Before the
Pennsylvania Public Utility Commission

LYCOMING-LOCK HAVEN #4
138/69 kV TRANSMISSION LINE

ATTACHMENTS IN SUPPORT OF THE
Letter of Notification

Application Docket No.____________

Submitted by: PPL Electric Utilities Corporation

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 construct approximately 1,300 feet of new single-circuit 138/69 kV transmission line. This line extension is required to reterminate the existing Lycoming-Lock Haven #4 138/69 kV Line into the proposed Lock Haven 138/69 kV Switchyard. This Project is located in the Castanea Township, Clinton County.

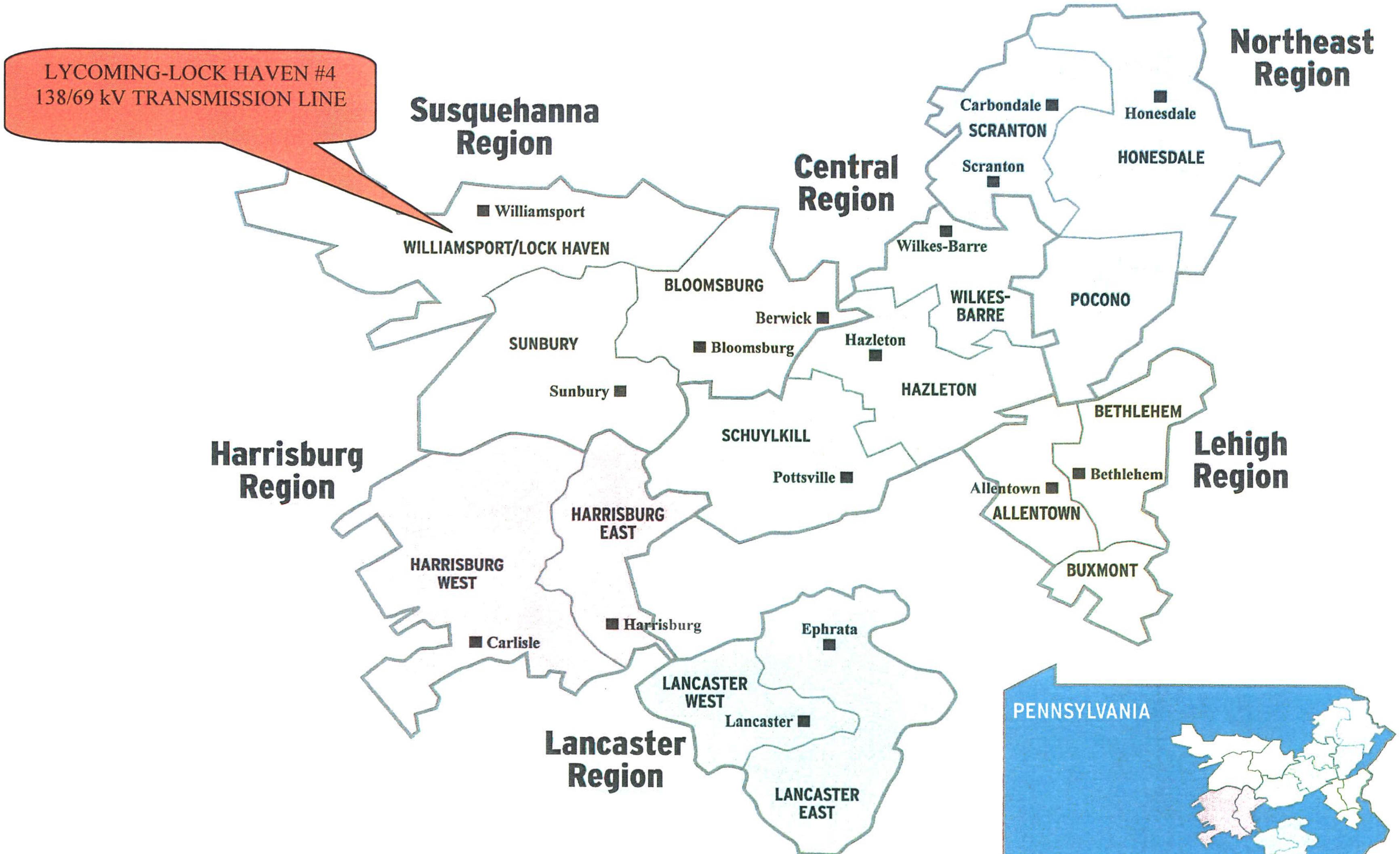
The Project, including the proposed switchyard, is required to improve reliability and operating flexibility of PPL Electric's system. The reconfiguration will also help to meet the increasing demand for electrical power in the area.

