

Before the
Pennsylvania Public Utility Commission

**ELLIOT HEIGHTS 138/69 kV TAP
TRANSMISSION LINE REBUILD**

ATTACHMENTS IN SUPPORT OF THE
Letter of Notification

Application Docket No. _____

Submitted by: PPL Electric Utilities Corporation



ATTACHMENT 1
ELLIOT HEIGHTS 138/69 KV TAP TRANSMISSION LINE REBUILD
NECESSITY STATEMENT

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ATTACHMENT 1
ELLIOT HEIGHTS 138/69 KV TAP TRANSMISSION LINE REBUILD
NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric Utilities Corporation (PPL Electric) proposes to rebuild approximately 2.6 miles of the existing Elliot Heights #1 and #2 138/69 kV Tap Line in order to improve electric reliability in the region (the “Project”). As explained below, the existing Elliot Heights Tap #1 and #2 138/69 kV Tap Line has exceeded its useful life and cannot be relied upon to continue to provide reliable service into the future. The proposed rebuild of the Elliot Heights #1 and #2 138/69 kV Tap Line is part of PPL Electric’s Asset Optimization Strategy, and involves rebuilding the line to meet all current design and lightning protection standards. The modernization of the line will help ensure reasonably continuous and reliable service.

The rebuilt Elliot Heights #1 and #2 138/69 kV Tap Line will be located in Salisbury Township and City of Bethlehem, Lehigh County, Pennsylvania. The estimated cost to design and construct the Project is approximately \$5.5 million. Subject to the Commission’s approval, the Project has a scheduled construction start date of February 2016 to meet an in-service date of July 2016.

B. SYSTEM PLANNING PROCESS

System Planning is the process which assures that the transmission system can supply electricity to all customer loads in a manner that is reliable and economic. This System Planning process assures that the electric system is planned and constructed so that:

- It is able to accommodate forecasted system flows during summer and winter peak load;

- It can adequately serve each customer's needs with regard to capacity, voltage and reliability for all load levels throughout the daily load cycle;
- It can sustain probable contingencies and disturbances with minimal customer service interruptions;
- It is in conformance with PPL Electric's transmission planning reliability principles, practices and standards for all normal and emergency operating conditions; and,
- The age and/or operability of electric system does not cause undue customer outages due to equipment failures while staying economically feasible and avoiding excessive maintenance costs.

The process of planning the transmission system requires PPL Electric to look into the future to develop a reinforcement plan far enough in advance to be able to complete a project when it is needed. Ideally, transmission facility upgrades are planned such that the in-service date has a safety margin prior to when the equipment is predicted to fail, causing customer outages. Significant lead times are needed to design and install new line and substation facilities where new sites and/or rights-of-way and regulatory approvals must be acquired.

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

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

- The system should have an adequate level of operability to provide functional options and data collection to improve the system operations and overall customer experience

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

C. EXISTING SYSTEM

The Elliot Heights #1 and #2 138/69 kV Tap Line serves the Elliot Heights 138-69 kV Substation, which currently supplies approximately 7,160 customers. From the Elliot Heights 138-69 kV Substation the Elliot Heights #1 and #2 138/69 kV Tap Line extends south approximately 0.4 miles to a tap point with the Fountain Hills #1 and #2 138/69 kV Tap Line, which feeds the Fountain Hill 138-69 kV Substation that serves approximately 2,099 customers. From the Fountain Hill tap point, the Elliot Heights #1 and #2 138/69 kV Tap Line continues southwest approximately 2.2 miles where it taps into the Hosensack-Quarry #1 and #2 138/69 kV Transmission Line.

The Elliot Heights #1 and #2 138/69 kV Tap Line parallels the Hosensack-Allentown #1 and #2 69 kV Transmission Line for approximately 0.6 miles between East Susquehanna Street to the tap point with the Hosensack-Quarry #1 and #2 138/69 kV Transmission Line. This segment of the Hosensack-Allentown

#1 and #2 69 kV Transmission Line is located approximately 100 to 225 feet to the east of the Elliot Heights #1 and #2 138/69 kV Tap Line. The Hosensack-Allentown #1 and #2 69 kV Transmission Line was inactivated in 2009 and no longer provides electric service to customers.

As explained in Attachment 3, PPL Electric is rebuilding the first 0.6 mile of the Hosensack – Allentown 69 kV Lines as opposed to rebuilding the entire Elliot Heights #1 and #2 138/69 kV Tap Lines to reduce the impact of the rebuild on adjacent residences.

Figure 1-1 provides a one-line diagram existing and proposed facilities. Figure 1-2 provides a map of the existing facilities.

D. DEFINITION OF THE PROBLEM

The Elliot Heights #1 and #2 138/69 kV Tap Line has been in service since 1960. The line is operating utilizing a mix of 4/0 copper and 4/0 aluminum-conductor steel-reinforced (ACSR) conductors. The existing structures consist of lattice steel and wooden monopole structures that do not meet current design or height standards.

PPL Electric has analyzed the Elliot Heights #1 and #2 138/69 kV Tap Line and concluded that the conductors and structures have reached the end of their useful lives. The assessment found deterioration of the structural components, foundations, insulators, line hardware, shield wire, grounding, signage, and an outdated structure design.

PPL Electric has also observed issues with the splices on the Elliot Heights #1 and #2 138/69 kV Tap Line. Specifically, certain splices demonstrated significant deterioration with resistance ratios well above acceptable levels. Conductor

splices that exceed the acceptable resistance ratios pose a significant risk of failure, which could result in outages to customers.

Based on this analysis, PPL Electric concluded that the conductors, hardware, splices, and tower structures of the existing Elliot Heights #1 and #2 138/69 kV Tap Line are nearing the end of their useful lives and should be rehabilitated or replaced.

