Before the
Pennsylvania Public Utility Commission

LONG POND #1 AND #2 138/69 kV TAP LINE

Attachments in Support of the Letter of Notification

Application Docket No. ____________

Submitted by: PPL Electric Utilities Corp.

SUMMARY

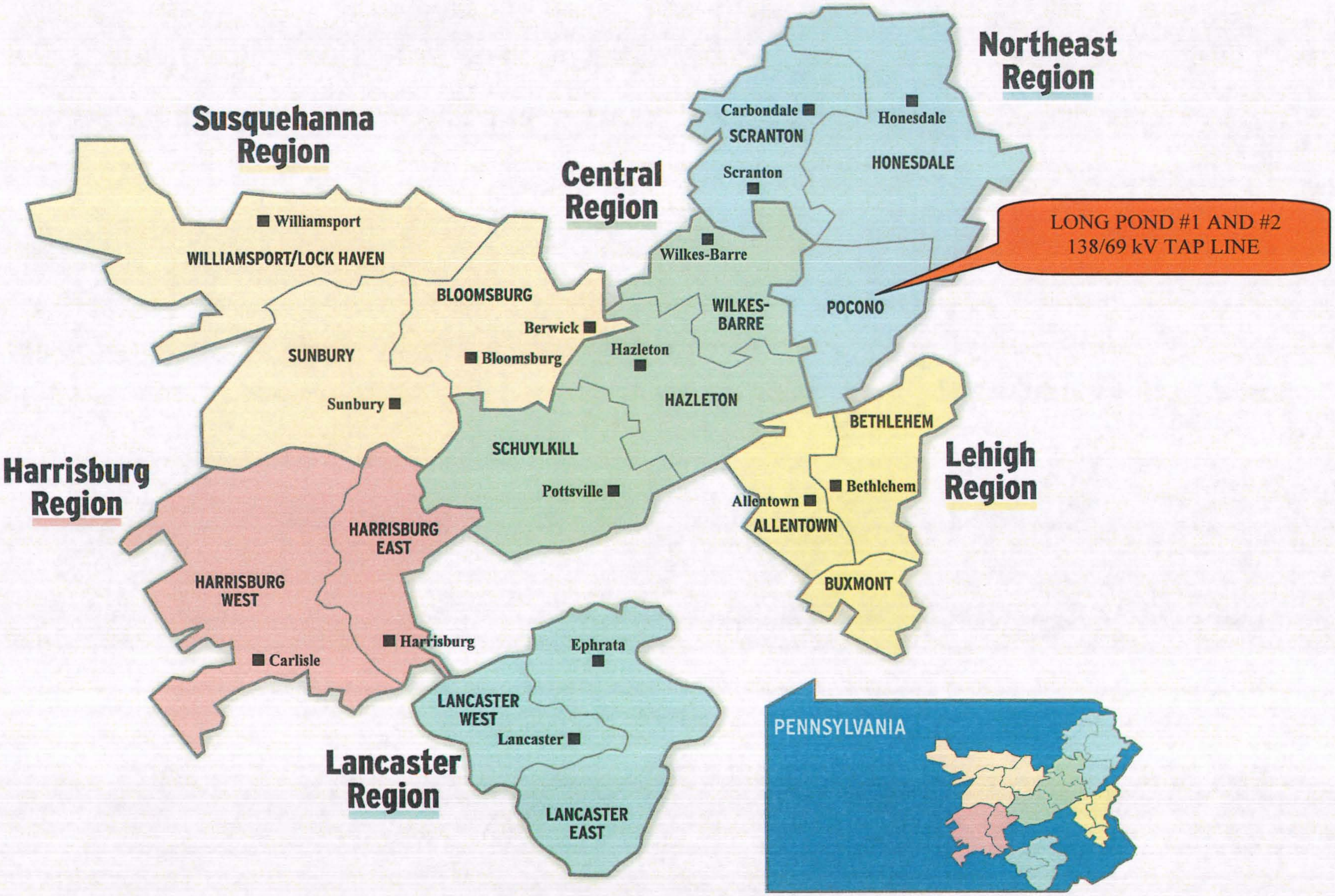
This Letter of Notification is being submitted by PPL Electric Utilities Corporation (PPL Electric) pursuant to the Pennsylvania Public Utility Commission's (PUC or the Commission) regulations at 52 Pa. Code §§57.71 through 57.77 for approval to site and construct the Long Pond #1 and #2 138/69 kV Tap Line to serve the planned Long Pond 69-12 kV Substation. Together, the tap line and substation are required to meet the increasing demand for electricity and improve reliability of service in Tobyhanna Township, Monroe County. The new line will be designed and constructed for double-circuit 138 kV operation, although, initially only one circuit will be installed and the line will be operated at 69 kV. PPL Electric will add the second circuit and increase the operating voltage when load growth in the area makes it appropriate to do so.

The total estimated cost of the proposed Project is approximately $2.95 million. This includes approximately $460,000 for the transmission line and approximately $2.49 million for the substation and distribution work associated with the Project. Construction is scheduled to begin in February, 2014 to support the Project's in-service date of November, 2014.

This document, which describes the need for the Project and discusses the engineering and siting 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	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
LONG POND #1 AND #2 138/69 kV TAP
NECESSITY STATEMENT

TABLE OF CONTENTS

LIST OF FIGURES

MAP

ATTACHMENT 1
LONG POND #1 AND #2 138/69 kV TAP
NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric is requesting PUC approval to site and construct a double-circuit 138/69 kV transmission tap line. The proposed Long Pond #1 and #2 138/69 kV Tap Line will extend approximately 650 feet from the Jackson-Wagners 138/69 kV Transmission Line to the new Long Pond 69-12 kV Substation. The proposed tap line will be designed for double-circuit 138 kV operation although, it will initially operate as a single-circuit 69 kV line. The additional circuit will be added, and the operating voltage will be increased, when load growth in the area makes it appropriate to do so. The proposed tap line and new substation are required to meet the increasing demand for electricity and improve reliability, in the Tobyhanna Township, Monroe County area.

