, or aquatic species. The Pennsylvania Department of Conservation and Natural Resources (DCNR) indicated that two plant species of concern are located within the vicinity of the project area: the white fringed-orchid (*Platanthera blephariglottis*) and the screw-stem (*Bartonia panoculata*). Neither species is currently listed in Pennsylvania. However, the white fringed-orchid is a proposed Pennsylvania endangered species and the screw-stem is a proposed Pennsylvania rare species. DCNR requested surveys for both species. In addition, one community of concern, scrub oak shrubland, has been documented within the transmission right-of-way in Hazle Township (see description of Humbodlt Barren in Section D). As a conservation measure, DCNR requests delineation of this community if encountered during the botanical survey for the above species. Subsequently, a botanist conducted surveys in November 2011. Neither species was identified during the survey. In addition, only two wetlands within the right-of-way have superficially similar habitat to wetlands where these two species are known to occur. PPL Electric submitted the survey report to DCNR. A response letter from DCNR dated December 27, 2011 indicates that no impact to plant species of special concern is anticipated and no further studies are requested.

The U.S. Fish and Wildlife Service (USFWS) indicated that the proposed Project is located within the range of the Indiana bat (*Myotis sodalis*), which is a federally endangered species. If trees greater than or equal to 5 inches in diameter at breast height are to be cut as part of this Project, the USFWS requests this work to occur between November 16 and March 31 to avoid killing or injuring Indiana bats. If this seasonal tree cutting restriction is implemented, and no significant acreage of tree clearing is required, the USFWS has determined that the effects of the Project on the Indiana bat would be insignificant or discountable. Further consultation with the USFWS may be required if more significant tree clearing activities are required. The Pennsylvania Game Commission (PGC) also indicated a potential impact to the Indiana bat as well as the Northern myotis (*Myotis septentrionalis*), which is a species of special concern in Pennsylvania. The PGC defers to USFWS regarding the Indiana bat, but suggests the following seasonal restriction for the Northern myotis: avoid harvesting trees or dead snags greater than 5 inches in diameter at breast height between November 1 and March 31. PPL Electric will consult with USFWS and PGC if necessary to resolve all PNDI conflicts.

F. SOURCES

Nature Conservancy, The. *A Natural Areas Inventory of Luzerne County, Pennsylvania*. Middletown: The Nature Conservancy, 2006 Update.

Pennsylvania Department of Conservation and Natural Resources. 2000. *Landforms of Pennsylvania.* [Online]. URL: http://www.dcnr.state.pa.us /topogeo/map13/map13.aspx (Last accessed October 2011).

Pennsylvania Department of Environmental Protection (PADEP) (a), Pennsylvania Code. Title 25. Chapter 93. Water Quality Standards. [Online]. URL: http://www.pacode.com/secure/data/025/chapter93/chap93toc.html (Last accessed October 2011).

Pennsylvania Historical and Museum Commission (PHMC), Bureau of Historic Preservation (BHP), Cultural Resources Geographic Information System (CRGIS). [Online]. URL: http://www.portal.state.pa.us/portal/server.pt/ community/crgis/3802 (Last accessed October 2011).

Pennsylvania Office of Water Management (PAOWM). 2008. Pennsylvania Statewide Existing Use Classifications, Water Quality Standards and Assessment Program. [Online]. URL: http://www.depweb.state.pa.us /watermgmt/site/default.asp (Last accessed October 2011).

Sevon, W.D. *Physiographic Provinces of Pennsylvania*. Pennsylvania Geological Survey, 4th ser. Map #13, 2000.

Woods, Alan J. and James M. Omneik and Douglas D. Brown. Level III and IV Ecoregions of Delaware, Maryland, Pennsylvania, Virginia, and West Virginia. U.S. Environmental Protection Agency, 1999.

ATTACHMENT "4"

SUSQUEHANNA – HARWOOD 230 kV LINE RECONDUCTOR PROJECT

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, with 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

	Vertical Clearance to Ground	
Surface Underneath Conductors	NESC Standard	PPL Electric Design
Roads, streets, alleys	21 Ft.	30 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	21 Ft.	30 Ft.
Spaces accessible to pedestrians only	17 Ft.	30 Ft.
Railroad tracks	31 Ft.	35 Ft.