E. PROPOSED SOLUTION

PPL Electric evaluated the cost to rehabilitate the Elliot Heights #1 and #2 138/69 kV Tap Line, and concluded that the total cost to rehabilitate the line would be greater than the cost to rebuild the Tap Line. Therefore, the rebuild of the existing 2.6 mile Elliot Heights #1 and #2 138/69 kV Tap Line to a double-circuit 138/69 kV transmission line was identified as the most prudent option. The double-circuit line will be designed to new 138 kV standards, but it will initially operate at 69 kV until the load growth in the area makes it appropriate to increase the operating voltage.

As explained above, the existing Elliot Heights #1 and #2 138/69 kV Tap Line parallels the Hosensack-Allentown #1 and #2 69 kV Transmission Line for approximately 0.6 miles between East Susquehanna Street to the tap point with the Hosensack-Quarry #1 and #2 138/69 kV Transmission Line. As explained in greater detail in Attachment 3, this segment of the Elliot Heights #1 and #2 138/69 kV Tap Line is in close proximity to densely populated residential areas that have been built since the Elliot Heights #1 and #2 138/69 kV Tap Line was originally installed in 1960. In an effort to reduce the impact to these residential areas, PPL Electric proposes to remove this 0.6 mile segment of the Elliot Heights #1 and #2 138/69 kV Tap Line and to rebuilt this segment of the line using the right-of-way for the de-energized Hosensack - Allentown #1 & #2 69 kV

Transmission Line. This shift will reduce the impact and risks associated with the rebuilding the Tap Line near residential areas.

The one-line diagram for the proposed facilities is the same as the one-line diagram for the existing facilities, as shown in Figure 1-1. Figure 1-3 provides a map of the proposed facilities.

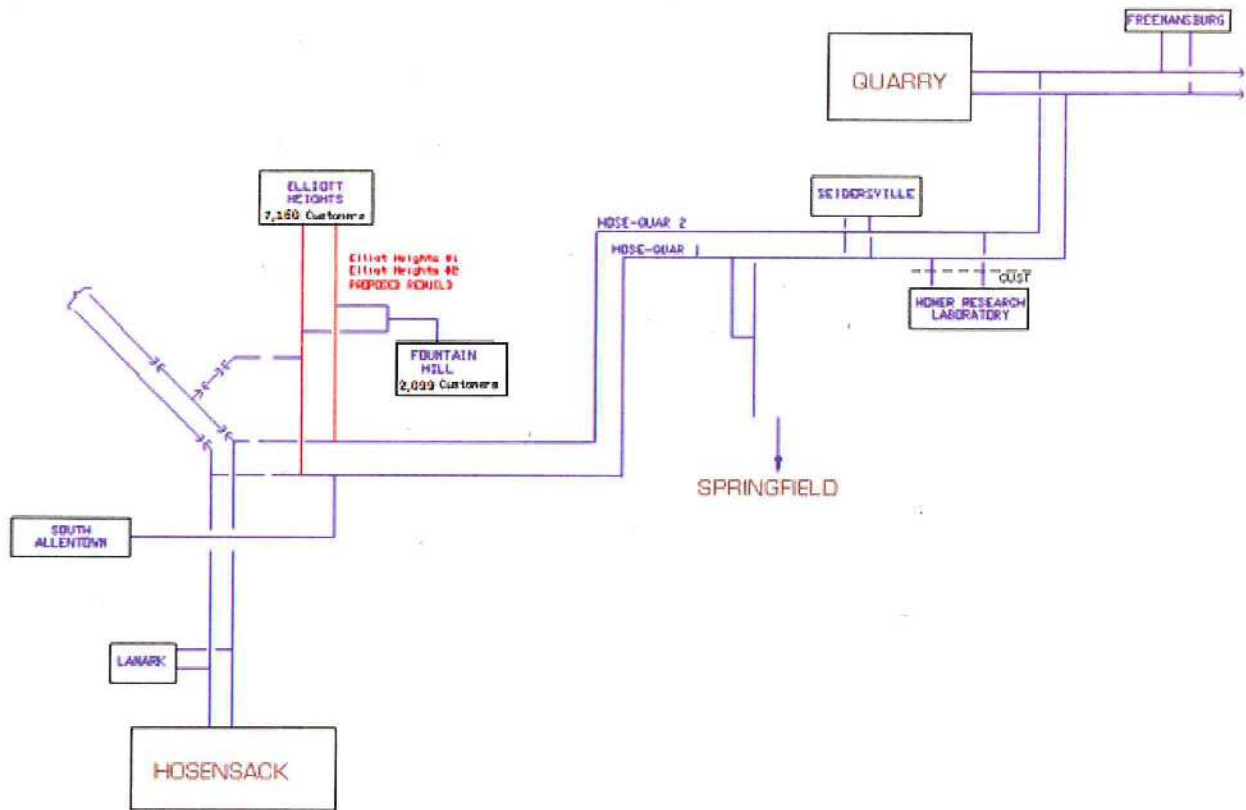
The proposed rebuild of the Elliot Heights #1 and #2 138/69 kV Tap Line will bring the line into compliance with current design standards. This would include an increased vertical ground clearance, increased phase spacing for galloping loop consideration, and installation of steel monopole structures for optimal structure longevity. The rebuild of the Elliot Heights #1 and #2 138/69 kV Tap Line will also increase the lightning protection of the line to reduce the frequency of momentary outages experienced by customers through an increased Critical Impulse Flash Over (CIFO) level,¹ installation of dual optical ground wire (OPGW) shielding cables and decreased footing impedances.