The total estimated cost of this solution is approximately $23.3 million, which includes: $22.8 million for the new switchyard and associated 69 kV line re-terminations; and $516,000 for the Lycoming-Lock Haven #4 138/69 kV Transmission Line extension. Construction is scheduled to begin in December, 2013 to support the Project's scheduled in-service date of June, 2015.

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
Attachment 7	List of Involved Governmental Agencies, Municipalities, and Other Public Entities

PPL ELECTRIC UTILITIES SERVICE TERRITORY



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ATTACHMENT 1
LYCOMING – LOCK HAVEN #4 138/69 kV TRANSMISSION LINE
NECESSITY STATEMENT

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ATTACHMENT 1
LYCOMING – LOCK HAVEN #4 138/69 TRANSMISSION LINE
NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric is requesting Commission approval to site and construct a single-circuit 138/69 kV transmission line extension. The proposed line will increase the length of the existing Lycoming – Lock Haven #4 line by approximately 1300 feet, and will be routed in a southward direction from its current termination point at the existing Lock Haven 69 kV Switchyard to a new termination point at the to-be-constructed Lock Haven 138/69 kV Switchyard.

The line extension is required so that the existing Lycoming – Lock Haven #4 line can be re-terminated into the new switchyard. The new switchyard is needed to resolve operating limitations during line and equipment maintenance. These limitations currently exist at the existing Lock Haven 69 kV switchyard. The new switchyard, when placed into service, will overcome those operating limitations and also improve reliability of service for the customers located in the Castanea Township and Lock Haven areas of Clinton County.

The proposed line extension will be designed as a single-circuit 138 kV pole-line, but initially operated at 69 kV. In the future, when customer load increases to a level where operation at a higher voltage is necessary to serve the local area, the line will then be converted to 138 kV operation.

The estimated cost to design and construct this project is approximately $23.3 million, which includes $22.8 million for the new switchyard and the 69 kV line terminations and $516,000 for the Lycoming – Lock Haven #4 138'69 kV Transmission Line Extension. Construction is scheduled to begin in December, 2013 to support the Project's scheduled in-service date of June, 2015.

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 Castanea Township and Lock Haven areas.

B. EXISTING SYSTEM

Currently, the Lock Haven 69-12 kV Substation (distribution asset) and the Lock Haven 69 kV Switchyard (transmission asset), including its seven 69 kV transmission lines, serve approximately 6,800 customers in the Castanea Township and Lock Haven areas. One of the transmission lines, the Lycoming – Lock Haven #4 138/69 kV line, is designed to operate at 138 kV, but currently operates at 69 kV. The existing 69 kV switchyard enables PPL Electric to switch transmission loads among the seven 69 kV lines and also provides electric power to the Lock Haven 69-12 kV distribution substation.

There is no source of electric power available from the bulk electric system[1] in the Lock Haven area. As a result, four 69 kV transmission lines are needed to connect the existing Lock Haven 69 kV Switchyard to a source at the Lycoming 230-69 kV Substation; and one 69 kV transmission line is needed to connect the Lock Haven 69 kV Switchyard to a second source at the Sunbury 230-138-69 kV Substation. Those five 69 kV lines are, and will continue to be, operated in a "networked" configuration. This networked configuration provides a source of power to the Lock Haven 69 kV Switchyard from both the Lycoming and Sunbury regional substations. However, these two sources of electric power are located approximately 25 miles to the northeast and 40 miles to the southeast of the Lock Haven 69 kV Switchyard. Two other 69 kV transmission lines are sourced from the Lock Haven 69 kV Switchyard through a radial configuration; the Lock Haven-Renovo 69 kV Line, has limited 12 kV back-up supply through the Renovo 69-12 kV distribution substation; the Lock Haven-Flemington 69 kV Line does not have a backup supply. Refer to Figure 1, on page 8, for a functional one-line diagram of the existing transmission system in the area.

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[1] Electric power facilities operating at voltages greater than 100 kV.

C. DEFINITION OF THE PROBLEM

Due to the existing electrical arrangement of the Lock Haven 69 kV Switchyard, see Figure 3 on Page 10, voltage violations would result at multiple 69 kV substation buses, and three 69 kV line segments would become loaded above the emergency rating under a 2012 summer peak load condition, if a certain contingency[2] occurs. These buses and lines are located throughout the Lock Haven area. Six different contingencies have been identified that would cause a voltage change that exceeds the PPL Electric "Reliability Principles & Practices" (RP&P) guidelines. Those guidelines require that any voltage change at a bus be limited to no more than a 5 percent difference from the pre-contingency voltage. Also, the post-contingency bus voltage must remain within the planning range of 62 kV to 68 kV. An additional five different contingencies have been identified that would cause multiple line segments to be loaded above the emergency rating. The RP&P guidelines state that no electrical facility may be loaded above its emergency rating after a contingency occurs. Furthermore, even under a light load scenario, two of the six contingencies would produce voltages at multiple buses that exceed the allowed 5 percent difference and fall below the lower limit.