The estimated cost to design and construct the proposed transmission tap line is $460,000. Construction is scheduled to begin in February 2014 to support the Project's scheduled in-service date of November 2014.

A PPL Electric system map showing existing transmission facilities with a design voltage of 35 kV or greater is included in the Attachment 1 map pocket. This filing addresses only the existing and proposed 138/69 kV regional transmission system in the Tobyhanna Township area.

B. EXISTING SYSTEM

Presently, the area of concern is served from the Lake Naomi 69-12 kV, Mount Pocono 69-12 kV and Wagners 69-12 kV Substations via 12 kV distribution lines. The associated 12 kV distribution lines, which currently serve the area, include the Wagners 68-1, Mount Pocono 64-6, and the Lake Naomi 86-1, 86-2, and 86-4 distribution lines. These 12 kV lines serve over 7,500 customers in the Tobyhanna Township area. Figure 1 on page 7 depicts a functional one-line diagram of the existing transmission facilities in the area. Figure 3 on page 9 provides a functional one-line diagram of the existing 12 kV distribution facilities in the area.

C. DEFINITION OF THE PROBLEM

There are six separate problems in the Tobyhanna area. First, loading on the Wagners 68-1 distribution line is projected to exceed the normal planning guidelines based on PPL Electric's Reliability Principles and Practices (RP&P). The existing Wagners 68-1 12 kV distribution line is constructed of 336 Aluminum conductor. The planning guideline for this type of conductor is 10,000 kVA (kilovolt Ampere). The winter 2014 peak load is projected to be 11,300 kVA. Overloading the Wagners 68-1 12 kV line could result in conductor damage or failure which would interrupt service to approximately 1,650 customers until repairs could be made. As a result, the existing distribution line cannot accommodate future load growth in the area.

Second, load on the Lake Naomi 86-1 distribution line is projected to exceed the normal planning guidelines based on PPL Electric's RP&P. The existing Lake Naomi 86-1 12 kV distribution line is constructed of 477 Al conductor. The planning guideline for such conductor is 11,000 kVA. The winter 2014 peak load is projected to be 11,900 kVA. Overloading the Lake Naomi 86-1 12 kV line could result in conductor damage or failure which would interrupt service to approximately 1,200 customers until repairs could be made. As a result, the existing distribution line cannot accommodate future load growth in the area.

Third, load on the Lake Naomi 86-2 distribution line is projected to exceed the normal planning guidelines based on PPL Electric's RP&P. The existing Lake Naomi 86-2 12 kV distribution line is constructed of 477 Aluminum conductor. The planning guideline for such conductor is 11,000 kVA. The winter 2014 peak load is projected to be 11,300 kVA. Overloading the Lake Naomi 86-2 12 kV line could result in conductor damage or failure which would interrupt service to approximately 1,950 customers until repairs are made. As a result, the existing distribution line cannot accommodate future load growth in the area.

Fourth, load on the Lake Naomi 86-4 distribution line is projected to exceed the normal planning guidelines based on PPL Electric's RP&P. The existing Lake Naomi 86-4 12 kV distribution line is constructed of 477 Aluminum conductor. The planning guideline for such conductor is 11,000 kVA. The winter 2014 peak load is projected to be 11,100 kVA. Overloading the Lake Naomi 86-4 12 kV line could result in conductor damage or failure which would interrupt service to approximately 2,100 customers until repairs are made. As a result, the existing distribution line cannot accommodate future load growth in the area.

Fifth, the existing Wagners 68-1, Lake Naomi 86-2, and 86-4 distribution lines exceed PPL Electric's RP&P guidelines for customer count per feeder. The RP&P guideline states that no more than 1,300 customers should be served from a 12 kV circuit. Presently these three circuits serve approximately 1,650, 1,950, and 2,100 customers respectively.

Sixth, the existing system configuration has limited transfer capability with the adjoining substations for maintenance and other outages on the equipment. Therefore, if the existing distribution lines were to fail or require maintenance, customers would be out of service until the work could be completed.

D. PROPOSED SOLUTION

In order to resolve the issues discussed above, PPL Electric seeks PUC approval to construct the Long Pond #1 and #2 138/69 kV Tap Line. After the Commission's approval of the new Tap Line, PPL Electric will also construct a new Long Pond 69-12 kV Substation that will be supplied by the Tap Line. Two new 12 kV distribution lines will be installed from the new substation to serve customer load in the area. These system additions will relieve loading and increase reliability and operating flexibility. The new Long Pond 69-12 kV Substation will serve approximately 2,830 customers and 11.8 MVA of load. The new lines will reduce the number of customers served per circuit on the existing lines. As an additional benefit, the new lines will also reduce the circuit length of the distribution lines in the area. The system additions, and the accompanying reductions in number of customers per circuit and circuit length, will reduce the customers' exposure to outages and reduce the number of customers affected by an outage.

One of the new 12 kV distribution lines will serve part of the load currently being supplied by the Lake Naomi 86-2 distribution line. The other new 12 kV distribution line will serve part of the load currently being supplied by the Lake Naomi 86-4 distribution line. This reinforcement Project will reduce peak loading on the Lake Naomi 86-2 and 86-4 distribution line by 7,300 and 4,500 kVA, respectively. These reductions will allow load to be transferred from the Wagners 68-1 and Lake Naomi 86-1 distribution lines to the 86-2 and 86-4 distribution lines. Additionally, the new facilities will also bring the customer counts on the new and existing distribution lines closer to the RP&P guidelines. The table below lists the projected winter 2014 loads and customer counts before and after the installation of the Long Pond 69-12 kV substation and related facilities.