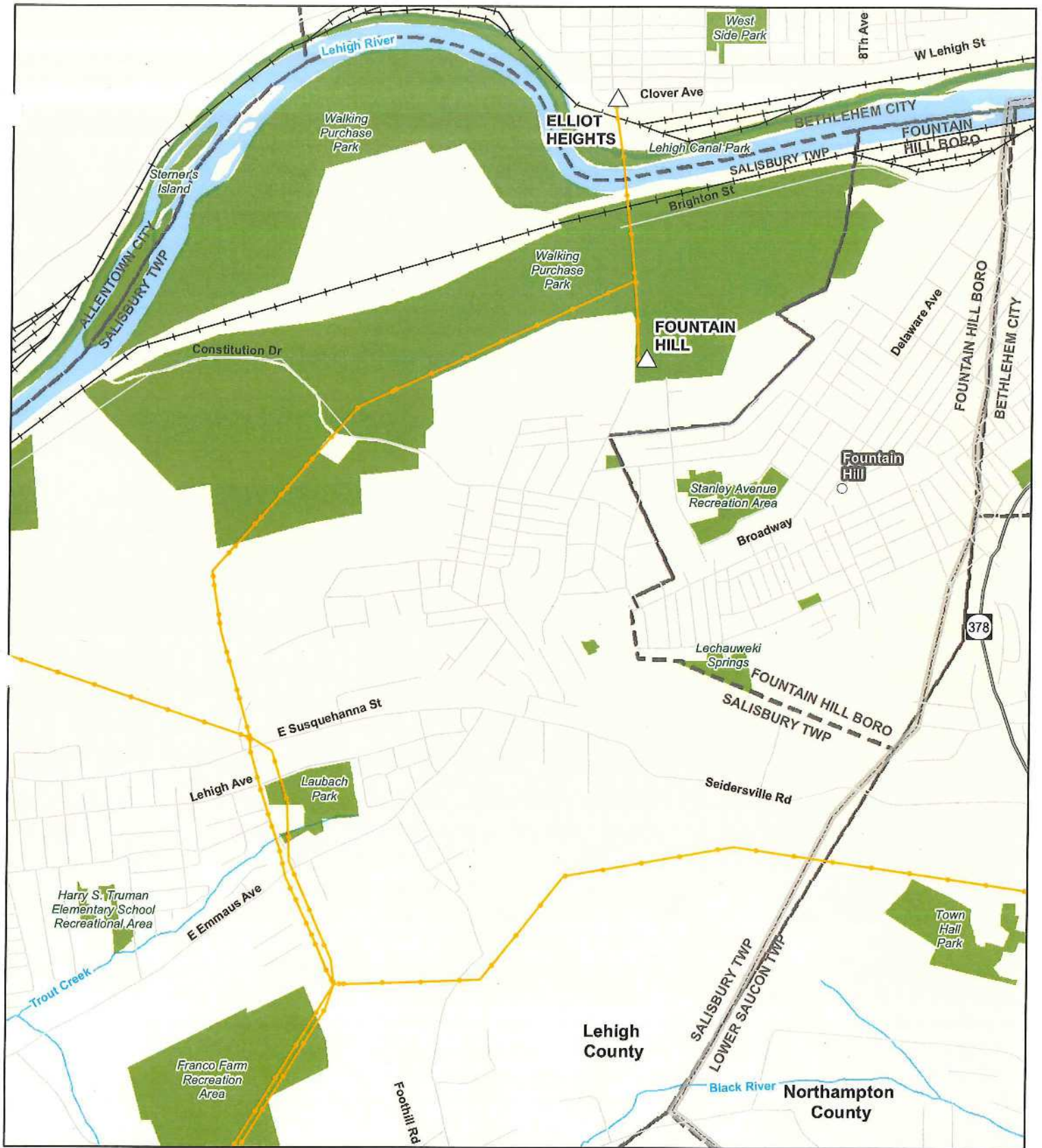
The future configuration will use higher ampacity conductors. After completion of this Project, the customers served from these lines will experience improved service reliability. The higher line capacity will allow for increased transfer capabilities; contributing to the higher level of reliability for the customers served from these lines.

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

¹ CIFO is a measure of the insulation level of a line as it relates to the protection level of an insulator to the impulse voltage across an insulator during a lightning strike.

Figure 1-1. One-Line Diagram of Existing and Proposed Transmission Facilities





Elliot Heights
Figure 1-2: Map of Existing Facilities

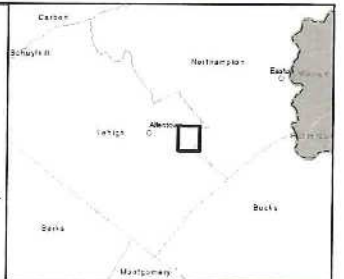
- Populated Place
- △ Substation
- Railroad
- Existing Transmission
- 138kV
- Stream
- Waterbody
- Local Park
- County Boundary
- Municipality Boundary