In the worst case scenario, one contingency would cause fourteen 69 kV buses to experience a voltage below 62 kV, with those low voltages ranging from 8.1 percent to 12.6 percent from pre-contingency levels. The latter voltage drop would result in a bus voltage of 56.6 kV. For that same contingency, those same fourteen 69 kV buses would experience a voltage change (drop) from the pre-contingency value that ranges from 7.1 percent to 12.6 percent. This post-contingency voltage range greatly exceeds the 5 percent deviation that the RP&P allows. The PPL Electric Transmission System Operator would have to shed customer load in order to restore the local 69 kV bus voltages to the 62 to 68 kV range that the RP&P requires.

In analyzing the outcomes of the six contingencies which result in voltage drop violations to the RP&P, the median[3] voltage change is 7.7 percent. The number of customers that would be interrupted if three of these contingencies were to occur ranges from approximately 2000 to 8800

[2] Unplanned outage of a line, bus, transformer, or other power system element.
[3] Half of the values are above the stated number and half are below.

customers. The other three contingencies will not interrupt customers initially but will cause voltages at local 69 kV buses to drop below the planning and operating range (62 kV). That outcome will require the Transmission System Operator to shed load and ultimately interrupt customers connected to those 69 kV lines.

As mentioned above, there are five contingencies that would result in overloaded line segments if they should occur during peak loading conditions. If an outage of the double-circuit Lycoming – Lock Haven #3 & #4 69 kV Line[4] were to occur, the Woolrich Tap to Jersey Shore #1 and # 2 line segments on the Lycoming-Lock Haven #1 & #2 69 kV line would be loaded to 114.4 percent and 116.4 percent, respectively, of their emergency rating. This level of line loading violates the RP&P guidelines. No residential or commercial customers, other than a large-power paper manufacturing facility, initially would be interrupted. However, due to the post-contingency line overloads, the Transmission System Operator would shed some customer load in order to restore line loadings to within the appropriate operating range. The load shed would remain in effect until the reason for the line outage could be determined and repairs made to restore the system.

If an outage of the Lycoming – Lock Haven #3 69 kV line were to occur along with the Lock Haven 69 kV circuit breaker 4-7, or breaker "B1" failing to operate or "open" (breaker 4-7 sticks, also identified as breaker "B1"), the Woolrich Tap to Jersey Shore #1 and #2 line segments on the Lycoming-Lock Haven #1 & #2 69 kV line would be loaded to 114.4 percent and 116.4 percent of the emergency rating – similar to the scenario described above. No customers initially would be interrupted. However, due to the post-contingency line overloads, the Transmission System Operator would shed some customer load in order to restore line loadings to the appropriate operating range. The load shed would remain in effect until the reason for the line outage could be determined and repairs made to restore the system. This contingency will not occur when the new breaker-and-a-half[5] switchyard arrangement is operational.

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[4] A double-circuit 69 kV pole-line is considered to be a single-element failure.
[5] A substation electrical arrangement whereby two transmission lines terminated within a line bay are protected by three circuit breakers; each line shares the third, or middle, breaker in addition to having its own breaker.

If an outage of the Lycoming – Lock Haven #4 138/69 kV line were to occur along with the Lock Haven 69 kV circuit breaker 7-5, or breaker "B2" failing to operate or "open" (breaker 7-5, or "B2" sticks), the Woolrich Tap to Jersey Shore #1 line segment on the Lycoming-Lock Haven #1 69 kV line would be loaded to 101.9 percent of the emergency rating. This level of line loading violates the RP&P guidelines. Based on 2011 customer data, approximately 6500 customers would be interrupted until the reason for the line outage could be determined and repairs made to restore the system. This contingency will not occur when the new breaker-and-half switchyard arrangement is operational.

When performing maintenance on the Lock Haven 69 kV circuit breaker 3-4, or breaker "A", if the Lock Haven 69 kV circuit breaker 5-6, or breaker "B" were to trip unexpectedly, the Lock Haven to Jersey Shore segment of the Lycoming-Lock Haven #1 69 kV line would be loaded to 144.0 percent and 122.4 percent, respectively, of the emergency rating. These levels of line loading would violate the RP&P guidelines. No customers initially would be interrupted. However, due to the post-contingency line overloads, the Transmission System Operator would shed some customer load in order to restore line loadings to the appropriate operating range. The load shed would remain in effect until the reason for the line outage could be determined and repairs made to restore the system. This contingency will not occur when the new breaker-and-a-half switchyard arrangement is operational.