Distribution line (Line Rating kVA)	Projected 2014 Load (kVA)	Customer Count	Projected 2014 Load w\ Long Pond (kVA)	Projected Customer Count w\ Long Pond
Wagners 68-1 (10,000)	11,300	1,650	9,600	1,350
Lake Naomi 86-1 (11,000)	11,900	1,200	8,700	1,150
Lake Naomi 86-2 (11,000)	11,300	1,950	5,700	820
Lake Naomi 86-4 (11,000)	11,100	2,100	8,300	725
Mount Pocono 64-6 (11,000)	7,200	625	8,700	650
Long Pond New-1 (11,000)	0	0	7,300	1,400
Long Pond New-2 (11,000)	0	0	4,500	1,430
Total	**52,800**	**7,525**	**52,800**	**7,525**

A total of five (5) existing feeder lines, providing service to approximately 7,500 PPL Electric customers, will gain additional transfer capability upon the completion of the new Long Pond Substation. The added transfer capability provided by the two new Long Pond distribution lines will help improve reliability for these customers through significant reductions in their outage durations. That is to say, if an outage were to occur on one of the five existing feeders, the customers on that feeder could be transferred to the four remaining feeders, rather than having to wait until the line is fully restored.

The total estimated cost of this solution is approximately $2.95 million, which includes: $2.49 million for the new substation and distribution work and $460,000 for the transmission line. Figure 2 on page 8 depicts the proposed transmission system modifications and Figure 4 on page 10 depicts the proposed distribution system modifications.

E. FUNCTIONAL ALTERNATIVE

An alternative to building the new substation and transmission line would be to build two new 12 kV distribution line and terminals from the Lake Naomi substation in order to relieve the Wagners 68-1, Lake Naomi 86-1, 86-2, and 86-4 lines. This alternative would require one of the new 12 kV distribution lines to follow the same line route as the Lake Naomi 86-4 for about two miles. The other new 12 kV distribution line would follow the same line route as the Lake Naomi 86-2 for about three miles. This alternative would improve reliability less than the preferred Project, due to fact that two distribution circuits installed on the same poles are susceptible outages on both lines. Upgrades to the Lake Naomi Substation would also be necessary to accommodate the additional lines and terminals.

PPL Electric rejected this alternative because the preferred alternative described in Section D above, will provide a more cost effective project that supplies additional reliability and operating flexibility, and will allow for a better long-term plan for the entire area.

Attachment 2

ATTACHMENT 2
LONG POND #1 AND #2 138/69 kV TAP
ENGINEERING DESCRIPTION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

MAP

ATTACHMENT 2
LONG POND #1 AND #2 138/69 kV TAP
ENGINEERING DESCRIPTION

A. DESCRIPTION OF PROPOSED LINE

PPL Electric proposes to construct the Long Pond #1 and #2 138/69 kV Tap Lines to serve the proposed Long Pond 69-12 kV Substation. The proposed Long Pond Tap Lines will extend from the existing Lake Naomi 138/69 kV Tap Line, which will be renamed the Jackson-Wagners 138/69 kV Line, into the proposed Long Pond 69-12 kV Substation. The proposed tap will be designed and constructed for double-circuit 138 kV operation, although initially only one circuit will be installed, and it will be operated at 69 kV. In the future, the Long Pond #2 Tap Line will be added and connected to a second transformer when justified by system requirements. In addition, the voltage on the line will be increased when load growth in the area makes it appropriate to do so. The Project is located in Tobyhanna Township, Monroe County. An aerial exhibit showing the location of the proposed facilities is provided at the end of Attachment 2.

The proposed tap line will be approximately 650 feet in length and will involve the installation of a total of six steel structures and the removal of three wood pole structures. A direct embedded high tap pole structure, approximately 97 feet in height, with guy anchors will be installed (see Figure 1). This pole will replace an existing wood pole similar to Figure 2. The two wood pole structures on either side of the high tap pole will be replaced with direct embedded steel poles which will be approximately 70 feet in height and in approximately the same location (see Figure 3). In addition, a direct embedded steel pole approximately 70 feet in height for a load sectionalizing air break switch, will be installed (see Figure 4). The remaining two structures will be direct embedded single steel poles with guy wires, approximately 79 feet in height (see Figures 5 and 6). Each circuit will consist of three power conductors, and there will be one fiber optic overhead ground wire (OPGW). The power conductors will be 556.5 thousand circular mills (kcmil)[1], 24/7 stranding, aluminum conductor steel reinforced (ACSR). The 0.567 inch

[1] KCMIL wire size is the equivalent cross sectional area in thousands of circular mils. A circular mil is the area of a circle with a diameter of one thousandth (0.001) of an inch.

OPGW will provide lightning protection for the proposed tap line and communications to the substations.