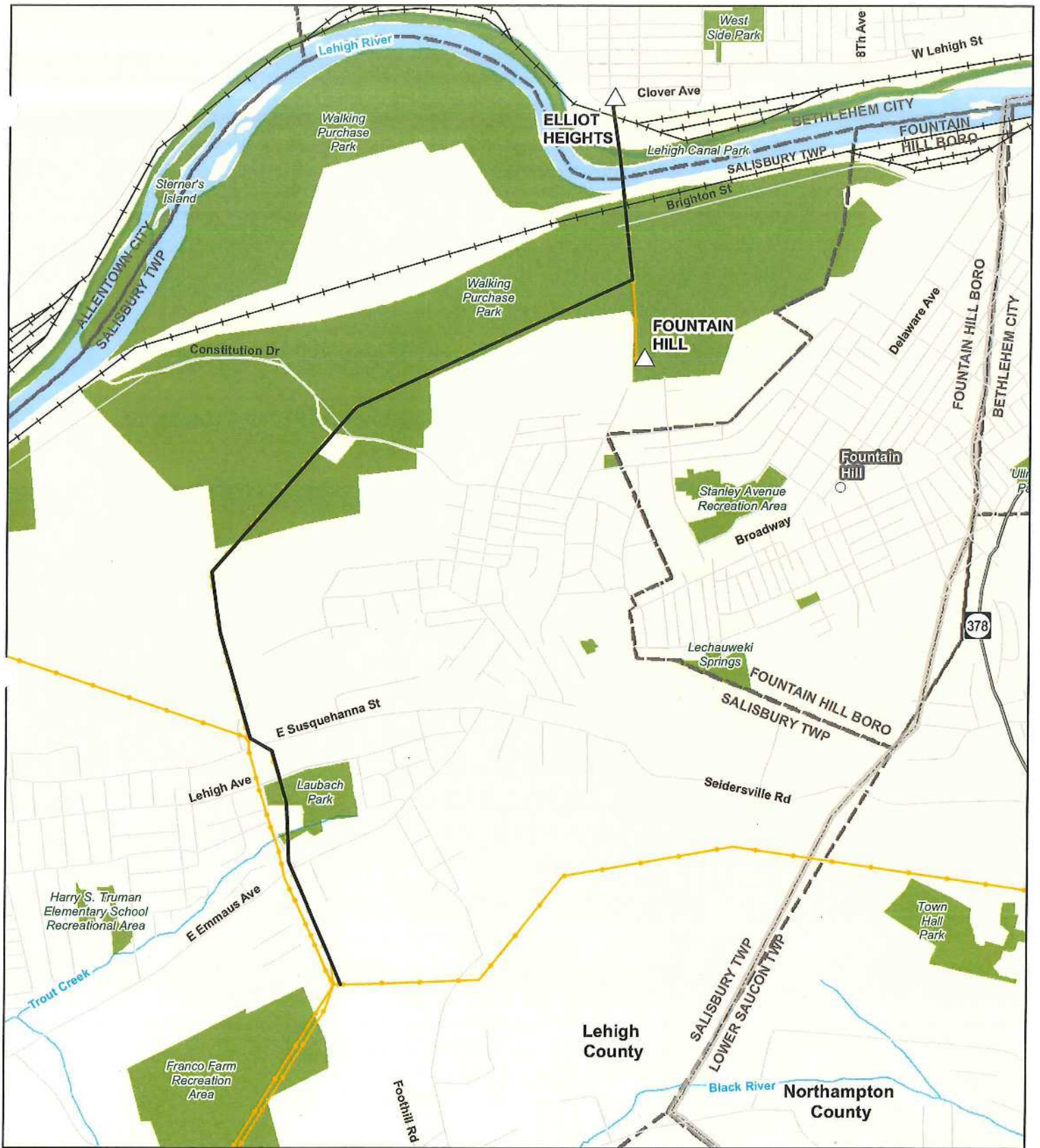


0 0.5 Miles



Projected Coordinate System: PA State Plane, South
Datum: North American Datum of 1983 (NAD83)
Projection: Lambert Conformal Conic
Linear Unit: Feet
Ellipsoid: Geodetic Reference System 80





Elliot Heights
Figure 1-3: Map of
Proposed Facilities

- Populated Place
- △ Substation
- Route
- +— Railroad
- Existing Transmission
- 138kV
- Stream
- Waterbody
- Local Park
- County Boundary
- Municipality Boundary



0.5
Miles



Projected Coordinate System: PA State Plane, South.
Datum: North American Datum of 1983 (NAD83).
Projection: Lambert Conformal Conic.
Linear Unit: Feet.
Ellipsoid: Geodetic Reference System 80.



ATTACHMENT 2
ELLIOT HEIGHTS 138/69 KV TRANSMISSION LINE REBUILD
ENGINEERING DESCRIPTION

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ATTACHMENT 2
ELLIOT HEIGHTS 138/69 KV TRANSMISSION LINE REBUILD
ENGINEERING DESCRIPTION

A. INTRODUCTION

As explained in Attachment 1, PPL Electric Utilities Corporation (PPL Electric) proposes to rebuild approximately 2.6 miles of the existing Elliot Heights #1 and #2 138/69 kV Tap Line in order to improve electric reliability in the region (the “Project”). The existing Elliot Heights Tap #1 and #2 138/69 kV Tap Line has exceeded its useful life and cannot be relied upon to continue to provide reliable service into the future. The proposed rebuild of the Elliot Heights #1 and #2 138/69 kV Tap Line is part of PPL Electric’s Asset Optimization Strategy, and involves rebuilding the line to meet all current design and lightning protection standards. The modernization of the line will help ensure reasonably continuous and reliable service as further described in Attachment 1.

B. DESCRIPTION OF THE EXISTING LINES

The existing Elliot Heights #1 and #2 138/69 kV Tap Line extends approximately 2.6 miles from the Elliot Heights 138-69 kV Substation to the Hosensack-Quarry #1 and #2 138/69 kV Transmission Line. The Elliot Heights #1 and #2 138/69 kV Tap Line has been in service since 1960. The Tap Line is operating utilizing a mix of 4/0 copper and 4/0 aluminum-conductor steel-reinforced (ACSR) conductors. The Tap Line consists of mainly outdated wood pole, steel lattice towers and H-frame pole structures that have reached the end of their useful life and do not meet current design standards.

The Hosensack – Allentown #1 and #2 69 kV Transmission Line extends approximately 3 miles from the Allentown 138/69 kV Substation to the Hosensack-Quarry #1 and #2 138/69 kV Transmission Line. The existing Elliot Heights #1 and #2 138/69 kV Tap Line parallels the Hosensack-Allentown #1 and #2 69 kV Transmission Line for

approximately 0.6 miles between East Susquehanna Street to the tap point with the Hosensack-Quarry #1 and #2 138/69 kV Transmission Line. The Hosensack-Allentown #1 and #2 69 kV Transmission Line consists of guyed wood poles. The Hosensack-Allentown #1 and #2 69 kV Transmission Line was inactivated in 2009 and no longer provides electric service to customers.