230 kV

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

500 kV

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

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 reconstruction 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:

Voltage (kV)	Minimum Clearance
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"

SUSQUEHANNA – HARWOOD 230 kV LINE RECONDUCTOR PROJECT

PPL ELECTRIC MAGNETIC FIELD MANAGEMENT PROGRAM

MAGNETIC FIELD MANAGEMENT

PPL Electric Utilities Corporation

DECEMBER 2004

TABLE OF CONTENTS

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

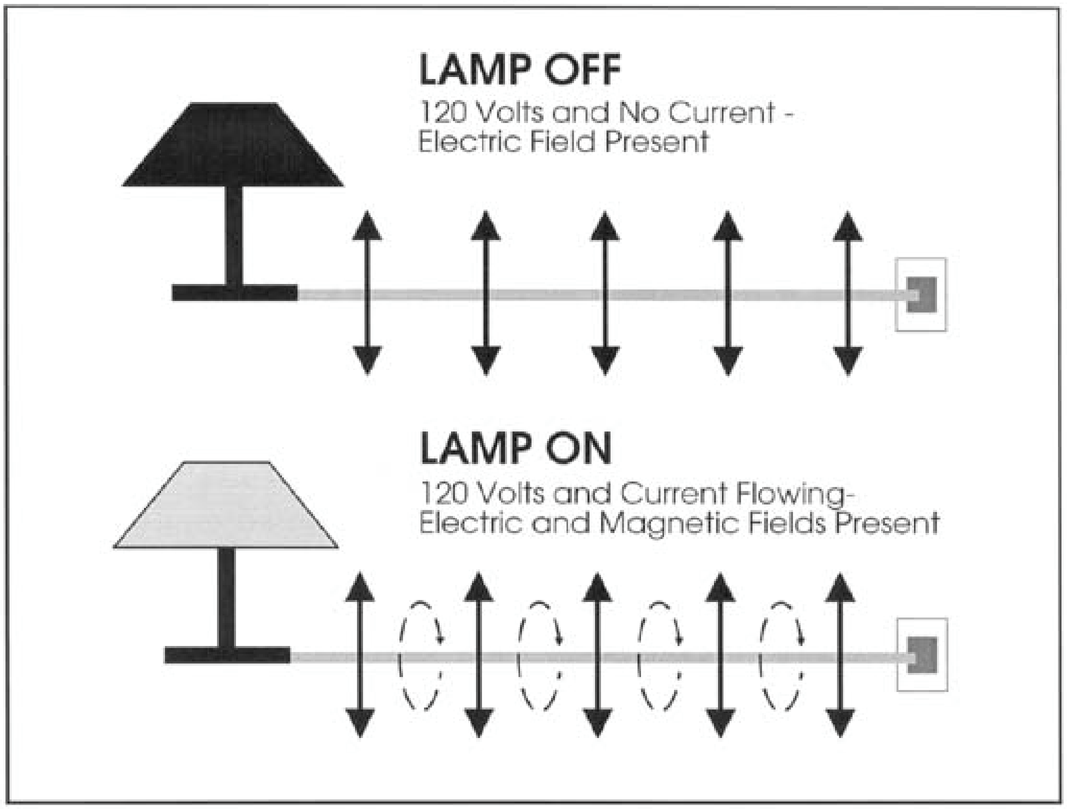

LAMP OFF
120 Volts and No Current -
Electric Field Present
LAMP ON
120 Volts and Current Flowing-
Electric and Magnetic Fields Present

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.