The proposed line will be designed to comply with National Electrical Safety Code (NESC) standards. Design specifications and safety rules practiced by PPL Electric are included in Attachment 4. The minimum conductor-to-ground clearance will be 30 feet, which occurs at a maximum conductor temperature of 125° C. The designed minimum conductor ground clearances and conductor thermal ratings are as follows:

TABLE 1
DESIGN MINIMUM CONDUCTOR CLEARANCES
FOR 556.5 KCMIL 24/7 STRANDING ACSR*

Condition	Double-Circuit Design Clearance-to-Ground
Normal load, average weather (16°C ambient, 60°F temperature)	32.90 feet
Predicted extreme thermal load (125°C conductor, 257°F temperature)	30.0 feet
Predicted NESC extreme wind load conditions (25 lbs., 16°C, 60°F temperature)	32.05 feet
Predicted extreme weather conditions, 0°F (1-inch ice, 4 lbs. wind, -18°C)	32.15 feet

[1] Clearances based on a maximum tension of 3,540 pounds at 1" Ice, 15 Deg F, 4# Wind and a ruling span of 270 feet (NESC Rule 250D).

TABLE 2
CONDUCTOR THERMAL RATING
556.5 KCMIL 24/7 STRANDING ACSR
(257°F) 125°C MAXIMUM CONDUCTOR TEMPERATURE

Condition	Ambient Temperature °C	Wind Speed Knots	Ampacity Amps
Summer Normal	35	0	815
Winter Normal	10	0	926
Summer Emergency	35	1 1/2	1,041
Winter Emergency	10	1 1/2	1,163

B. MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program, summarized in Attachment 5, is applied to new and reconstructed transmission line projects. The company does not believe that the current scientific evidence demonstrates that magnetic fields cause any adverse health effects or pose a health or safety danger to the public. Nevertheless, PPL Electric has determined, as a matter of policy, to design its new and rebuilt transmission lines to reduce magnetic fields when that can be done at low or no cost and consistent with functional requirements. PPL Electric's Magnetic Field Management Program has been developed to implement that policy decision. To reduce magnetic field exposures, the program generally prescribes the use of a line design that provides five feet higher ground clearance than NESC standards and reverse phasing of new double-circuit lines where it is feasible to do so at low or no cost.

Consistent with the program, PPL Electric will construct the new overhead line for a minimum of five feet higher ground clearance than NESC standards to reduce magnetic field exposures. Since the design is initially only a single circuit, reverse phasing is not possible. Reverse phasing will be evaluated in the future when system conditions require the installation of the second circuit.

C. RIGHT-OF-WAY STATUS

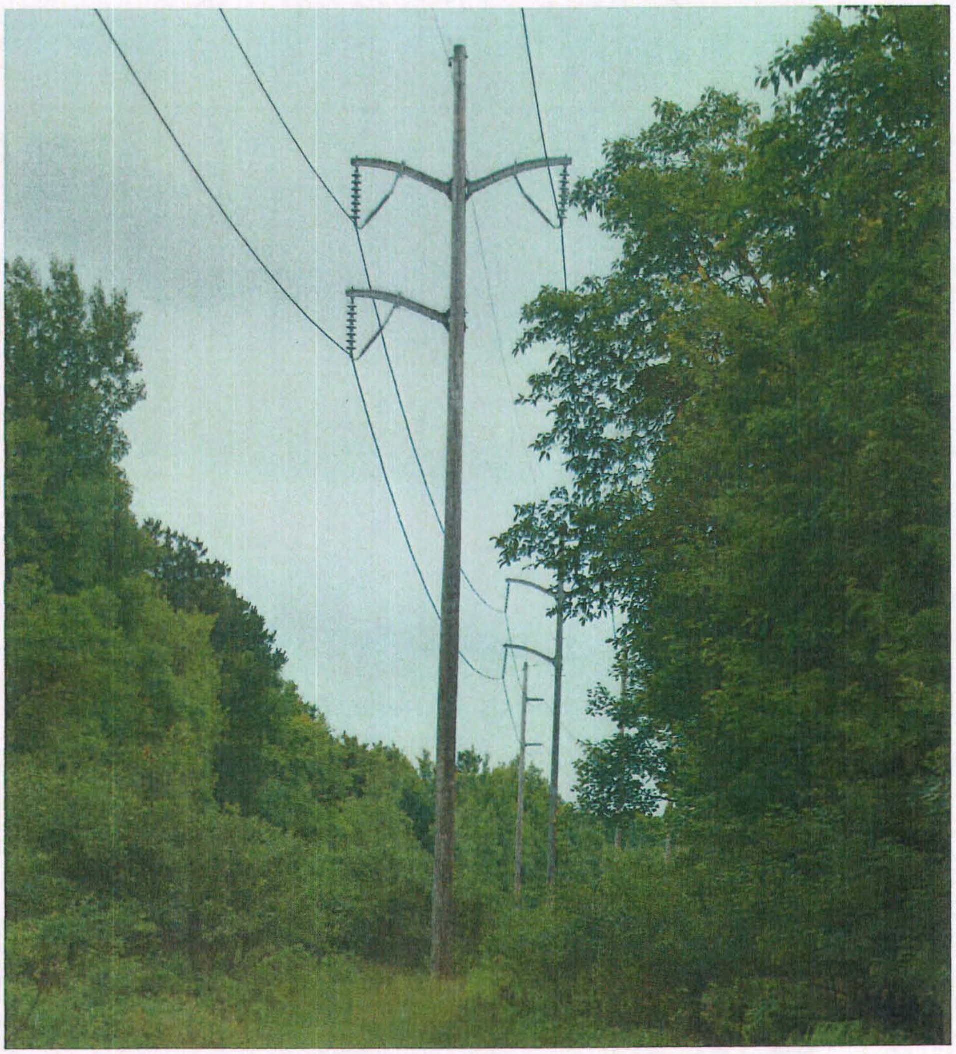
The Long Pond Tap Lines and Substation will be constructed on two separate parcels. PPL Electric requires a small section of new 100 foot wide right-of-way from one of the parcels crossed by the tap line in order to construct the project. The property owner has signed a right-of-way agreement for the required easement. The remaining property on which the tap line and substation will be constructed is owned in fee by PPL Electric. Attachment 6 identifies the owner of the property which will contain the proposed new right-of-way.