C. DESCRIPTION OF THE PROPOSED LINES

PPL Electric proposes to rebuild the existing 2.6-mile Elliot Heights #1 and #2 138/69 kV Tap Line. The first 2.0 miles of the Elliot Heights #1 and #2 138/69 kV Tap Line extending from the Elliot Heights 138-69 kV Substation will be rebuilt in place within the existing right-of-way. As explained in Attachment 1, the remaining 0.6 mile segment of the Elliot Heights #1 and #2 138/69 kV Tap Line will be removed and rebuilt within the parallel right-of-way for the de-energized Hosensack - Allentown #1 & #2 69 kV Transmission Line. The rebuilt Elliot Heights #1 and #2 138/69 kV Tap Line will be reconstructed with new steel monopoles, high capacity conductors, and two optical ground wires.

The existing transmission structures, which include a combination of wood pole, steel lattice, and H-frame pole structures, will be replaced with double-circuit, self-weathering steel monopoles equipped with steel arms and glass 138 kV insulator assemblies. All new poles will be self-supported either direct embedded or on concrete caisson foundations. The new structures for the entire line will consist of steel monopoles and are expected to range between 90 and 115 feet in height, with an average height of approximately 105 feet. Figures 2-1 through 2-5 depict typical structure types that will be used for the Project.

There will be a total of 27 new tower structures. With the exception of one structure, all new tower structures will be located in in the same vicinity as the existing tower structures. One tower structure will need to be relocated by approximately 50 feet from

the existing structure location in order to avoid wetlands. However, no new poles will be placed on any property that currently does not have an existing pole.

The Project will utilize six power conductors and two overhead ground wires. The power conductors will be 556.5 kcmil,¹ 24/7 stranding, ACSR² conductors. The overhead ground wires will be 0.567-inch diameter Optical Ground Wires (OPGW). The new lines will be constructed for future double-circuit 138 kV operation but will initially operate as double-circuit 69 kV lines until the load growth in the area makes it appropriate to increase the operating voltage.

The new recondored and reconstruction lines will be designed according to, and generally exceed, all National Electrical Safety Code (NESC) minimum standards. Design specifications and safety rules practiced by PPL Electric are included in Attachment 4. The existing right-of-way varies from 50 to 100 feet in width. PPL Electric has designed the rebuild to fit within the existing right-of-way. In areas with less than 100 feet of right-of-way, PPL Electric is using shorter arms and/or use of deadend structures to reduce blow-out and meet NESC standards.

The minimum conductor-to-ground clearance will be 30 feet which occurs at a maximum thermal conductor temperature of 125°C. The design minimum conductor clearances and conductor thermal ratings for the recondored and reconstructed lines are shown in Tables 2-1 and 2-2.

¹ A kcmil is a thousand circular mils. A circular mil is the cross-sectional area of a wire one mil in diameter, where 1 kcmil = 0.5067 mm².

² Aluminum conductor steel reinforced.

Table 2-1 Design for Minimum Conductor Clearances for 556.5 kcmil 24/7 strand ACSR³	
Condition	Transmission Double-Circuit Design Clearance-to-Ground
Heavy Ice (1" Ice at 0°C ambient temperature)	30 feet
Predicted extreme thermal load (125°C conductor temperature)	30 feet
Predicted blowout (6 lbs., 16°C, ambient temperature)	30 feet

Table 2-2 Conductor Thermal Rating 556.5 kcmil 24/7 Stranding ACSR 125°C Maximum Conductor			
Condition	Ambient Temperature (°C)	Wind Speed (Ft./sec)	Ampacity (Amps)
Summer Normal	35	0	800
Winter Normal	10	0	923
Summer Emergency	35	2.533	1047
Winter Emergency	10	2.533	1180

The estimated cost to design and construct the Project is approximately \$5.5 million. Subject to the Commission's approval, the Project has a scheduled construction start date of February 2016 to meet an in-service date of July 2016.

D. MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program 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.

³ Clearances based on an initial maximum tension of 6,000-10,000 pounds at ½ inch ice, 0°F, 4# wind and maximum ruling span of 200-1250 feet.

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 with ground clearance that is five feet higher than NESC standards and reverses phasing of new double-circuit lines where it is feasible to do so at low or no cost. The rebuilt Elliot Heights #1 and #2 138/69 kV Tap Line will be designed to comply with both of these measures.