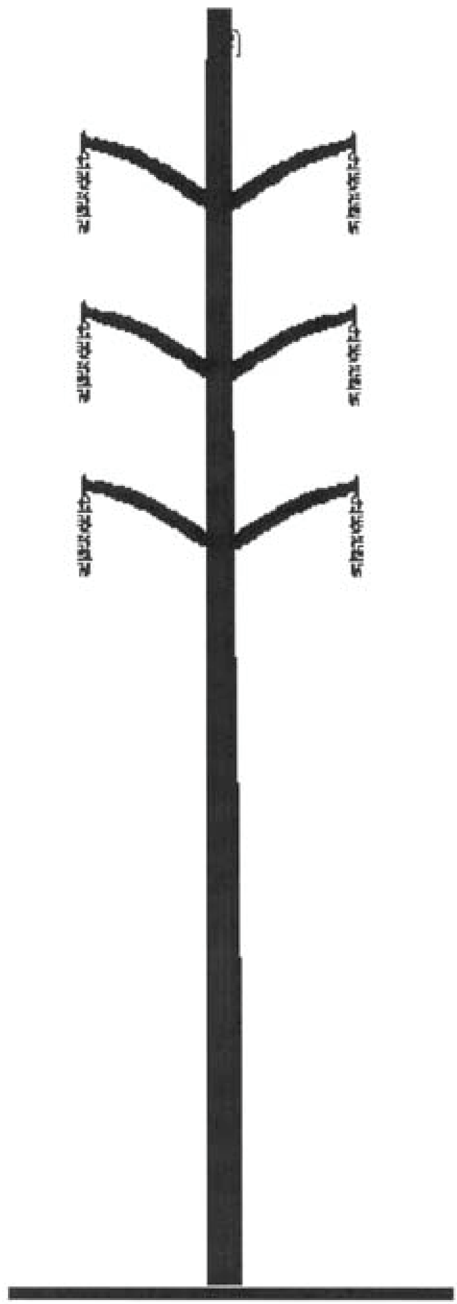
- Main lines are the most heavily loaded sections of a distribution line and therefore have the highest magnetic fields associated with them.
- Increasing the ground clearance by five feet reduces the magnetic field under the line from 14 mG to 11 mG using the standard eight-foot crossarm design. These 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.