FIGURE 1 - TYPICAL 138/69 kV HIGH TAP POLE WITH GUY WIRES

Pole Height: 97 Feet

Phase Spacing: 12 Feet

FIGURE 2 - TYPICAL WOOD POLE TO BE REMOVED



Average Height: 65.5 Feet

Length of Wood Arms: 7 Feet

FIGURE 3 – TYPICAL 138/69 kV STEEL POLE

Pole Height: 70 Feet

Arm Length: 7 Feet

Phase Spacing: 12 Feet

FIGURE 4 – TYPICAL 138/69 kV STEEL SWITCH POLE

Pole Height: 70 Feet

Phase Spacing: 9 Feet

FIGURE 5 – TYPICAL 138/69 kV ANGLE POLE

Pole Height: 79 Feet

Phase Spacing: 12 Feet

FIGURE 6 – TYPICAL 138/69 kV STEEL POLE WITH STEEL UPSWEPT ARMS AND ANCHOR GUYS

Pole Height: 74.5 Feet

Arm Length: 7 Feet

Phase Spacing: 12 Feet

Attachment 3

ATTACHMENT 3
LONG POND #1 AND #2 138/69 kV TAP
ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

ATTACHMENT 3
LONG POND #1 AND #2 138/69 kV TAP
ENVIRONMENTAL ASSESSMENT

A. INTRODUCTION

To meet the increasing demand for electricity and to improve reliability, PPL Electric is proposing to construct the Long Pond #1 and #2 138/69 kV Tap to serve the proposed Long Pond 69-12 kV Substation. The Project involves the installation of approximately 650 feet of transmission line and six structures. The short tap will be designed for ultimate double-circuit 138 kV operation, although initially only one circuit will be installed, and it will be operated at 69 kV.

The Project was reviewed with Tobyhanna Township and Monroe County. Neither the Township nor the County had any objection. A list of involved governmental agencies, municipalities and other public entities is presented in Attachment 6.

B. LAND USE

The proposed tap line is located on two separate parcels of land in Tobyhanna Township, Monroe County. One property is a 20 acre parcel owned in fee by PPL Electric. This parcel will contain the proposed Long Pond Substation and a portion of the proposed tap line. The other property is an abandoned railroad corridor which contains an existing PPL Electric right-of-way and is traversed by the existing Lake Naomi 138/69 kV Tap Line, which will be renamed the Jackson-Wagners 138/69 kV Line as a result of a separate project currently pending with the Commission. The existing Lake Naomi Tap will be the electrical source for the proposed Long Pond Tap and Substation. A small section of new 100 foot wide right-of-way is required across this parcel to complete the Project. A right-of-way agreement has been signed by the property owner of the required parcel. The properties which will contain the proposed tap and substation are mostly wooded, with the exception of the existing transmission line right-of-way, and are within the Low-Density Residential Zoning District. The parcels adjoining the proposed tap and substation property are either residential lots or wooded parcels. Incremental land use impacts are anticipated to be minimal due to the fact that the Project is located in an area that contains existing PPL Electric facilities.

No nearby communication towers, pipelines, or other utilities will be affected by the proposed Project. Pocono Mountains Municipal Airport is located approximately 2.7 miles north of the Project area. PPL Electric does not anticipate any interference with airport operations because there are already existing transmission structures located in the Project area. However, PPL Electric will file any required documentation with both the Federal Aviation Administration and the Pennsylvania Department of Transportation Bureau of Aviation.

C. CULTURAL RESOURCES

The Project was reviewed by the Pennsylvania Historical and Museum Commission (PHMC). The PHMC has determined that there are no National Register eligible or listed historic or archaeological properties in the area.[1] Therefore, there are no anticipated impacts to such resources and no further investigations are required.

D. NATURAL FEATURES

The Project will not affect any unique geological, scenic, or natural areas. The recreational area located closest to the Project is State Game Lands (SGL) 127, which is located approximately 2 miles north of the Project location. There are no anticipated impacts to these features due to the distance from the project area, and the extensive development between the project area and the features.

Tree clearing is required, and PPL Electric will apply its "Specifications 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." The transmission tap line will not cross any wetlands or areas designated as "Waters of the U.S." or "Waters of the Commonwealth". PPL Electric will obtain all necessary permits from the Pennsylvania Department of Environmental

[1] File No. ER 2012-0743-089-A.

Protection and the United States Army Corps of Engineers and will comply with all conditions placed on the permits. In addition, PPL Electric will acquire any required soil erosion and sedimentation control permits and will comply with any conditions placed on those permits.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric has coordinated with state and federal agencies to obtain information regarding threatened and endangered species in close proximity to the project area. A review of the Pennsylvania Natural Diversity Inventory (PNDI) records indicates that there are no anticipated impacts to threatened and endangered species and/or special concern species and resources.[2]

[2] PNDI Search ID: 2012031334361.