When performing maintenance on the Lock Haven 69 kV circuit breaker 4-7, or breaker "B1", if the Lock Haven 69 kV circuit breaker 5-6, or breaker "B" would trip unexpectedly, the Woolrich Tap to Jersey Shore #1 line segment on the Lycoming-Lock Haven #1 69 kV line would be loaded to 115.4 percent of the emergency rating. This level of line loading violates the RP&P guidelines. No customers initially would be interrupted. However, due to the post-contingency line overloads, the Transmission System Operator would shed some customer load in order to restore line loadings to the appropriate operating range. The load shed would remain in effect until the reason for the line outage could be determined and repairs made to restore the system.

This contingency will not occur when the new breaker-and-a-half switchyard arrangement is operational.

The existing switchyard design has physical constraints that prevent expansion.
The seven-breaker ring-bus arrangement in the existing yard cannot be modified in its present location to create a switchyard of standard design due to the lack of available space. The seven-breaker ring-bus is the major reason why the voltage RP&P violations explained above occur. In a ring-bus arrangement, when one transmission line experiences a contingency, the circuit breakers on either side of that line termination will "open" in order to remove that line from service (Figure 3). The opening of those two circuit breakers "separates" the ring. The remaining transmission lines that are still in-service lose the electrical support provided by an intact ring-bus, and in some scenarios the remaining lines lose the electric support provided by the regional substations at Lycoming and Sunbury. The ring-bus is electrically weakened, and the result is either overloaded line segments or bus voltages that drop below the lower planning and operating limits. PPL Electric current design standards now require a breaker-and-half arrangement.

Due to the existing ring-bus design at the switchyard, the ability to perform periodic maintenance on substation equipment in the future will become more and more difficult due to of the system configuration that results. A breaker out for maintenance and a subsequent line outage may lead to overloads and unacceptable voltage levels, even in lighter load periods. The ultimate consequence would be that periodic maintenance of certain station equipment would not be allowed due to of the harm it would cause to the electrical grid. Not performing maintenance is counter to PPL Electric operational standards and good utility practice.

D. PROPOSED SOLUTION

In order to resolve the issues discussed above, PPL Electric proposes to build a new Lock Haven 138/69 kV switchyard and therefore seeks PUC approval to construct the Lycoming – Lock Haven #4 138/69 kV line extension so that the existing transmission line can be re-connected from the existing yard into the new yard. After the Commission's approval of the new line extension, PPL Electric will construct the Lock Haven 138/69 kV switchyard that will terminate the line extension and six other 69 kV lines. These system additions will mitigate maintenance constraints that currently exist, while increasing reliability and operating flexibility in the local area, which would give the Transmission System Operator more options to reconfigure the transmission lines when maintenance needs to be performed.

The total estimated cost of this solution is approximately $23.3 million, which includes: $22.8 million for the new switchyard and associated 69 kV line re-terminations; and $516,000 for the Lycoming-Lock Haven #4 138/69 kV Transmission Line extension. Refer to Figure 2, on page 9, for a functional one-line diagram of the proposed transmission system configuration in this area.

E. FUNCTIONAL ALTERNATIVE

There is no alternative solution to extending the Lycoming – Lock Haven #4 line or to building the new switchyard that would resolve all of the RP&P violations explained above. Without the proposed Project explained above, the current maintenance and operating issues would remain. PPL Electric would find it increasingly difficult, if not impossible at some future date, to schedule equipment maintenance at the existing switchyard and on the seven lines that terminate into it. The result would be a degradation in switchyard equipment and electric power lines, exposing the utility employees to danger. Reliability to the local area would decrease. The Transmission System Operators, who operate the system, would gain no improvement in operational flexibility without the new switchyard and the related line extension.

The Project described in Section D, above, will enable the Company to perform necessary maintenance on the lines connected to, and the equipment located in, the new Lock Haven 138/69 kV Switchyard, while providing additional reliability and operating flexibility to the local 69 kV system. Furthermore, the preferred alternative will resolve the voltage violations and line segment overloads that occur under contingency situations.

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ATTACHMENT 3
LYCOMING-LOCK HAVEN #4 138/69 kV TRANSMISSION LINE
ENVIRONMENTAL ASSESSMENT

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ATTACHMENT 3
LYCOMING-LOCK HAVEN #4 138/69 kV TRANSMISSION LINE
ENVIRONMENTAL ASSESSMENT

A. INTRODUCTION

PPL Electric is seeking Commission approval to construct approximately 1,300 feet of new 138/69 kV transmission line. The new section of line will become part of the existing Lycoming-Lock Haven #4 138/69 kV Transmission Line and terminate into the proposed Lock Haven Switchyard. This Project is required to resolve reliability and low voltage issues, as well as improve operating flexibility in the area.

The proposed Project was reviewed with Castanea Township and Clinton County. The Township and the County had no objection. A list of involved governmental agencies, municipalities and other public entities is included as Attachment 7.