Figure 2-2. Typical Double-Circuit 138/69 kV Single Pole Deadend

NEW STRUCTURE WILL HAVE TWO ARMS AT THE TOP OF THE POLE TO SUPPORT TWO OVERHEAD GROUNDWIRES

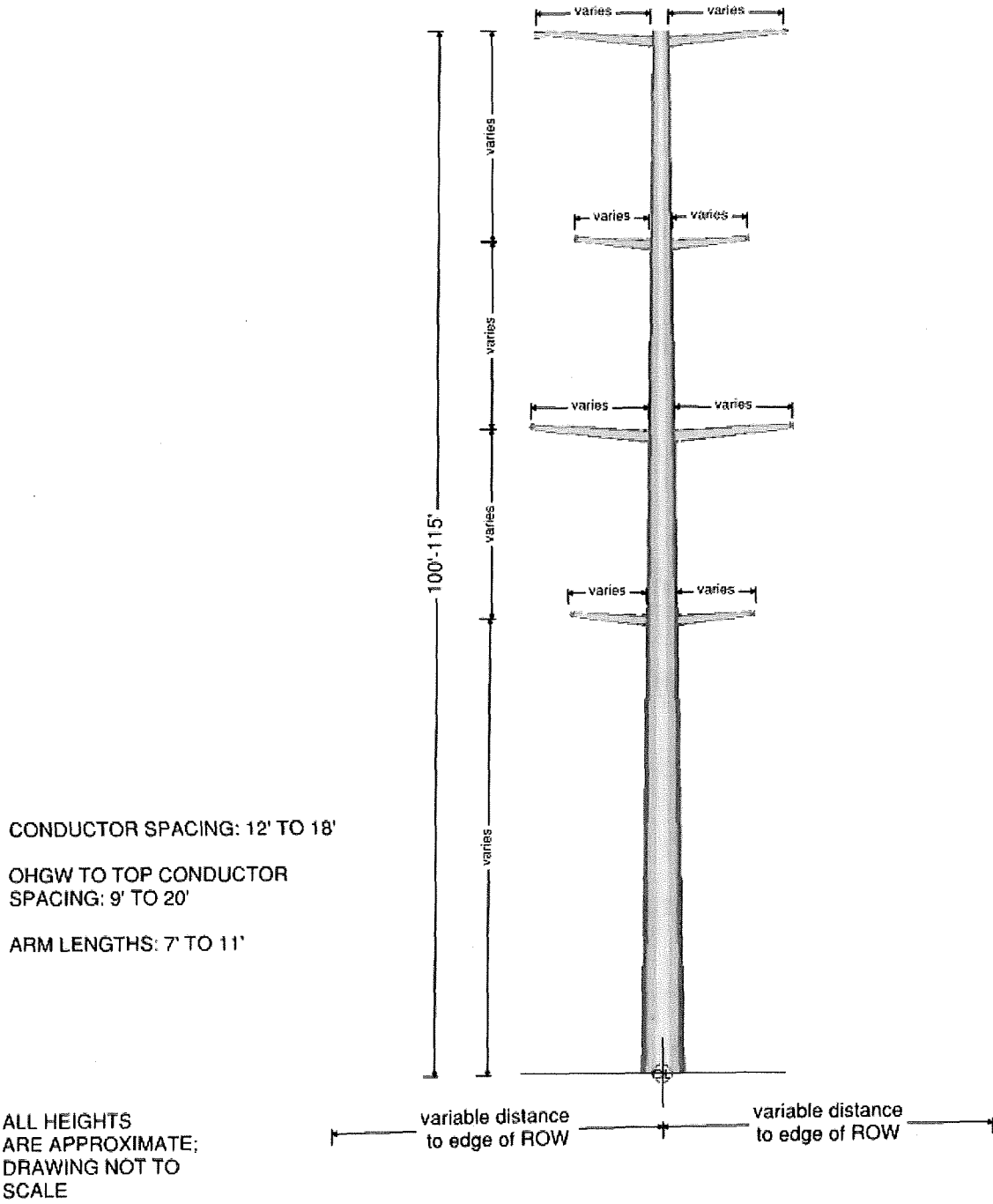
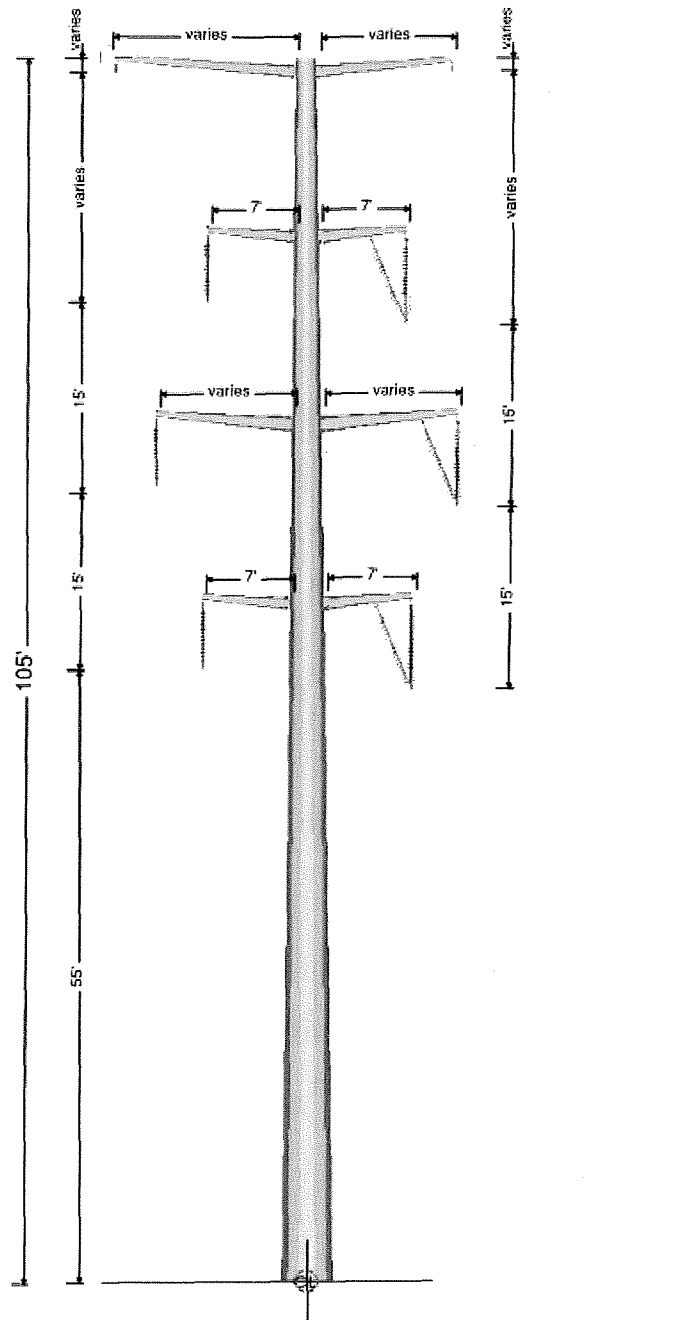


Figure 2-3. Typical Double-Circuit 138/69 kV Angle Suspension with Struts

NEW STRUCTURE WILL HAVE TWO ARMS AT THE TOP OF THE POLE TO SUPPORT TWO OVERHEAD GROUNDWIRES



CONDUCTOR SPACING: 15'

OHGW TO TOP CONDUCTOR SPACING (LEFT SIDE): 18.75' TO 19'