Attachment 4

ATTACHMENT 4
LONG POND #1 AND #2 138/69 kV TAP
PPL ELECTRIC DESING 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 provisions 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 such things 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 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	Vertical Clearance to Ground 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	Vertical Clearance to Ground 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

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

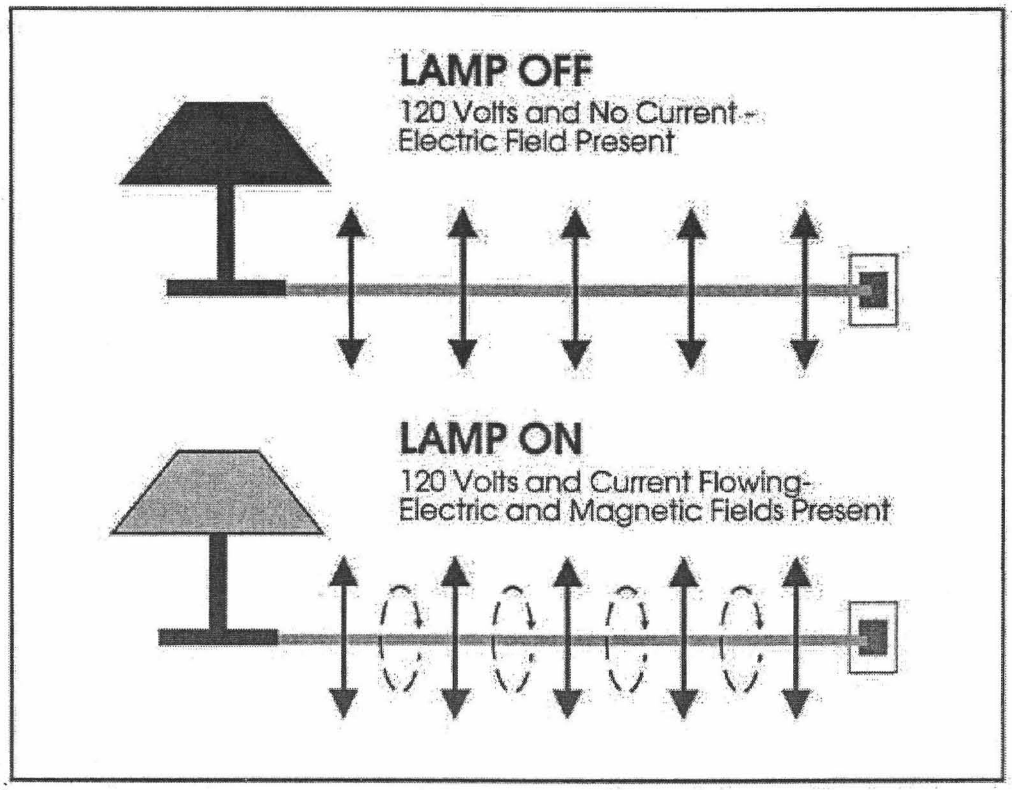

LAMP OFF
120 Volts and No Current -
Electric Field Present
LAMP ON
120 Volts and Current Flowing-
Electric and Magnetic Fields Present

Figure 2

Magnetic field strengths decrease with distance Magnetic fields are measured in milligauss	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

Source: "EMF In Your Environment", U.S. Environmental Protection Agency 1992

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.

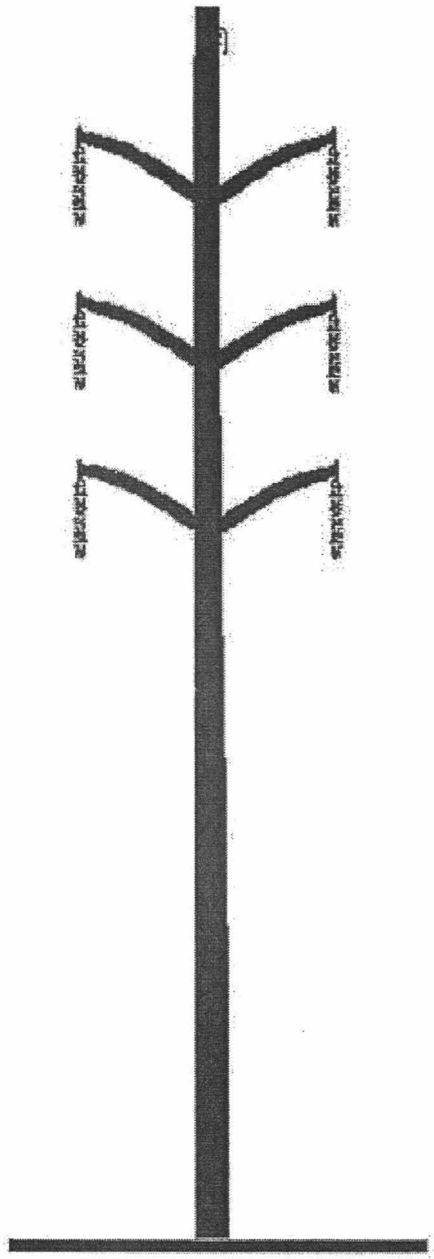
- Main lines are the most heavily loaded sections of a distribution line and therefore have the highest magnetic fields associated with them.
- Increasing the ground clearance by five feet reduces the magnetic field under the line from 14 mG to 11 mG using the standard eight-foot crossarm design. These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