B. LAND USE

The Project is located on property owned in fee by PPL Electric. No additional property rights are required to complete this Project.

Existing land use in the area is mixed. The property on which the Project is located is mostly wooded and contains existing PPL Electric facilities such as transmission lines and the existing Lock Haven 69 kV Switchyard. The surrounding properties are either residential or wooded lots. Zoning in the area of the Project is Residential Use. Incremental land use impacts are anticipated to be minimal due to the facts that the Project is located in an area that contains existing PPL Electric facilities and that no additional land rights are required.

No nearby communication towers, pipelines or other utilities will be affected by the proposed construction. The closest point of the William T Piper Memorial airport is approximately 0.80 miles from the Project location. PPL Electric does not anticipate any interference with airport operations because there are already existing structures located in the area of this Project. The new structures will be approximately the same height as the existing structures. However, PPL Electric will file any required documentation with both the Federal Aviation Administration and the PennDOT Bureau of Aviation.

C. CULTURAL RESOURCES

The proposed Project was reviewed by the Pennsylvania Historical and Museum Commission (PHMC). The PHMC has reviewed the Project in relation to potential effects on both historic and archaeological resources. Correspondence from the PHMC, dated February 24, 2012 (File No. ER 2012-0718-035-A) indicates that the Logan Avenue Historic District is located near the project area. Although the Logan Avenue Historic District is located near the project area, the PHMC has determined that the proposed Project will have no effect on the resource. In addition, the PHMC has determined that no archaeological investigations are required. If, however, PPL Electric becomes aware of any previously unidentified resources that would be affected by the construction, the Bureau for Historic Preservation will be contacted immediately.

D. NATURAL FEATURES

The proposed Project will not affect any unique geological, scenic, or natural areas. No National Natural Landmarks, parks, recreational facilities, or natural areas will be affected by the proposed Project. Bald Eagle State Forest is the closest recreation area and is located approximately 0.50 miles from the project area. No impacts are anticipated due to the distance from the Project, the extensive development in the area surrounding the proposed Project, and the fact that there are existing PPL Electric facilities in the area of the proposed Project.

Vegetation removal will be necessary for this Project. 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" to mitigate any impacts.

PPL Electric will obtain all necessary permits from the Pennsylvania Department of Environmental 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 all conditions placed on those permits.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric has contacted different 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 (PNDI Search ID 20120306342317) indicates that there are no potential impacts for species of special concern and resources within, or in close proximity to, the project area.

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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	Vertical Clearance to Ground: 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.

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MAGNETIC FIELD MANAGEMENT

PPL Electric Utilities Corporation

DECEMBER 2004

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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

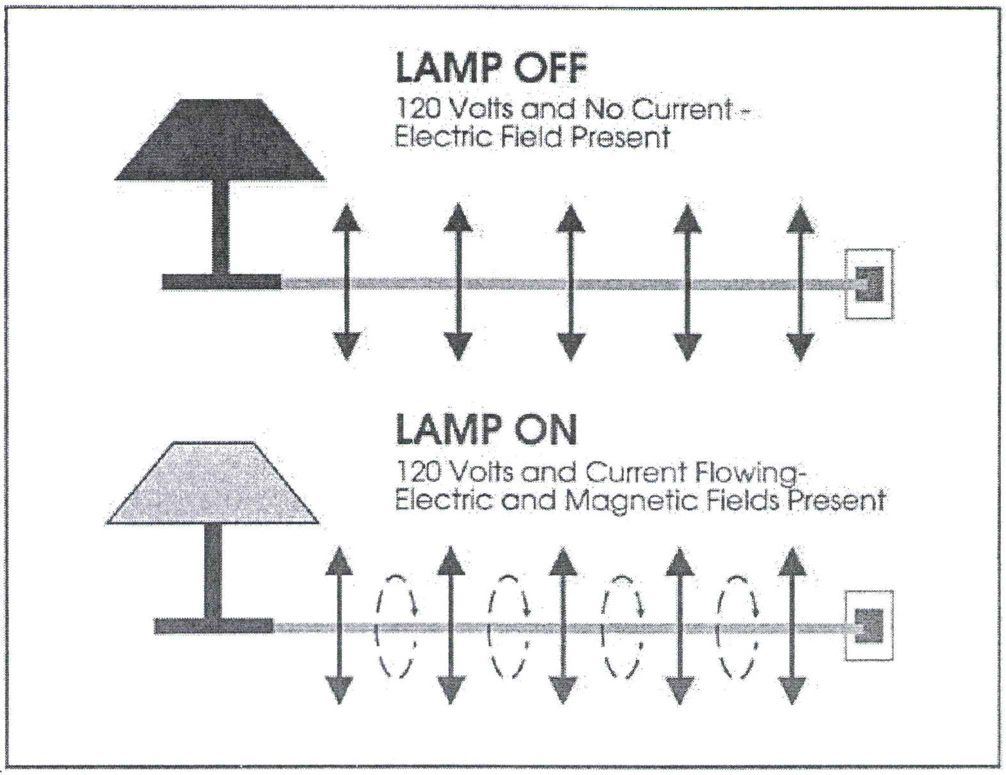

LAMP OFF
120 Volts and No Current -
Electric Field Present
LAMP ON
120 Volts and Current Flowing-
Electric and Magnetic Fields Present

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.