OHGW TO TOP CONDUCTOR SPACING (RIGHT SIDE): 20' TO 20.25'

ARM LENGTHS (TOP LEFT OHGW ARM): 11' TO 15'

ARM LENGTHS (TOP RIGHT OHGW ARM): 7' TO 11'

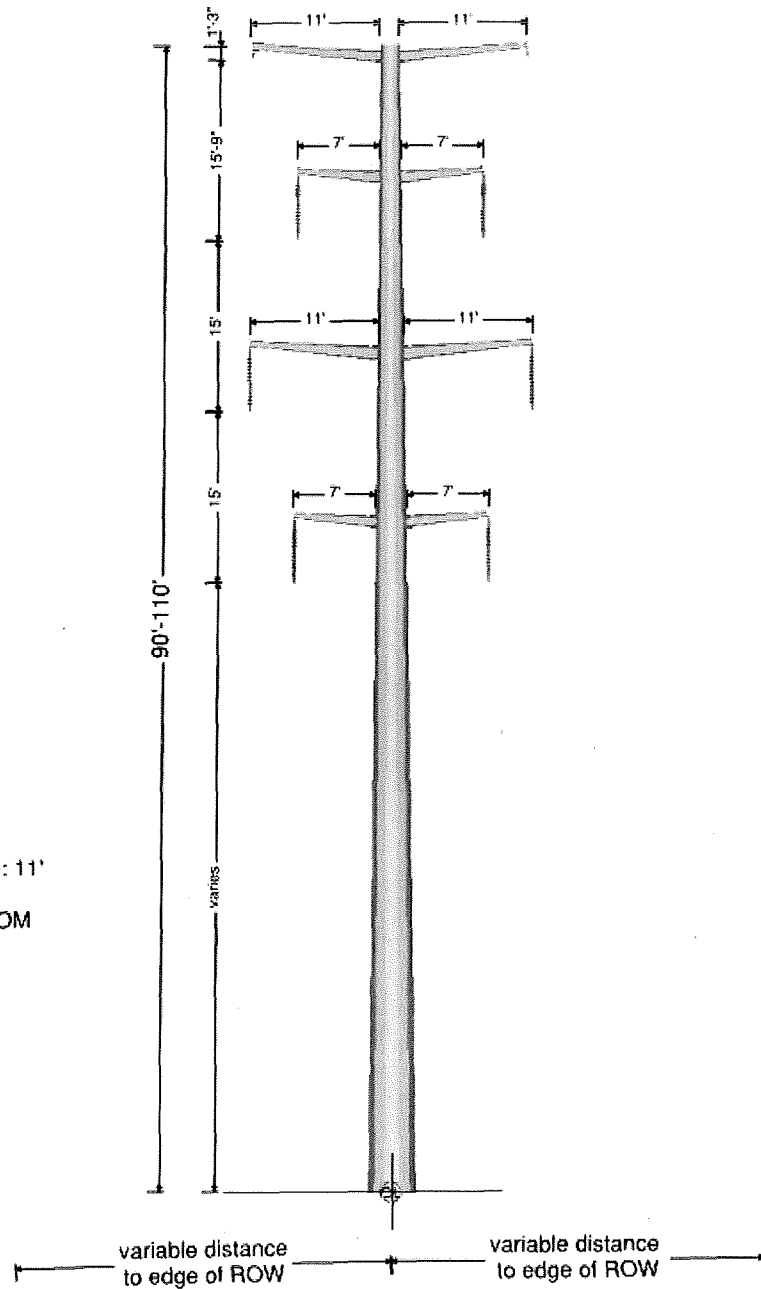
ARM LENGTHS (TOP & BOTTOM CONDUCTOR ARMS): 7'

ARM LENGTHS (MIDDLE CONDUCTOR ARMS): 7' TO 11'

ALL HEIGHTS ARE APPROXIMATE; DRAWING NOT TO SCALE

Figure 2-4. Typical Double-Circuit 138/69 kV Tangent Suspension

NEW STRUCTURE WILL HAVE TWO ARMS AT THE TOP OF THE POLE TO SUPPORT TWO OVERHEAD GROUNDWIRES



CONDUCTOR SPACING: 15'

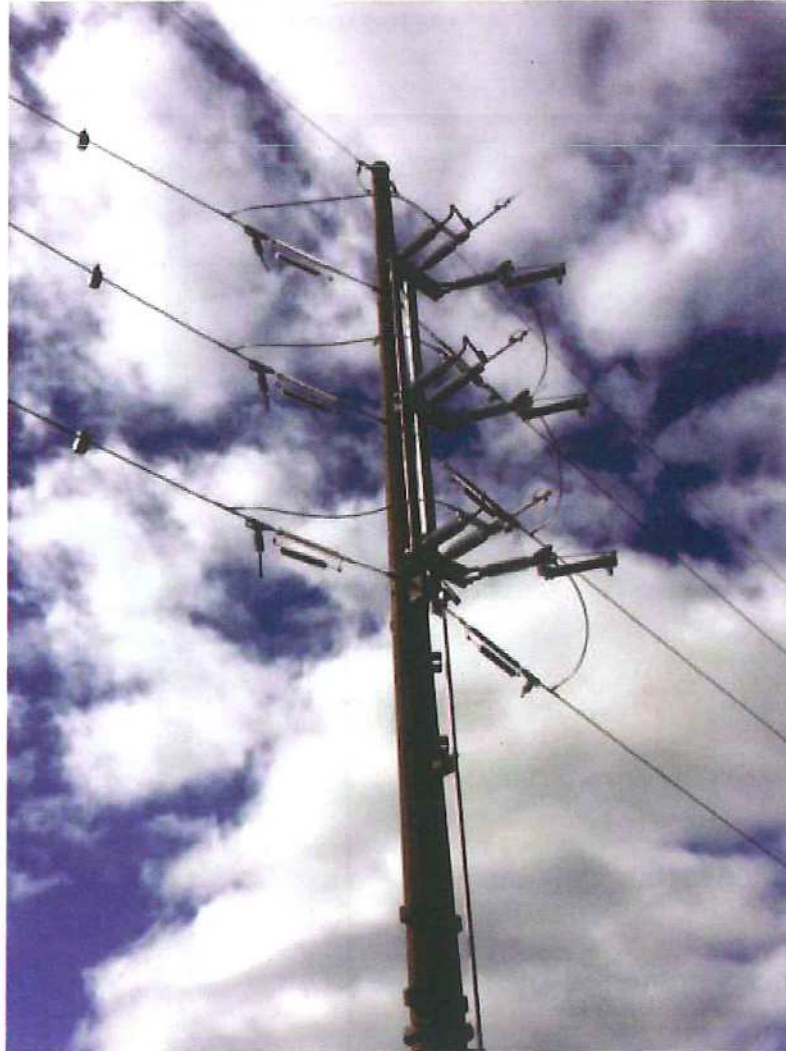
OHGW TO TOP CONDUCTOR SPACING: 15.75'