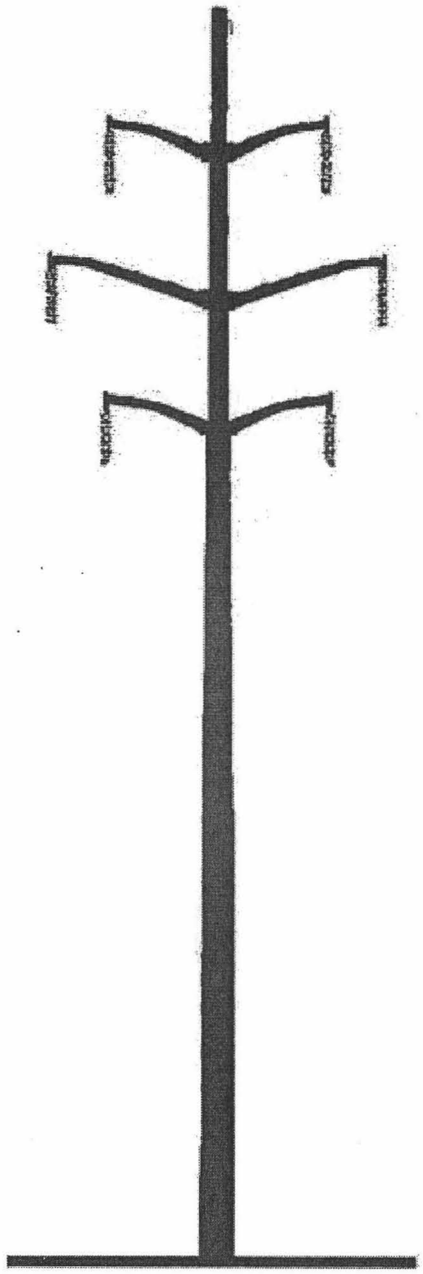
Short-Span Construction



- 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:**

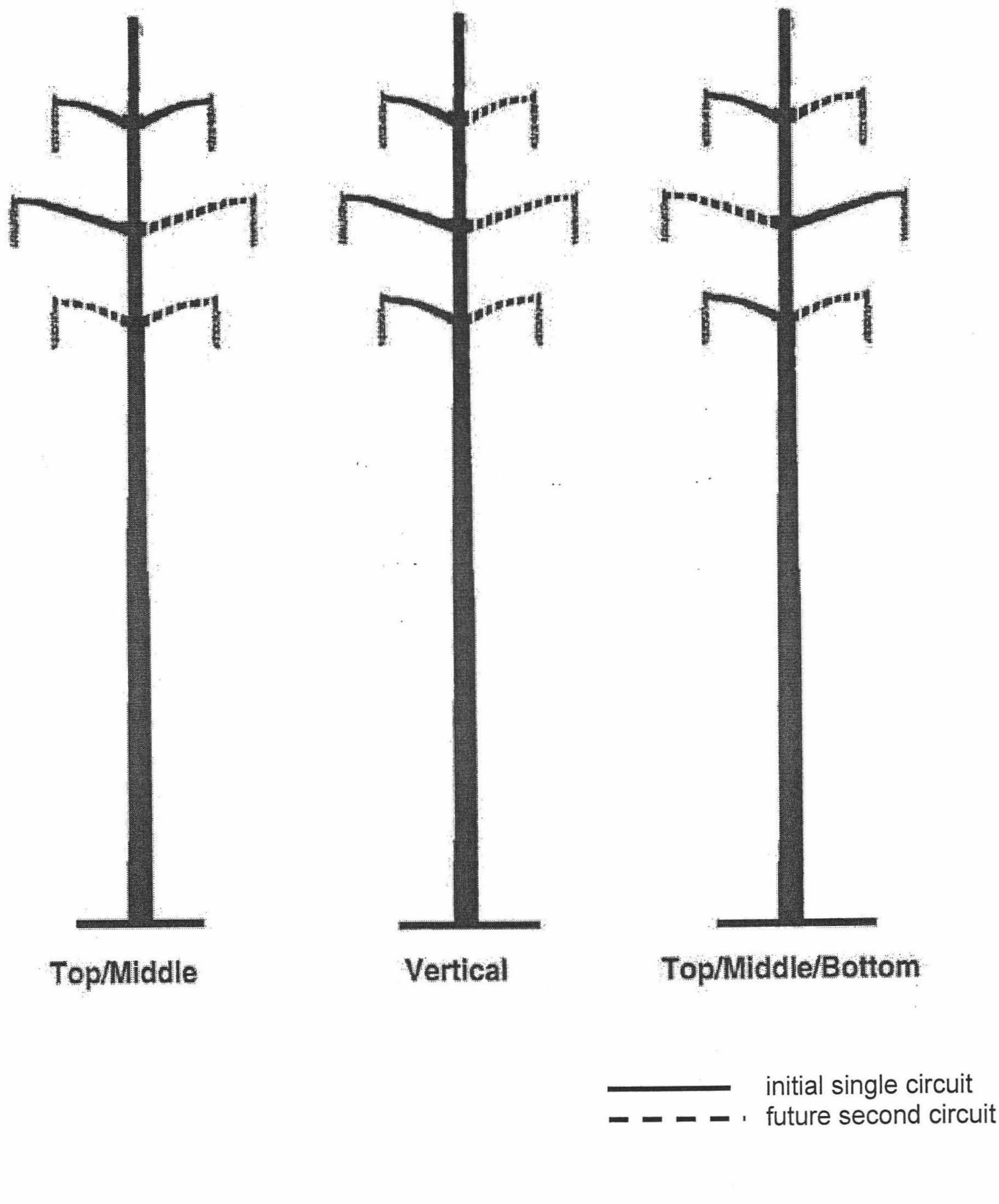
1 3/8" HS steel overhead ground wire - 17.3 feet sag
6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 23.0 feet sag
Average span - 600 feet