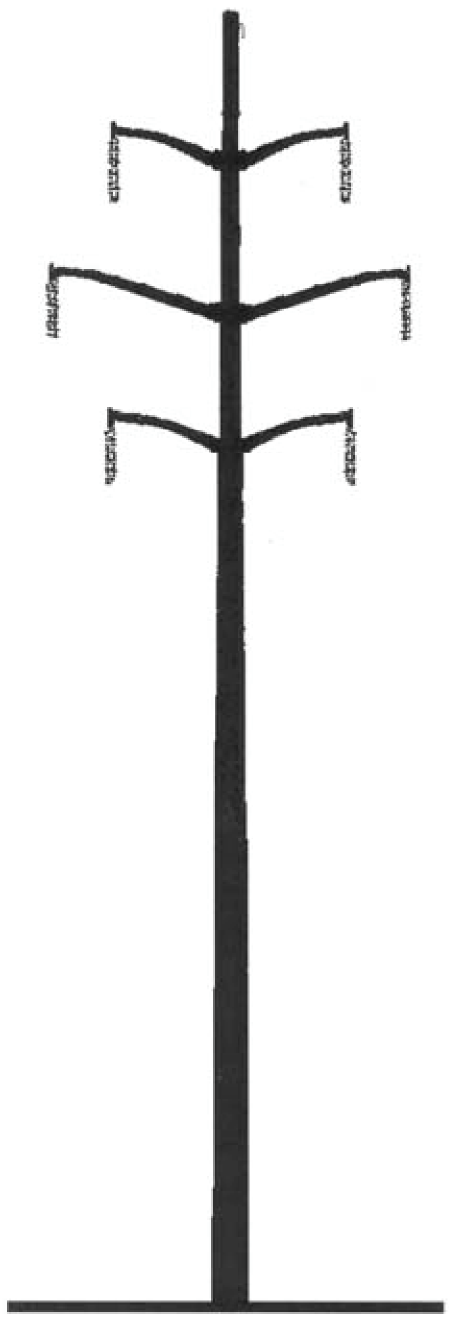
Short-Span Construction



- **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:**

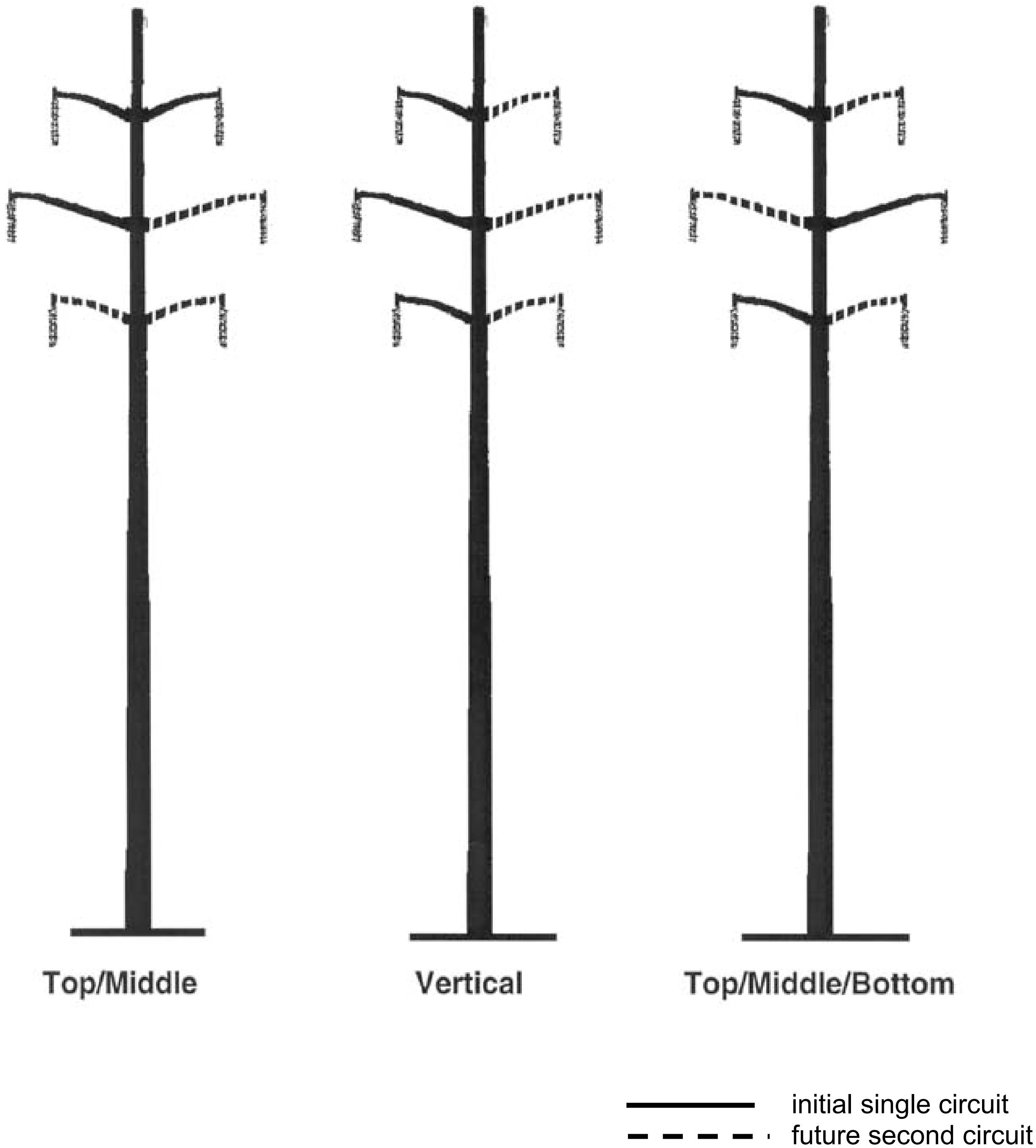
  1 3/8" HS steel overhead ground wire - 17.3 feet sag
  6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 23.0 feet sag
  Average span - 600 feet

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

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLLIGAUSS 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