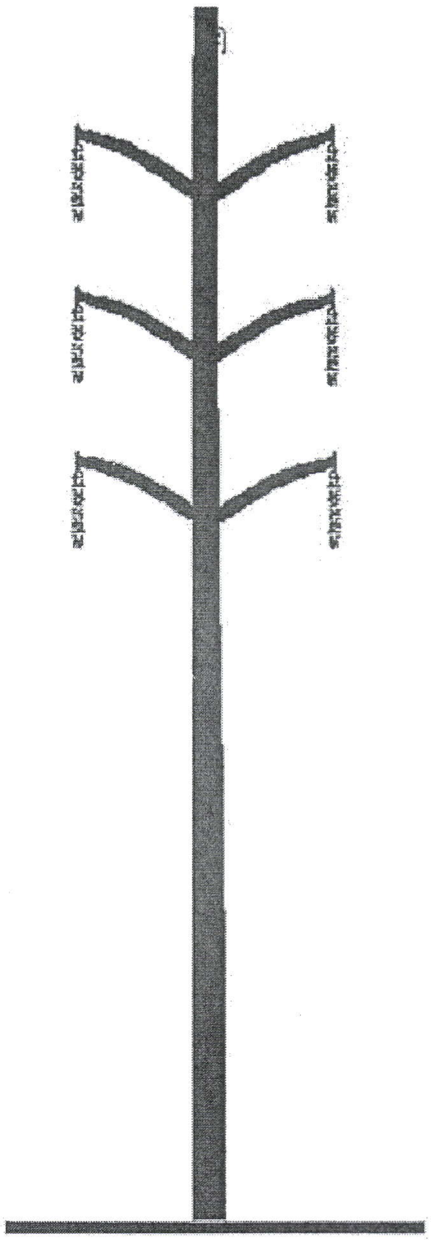
UNDERGROUND TRANSMISSION LINES

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.

CHART I

Short-Span Construction

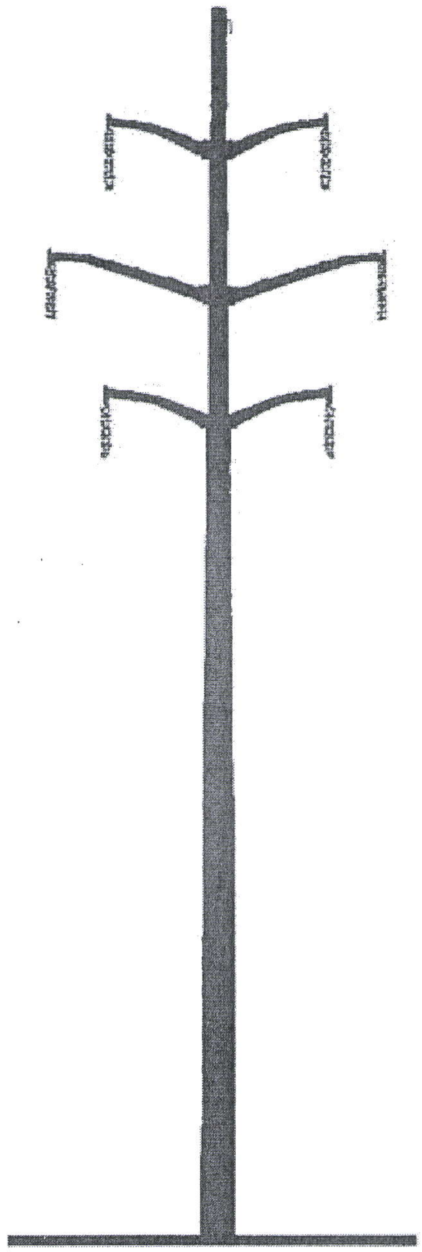


- **More compact design**
- **Should not be used solely to reduce magnetic fields**
- **Typical conductor data:**