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

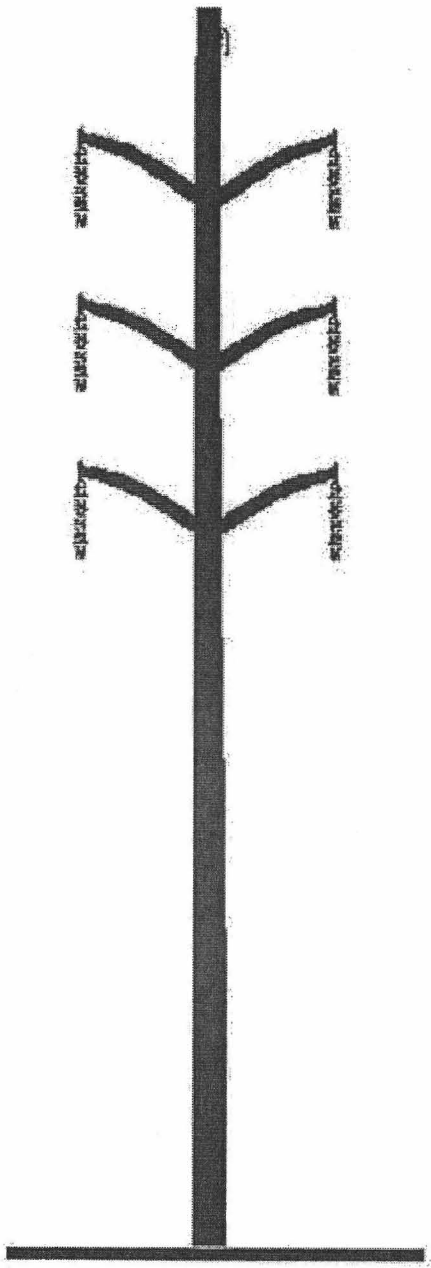


138/69 kV SINGLE CIRCUIT TRANSMISSION LINES
CALCULATED MAGNETIC FIELDS AT 400 AMPERES

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.

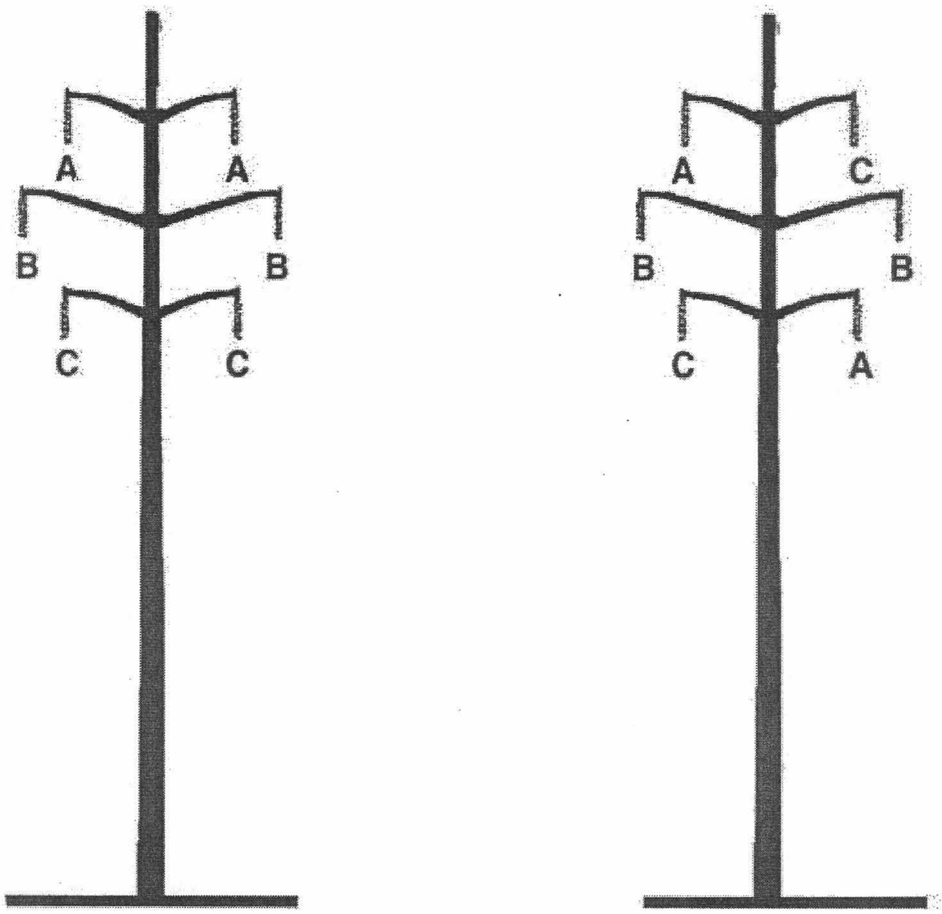
Compact Design Structure



- **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.

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
LONG POND #1 AND #2 138/69 kV TAP
LIST OF OWNERS OF PROPERTY WITHIN THE RIGHT-OF-WAY

Emerald Lakes Association Inc.
1112 Glade Drive
Long Pond, PA 18334

PPL Electric
2 North Ninth St
Allentown, PA 18101

Attachment 7

ATTACHMENT 7
LONG POND #1 AND #2 138/69 kV TAP
LIST OF INVOLVED GOVERNMENTAL AGENCIES, MUNICIPALITIES AND OTHER PUBLIC ENTITIES

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. Honorable Barry Schoch, P.E., Secretary
   Pennsylvania Department of Transportation
   c/o Office of Chief Counsel
   Commonwealth Keystone Building
   400 North Street, 9th Floor
   Harrisburg, PA 17120
   ATTN: Andrew Gordon, Esquire

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

4. Monroe County Planning Commission
   1 Quaker Plaza, Room 106
   Stroudsburg, Pennsylvania 18360
   Attn: Dan Ferguson

5. Monroe County Board of Commissioners
   1 Quaker Plaza, Room 201
   Stroudsburg, Pennsylvania 18360-2141
   Attn: John Moyer, Chairman

6. Tobyhanna Township Planning Commission
   105 Government Center Way
   Pocono Pines, PA 18350
   Attn: Mark Sincavage, Chairman

7. Tobyhanna Township Board of Supervisors
   105 Government Center Way
   Pocono Pines, PA 18350
   Attn: John Kerrick, Chairman