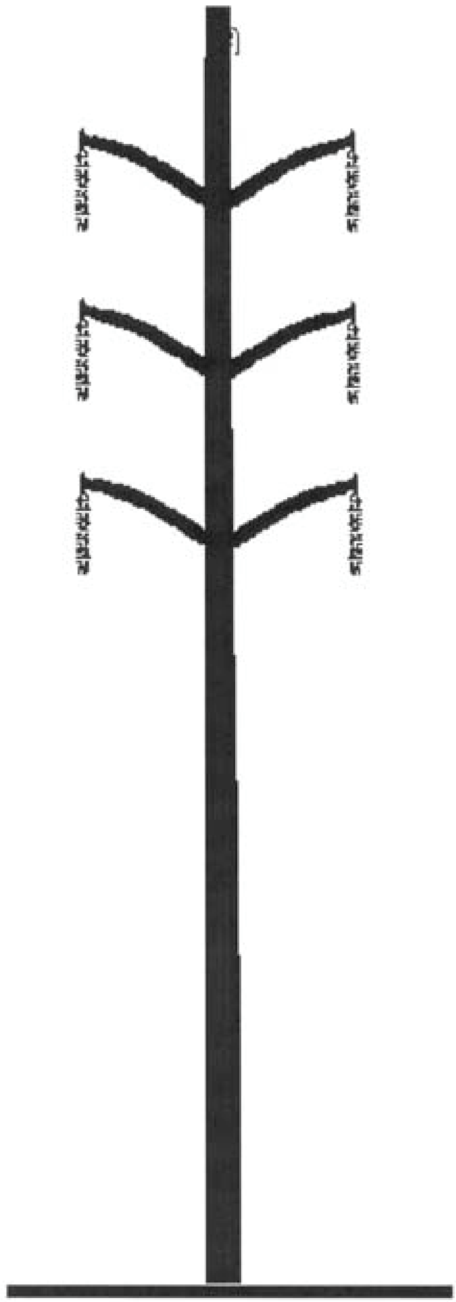


138/69 kV SINGLE CIRCUIT TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 400 AMPERES

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.

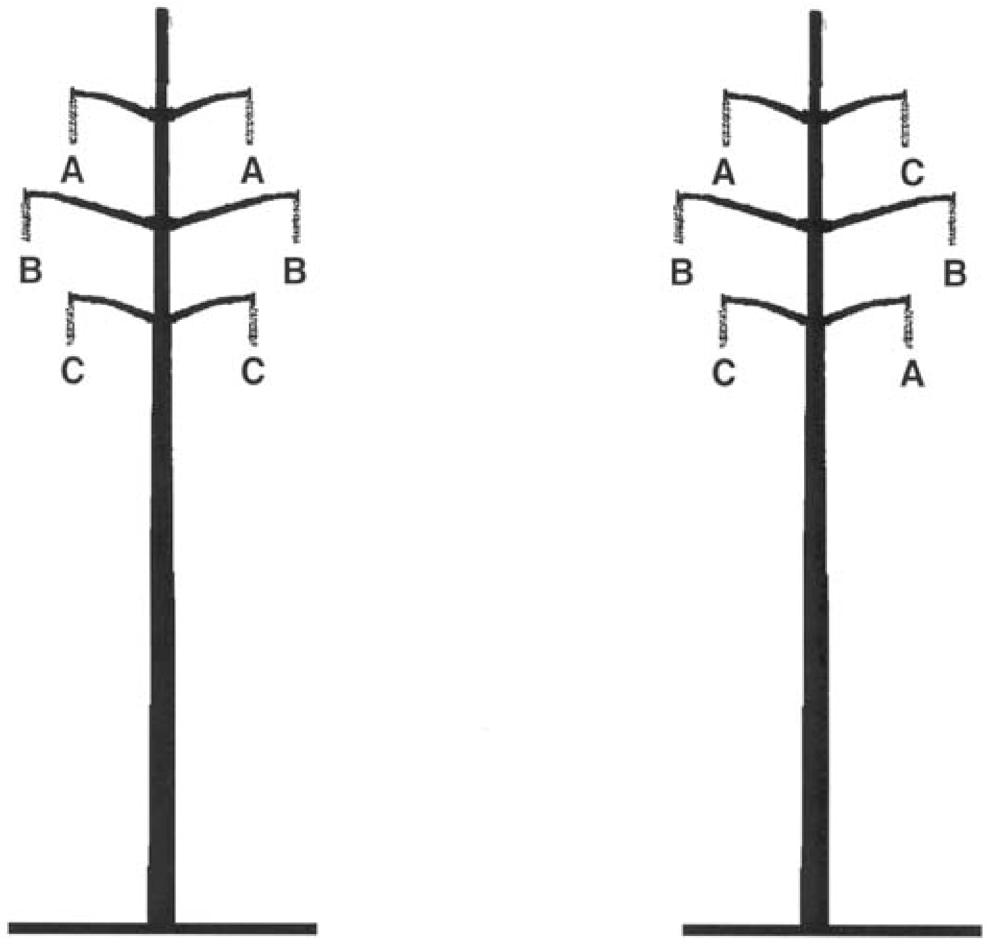
Compact Design Structure



- **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**

CHART VIII

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.

CHART IX

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.

CHART X

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.

CHART XI

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.