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

CHART II

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

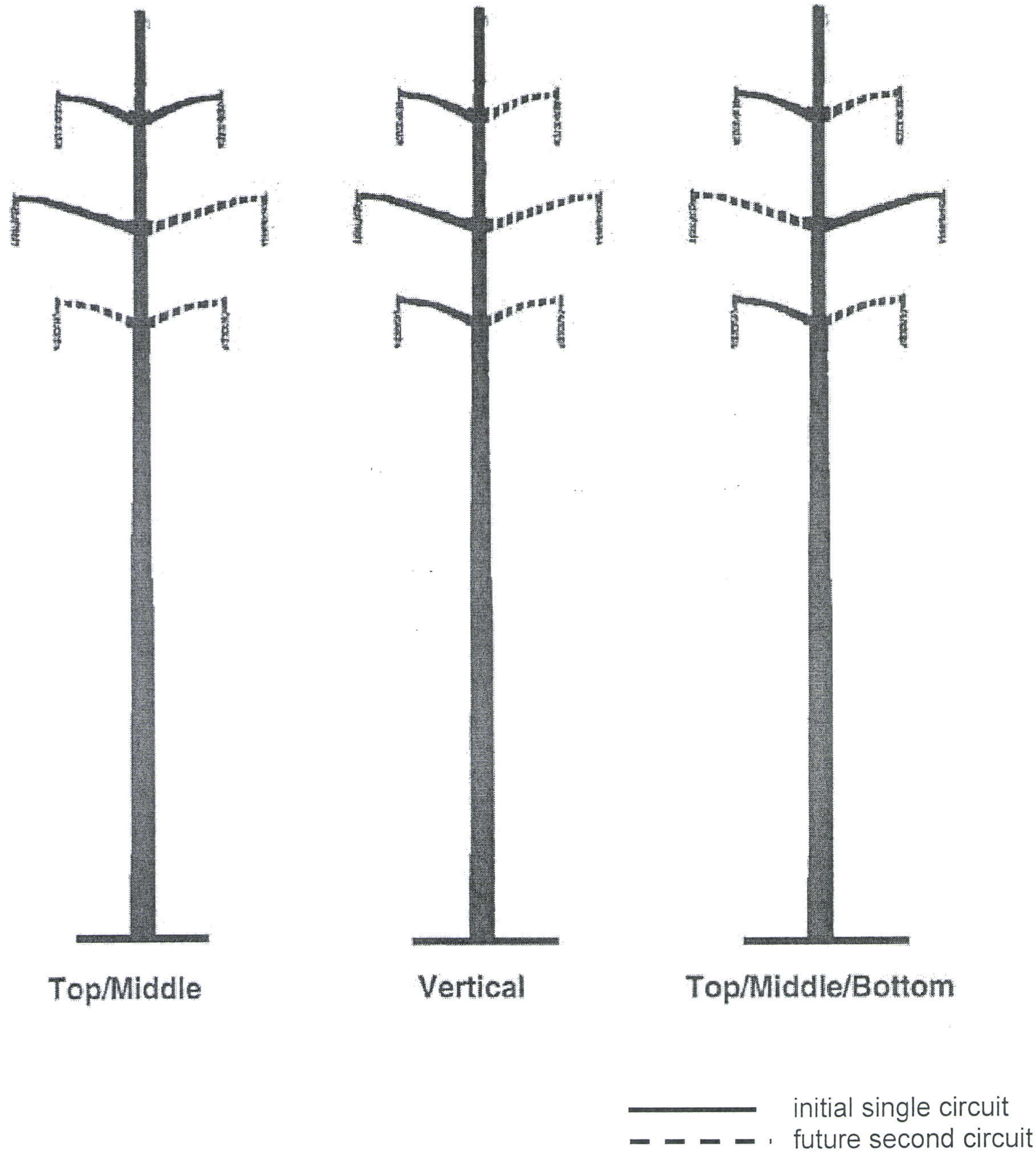


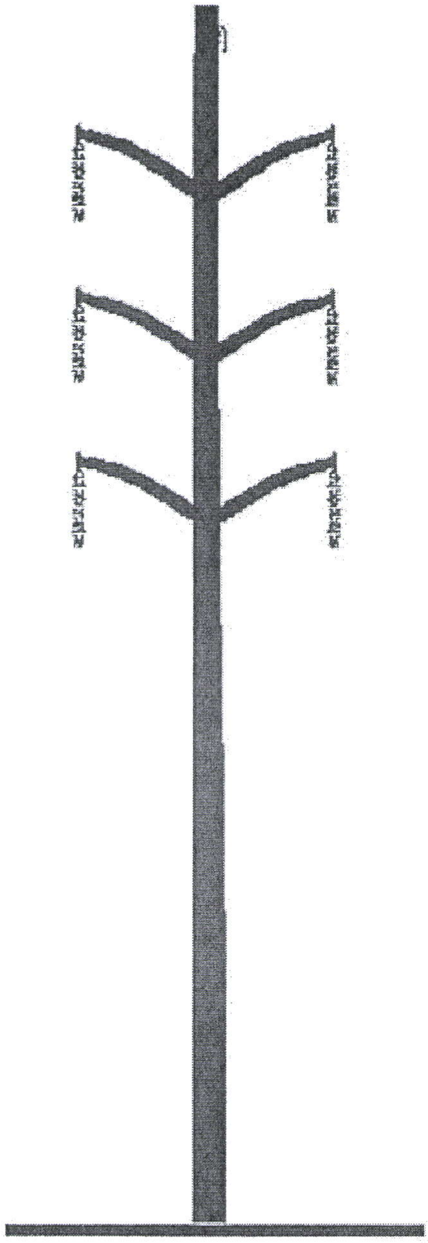
CHART V

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

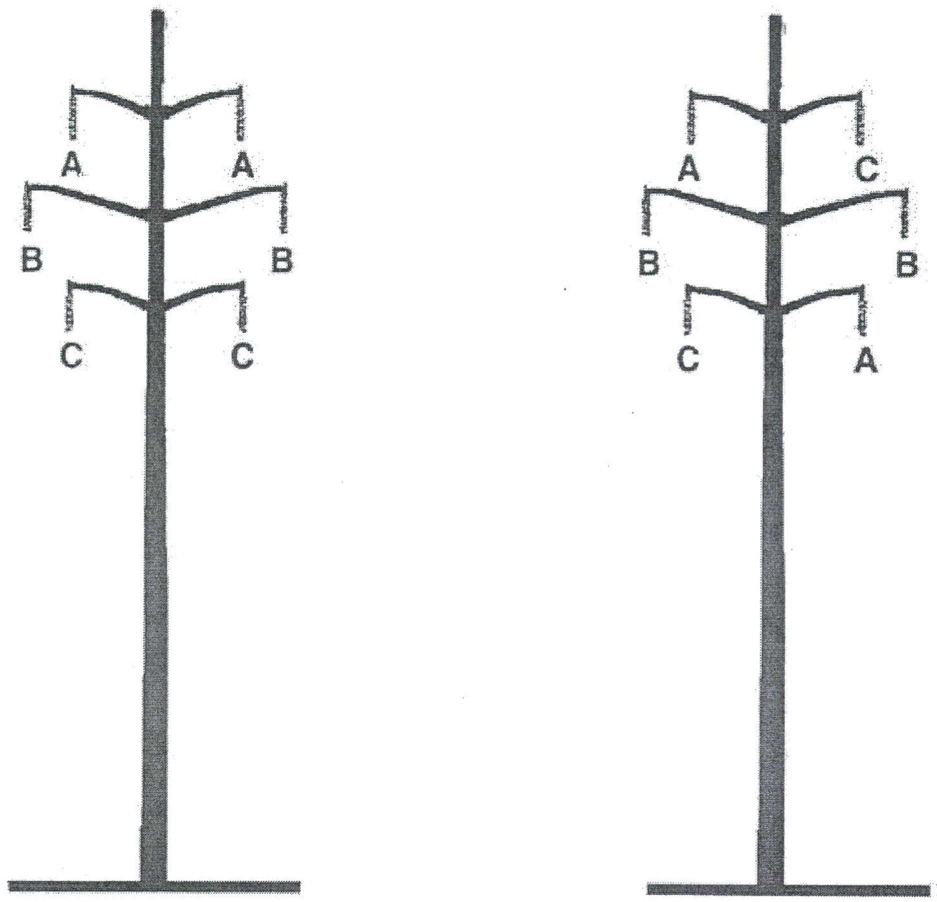


- Minimize magnetic fields due to compact design
- Not a low-cost alternative
- Typical conductor data:

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

CHART VII

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.

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.

CHART XII

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

Tab

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ATTACHMENT 6
LYCOMING-LOCK HAVEN #4 138/69 kV TRANSMISSION LINE
LIST OF OWNERS OF PROPERTY

PPL Electric
2 N 9Th St
Allentown, PA 18101

Tab

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ATTACHMENT 7
LYCOMING-LOCK HAVEN #4 138/69 kV TRANSMISSION LINE
LIST OF INVOLVED GOVERNMENTAL AGENCIES, MUNICIPALITIES AND OTHER PUBLIC ENTITIES

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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: Barry J. Schoch, P.E., Secretary

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

4. Clinton County Planning Commission
   232 East Main Street
   Lock Haven, PA 17745

5. Clinton County Board of Commissioners
   232 East Main Street
   Lock Haven, PA 17745
   Attn: Robert Smeltz, Chairman

6. Castanea Township Planning Commission
   347 Nittany Road
   Lock Haven, PA 17745
   Attn: Joseph Miller, Chairman

7. Castanea Township Board of Supervisors
   347 Nittany Road
   Lock Haven, PA 17745
   Attn: Susan Heaton, Township Secretary