Siting/Magnetic Field Management.doc/mlt

ATTACHMENT "6"

SUSQUEHANNA – HARWOOD 230 kV LINE RECONDUCTOR PROJECT

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

Property Owner/Address	Parcel Number
PPL Susquehanna LLC 2 N Ninth St, Gentw11 Allentown, PA 18101	1
PPL Susquehanna LLC 2 N Ninth St Allentown, PA 18101-1139	2
Gerard A Rish 34 W Railroad St Alden, PA 18634	3
David Travelpiece et al. c/o David A Travelpiece 543 Council Cup Rd Wapwallopen, PA 18660-2135	4
Daniel A JR and Dean J Limongelli 1233 Laurel Run Road Bear Creek, PA 18702	5
James and David Peters 4660 Clydesdale Court Ellicott City, MD 21043-6402	6
Todd and Susan Stair 250 Maple Rd Wapwallopen, PA 18660-2020	7
Dawson Family Trust 344 W County Rd Wapwallopen, PA 18660-1510	8
Vanhorn George A and Alma J 306 W County Rd Wapwallopen, PA 18660-1510	9
Scott W Gulliver et al. 317 W County Rd Wapwallopen, PA 18660-1511	10

Property Owner/Address	Parcel Number
Brice and Romayne Conklin 127 Valley Rd Wapwallopen, PA 18660-1533	11
Brice and Romayne D Conklin 127 Valley Rd Wapwallopen, PA 18660-1533	12
Bradley W and Denise A Conklin 134 Valley Rd Wapwallopen, PA 18660-1532	13
Aleksey and Olga Bagan 138 Valley Rd Wapwallopen, PA 18660-1532	14
Ray Dawson et al. c/o Keith R Dawson 524 Hobbie Rd Nescopeck, PA 18635-2406	15
Atwood and Florence Moyer 587 Hobbie Rd Nescopeck, PA 18635-2408	16
Darrell J and Kathleen Moyer 575 Hobbie Rd Nescopeck, PA 18635-2408	17
Terry L Houck 174 Overlook Road Morgantown, PA 19543	18
Robert L Good 825 Switze Rd Nescopeck, PA 18635-2422	19
David Lee Burger et al. 701 Mifflin Ave Nescopeck, PA 18635-1201	20
American Tower Asset Sub LLC 116 Huntington Ave Boston, MA 02116	21
Chad M Balliet - Croop Family Trust c/o Robert H Croop Jr. 257 Old Mountain Rd Nescopeck, PA 18635-2423	22

Property Owner/Address	Parcel Number
Shanon C and Sandra Lee Howell 76 Mountain Lane Drums, PA 18222	23
Larock Family Limited Partnership 306 W County Rd Sugarloaf, PA 18249-3252	24
Trudie Slimmen c/o Trudie Powell 105 Brandywine Creek Rd Coatesville, PA 19320-4648	25
Donald R and Ruth Ann Woodring 133 Old Berwick Rd Drums, PA 18222-2804	26
Harold W and Megan C Roth 1164 New London Rd Landenberg, PA 19350	27
Francis S Kossa RR 2 Box 244 Acer Rd Drums, PA 18222	28
Eric A and Linda Mantush 61 Acer Ln Drums, PA 18222-2832	29
Joanne Roberts 265 Oak Rd Drums, PA 18222-2814	30
Robert and Lucille Siegfried 34425 River Road Millsboro, DE 19966	31
Roger and Karen D Thomas 279 Oak Rd Drums, PA 18222-2815	32
Roger and Karen D Thomas 279 Oak Rd Drums, PA 18222-2815	33
Glen A Burger 493 Old Airport Rd Drums, PA 18222-1537	34

Property Owner/Address	Parcel Number
Dale and Eunice Frederick 115 Fredericks Rd Sugarloaf, PA 18249-3117	35
Ralph Dougherty et al. 642 N James St Hazleton, PA 18201-3054	36
Jeddo Highland Co. 46 Public Square Suite 600 Wilkes-Barre, PA 18701-2609	37
Dale and Eunice Frederick 115 Fredericks Rd Sugarloaf, PA 18249-3117	38
Allan R and Corrine Dick PO Box 35 Conyngham, PA 18219-0035	39
Edward and Deborah Horensky et al. c/o Katherine & Ronald Rhodes 1414 Fox Pl Plainfield, NJ 07080-1534	40
John J, Albert J III, James J Wolk 20 Mill Hill Rd Sugarloaf, PA 18249-3307	41
Rachel A Paden et al. 1044 Cedar Head Rd Sugarloaf, PA 18249	42
Zeisloft Farms Inc. PO Box 84 Sybertsville, PA 18251-0084	43
Keith R Hilliard 209 Turkey Path Rd Sugarloaf, PA 18249	44
Keith R Hilliard 209 Turkey Path Rd Sugarloaf, PA 18249	45
Richard E Angelo Family LTD Partner PO Box 23 Conyngham, PA 18219	46

Property Owner/Address	Parcel Number
Joseph R Beltrami PO Box 552 Sugarloaf, PA 18249-0552	47
Butler Enterprises Inc. 15 East Broad Street Hazleton, PA 18201-6520	48
Butler Enterprises Inc. 15 E Broad St Hazleton, PA 18201-6520	49
PPL Electric Utilities Corp. Attn: Marc A. Jackson 2 N Ninth St, GENTW2 Allentown, PA 18101	50
Butler Enterprises 15 E Broad St Hazleton, PA 18201-6520	51
Hazleton City Authority S Church St Hazleton, PA 18202	52
Hazleton City Authority S Church St Hazleton, PA 18202	53
Hazleton City Authority 400 E Arthur Gardner Pkwy Hazleton, PA 18201-7359	54
Greater Hazelton Community Area New Development Organization, Inc. 1 S Church St Hazleton, PA 18201	55
PPL Electric Utilities Corp. c/o Real Estate Services 2 North Ninth Street Allentown, PA 18101-1179	56
Greater Hazleton Community Area New Development Organization Inc One South Church St Hazleton, PA 18201	57
Joseph and Elizabeth A Marushin 566 State Route Sugarloaf, PA 18249	58

Property Owner/Address	Parcel Number
Greater Hazleton Community Area New Dev Org c/o Can Do Renaissance Center 1 S Church St. Suite 200 Hazleton, PA 18201-6200	59
B&T @ 924 78 Pamela Dr Drums, PA 18222-2300	60
Baidwan Investments, LLC 9 Jennifer Lane Sugarloaf, PA 18249	61
Humboldt Realty c/o Romark Management LLC 822 South Avenue W Westfield, NJ 07090	62
Hazle Twp Supervisors 23rd & Peace Sts Hazleton, PA 18202	63
Commercial Net Lease Realty Trust 450 S Orange Ave Ste 900 Orlando, FL 32801-3339	64
PPL Electric Utilities Corp. 2 N 9th St Allentown, PA 18101-1139	65
PPL Montour LLC 2 N Ninth St, Gentw11 Allentown, PA 18101	66

ATTACHMENT "7"

SUSQUEHANNA – HARWOOD 230 kV LINE RECONDUCTOR PROJECT

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, Pennsylvania 17120-0053
   Attn: Mr. Douglas C. McLearen, Chief

2. Pennsylvania Department of Transportation
   Commonwealth Keystone Building
   400 North Street, 8th Floor
   Harrisburg, Pennsylvania 17120
   Attn: The Honorable Allen D. Biehler, P.E., Secretary

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

4. Luzerne County Commissioners
   200 North River Street
   Wilkes-Barre, PA 18711
   Attn: Ms. Maryanne C. Petrilla, Chairman

5. Mr. Adrian Merolli, Planning Director
   Luzerne County
   20 N. Pennsylvania Avenue
   Wilkes-Barre, PA 18711

6. Conyngham Township Board of Supervisors
   Box 1 – 10 Pond Hill Road
   Mocanaqua, PA 18655
   Attn: Mr. Ed Whitebread, Chairman

7. Hazle Township Board of Supervisors
   101 W. 27th Street
   Hazle Township, PA 18202
   Attn: Mr. William Gallagher, Chairman

8. Hazle Township Planning Commission
101 W. 27th Street
Hazle Township, PA 18202
Attn: Mr. Paul Matulevich, Chairman

9. Hollenback Township Board of Supervisors
P.O. Box 155
Wapwallopen, PA 18660
Attn: Ms. Maryann Smith, Chairman

10. Hollenback Township Planning Commission
P.O. Box 155
Wapwallopen, PA 18660
Attn: Mr. Ralph Wintersteen, Chairman

11. Sugarloaf Township Board of Supervisors
154 North Main Street, P.O. Box 61
Sybertsville, PA 18251
Attn: Mr. Robert M. Stanziola, Chairman

12. Sugarloaf Township Planning Commission
154 North Main Street, P.O. Box 61
Sybertsville, PA 18261
Attn: Mr. Jack Wittig, Chairman