ARM LENGTHS (OHGW AND MIDDLE CONDUCTOR ARMS): 11'

ARM LENGTHS (TOP & BOTTOM CONDUCTOR ARMS): 7'

ALL HEIGHTS ARE APPROXIMATE;
DRAWING NOT TO SCALE

Figure 2-5. Typical 138 kV Motor Operated Load Break Air Switch Steel Pole



CONDUCTOR SPACING: 9'

OHGW TO TOP CONDUCTOR
SPACING: 9.5'

HEIGHT RANGE: TBD

ATTACHMENT 3
ELLIOT HEIGHTS 138/69 KV TRANSMISSION LINE REBUILD
STATEMENT OF THE IMPACTS TO THE RIGHT-OF-WAY

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ATTACHMENT 3

ELLIOT HEIGHTS 138/69 KV TRANSMISSION LINE REBUILD STATEMENT OF THE IMPACTS TO THE RIGHT-OF-WAY

A. INTRODUCTION

As explained in Attachment 1, PPL Electric Utilities Corporation (PPL Electric) proposes to rebuild approximately 2.6 miles of the existing Elliot Heights #1 and #2 138/69 kV Tap Line in order to improve electric reliability in the region (the “Project”). The existing Elliot Heights Tap #1 and #2 138/69 kV Tap Line has exceeded its useful life and cannot be relied upon to continue to provide reliable service into the future. The proposed rebuild of the Elliot Heights #1 and #2 138/69 kV Tap Line is part of PPL Electric’s Asset Optimization Strategy, and involves rebuilding the line to meet all current design and lightning protection standards. The modernization of the line will help ensure reasonably continuous and reliable service as further described in Attachment 1.

B. DESCRIPTION OF THE RIGHT-OF-WAY

The existing Elliot Heights #1 and #2 138/69 kV Tap Line extends approximately 2.6 miles from the Elliot Heights 138-69 kV Substation located in the City of Bethlehem, Lehigh County, Pennsylvania to the tap point with the Hosensack-Quarry #1 and #2 138/69 kV Transmission Line located in Salisbury Township, Lehigh County, Pennsylvania. PPL Electric has discussed the proposed Project with representatives from Lehigh County, Salisbury Township, and the City of Bethlehem. PPL Electric is working with Salisbury Township to address concerns about construction within the existing right-of-way through two local parks. Lehigh County and the City of Bethlehem did not have any concerns about the Project. Figure 3-1 is an aerial map of the Project that identifies the location and properties crossed by the proposed Project.

The first 2.0 miles of the Elliot Heights #1 and #2 138/69 kV Tap Line extending from the Elliot Heights 138-69 kV Substation will be rebuilt in place within the existing right-

of-way. As shown on Figure 3-1, this segment of the Elliot Heights #1 and #2 138/69 kV Tap Line is located in largely undeveloped forested areas, including Walking Purchase Park located within Lehigh Mountain Park. PPL Electric is coordinating with Salisbury Township to minimize any potential impacts to the Walking Purchase Park. The existing right-of-way for this 2.0-mile segment of the Elliot Heights #1 and #2 138/69 kV Tap Line is 100 feet with the exception of one 225-foot-long stretch that is 50 feet wide. As explained in Attachment 2, PPL Electric has designed the line to fit within the existing right-of-way and meet NESC standards. No new right-of-way is required for the construction, operation, or maintenance of this 2.0-mile segment of the rebuilt Elliot Heights #1 and #2 138/69 kV Tap Line.

As shown on Figure 3-1, the remaining 0.6 miles of the existing Elliot Heights #1 and #2 138/69 kV Tap Line is located in close proximity to densely populated areas that have been developed since the time the Tap Line was originally constructed. In this area, eleven residences are located within 50 feet and twenty-two residences are located within 100 feet of the Tap Line. Further, PPL Electric has only centerline rights along this section of the Elliot Heights #1 and #2 138/69 kV Tap Line. In an effort to reduce the impact to these residential areas, PPL Electric proposes to remove this 0.6 mile segment of the Elliot Heights #1 and #2 138/69 kV Tap Line and to rebuilt this segment of the line using the right-of-way for the de-energized Hosensack - Allentown #1 & #2 69 kV Transmission Line. This segment of the Hosensack-Allentown #1 and #2 69 kV Transmission Line is located approximately 100 to 225 feet to the east of the Elliot Heights #1 and #2 138/69 kV Tap Line. In this area, only two residences are located within 50 feet and eight residences within 100 feet of the Hosensack-Allentown #1 and #2 69 kV Transmission Line. The existing right-of-way traverses through a portion of Lauback Park. PPL Electric is coordinated with Salisbury Township to minimize potential impacts to the park. The existing right-of-way for the Hosensack-Allentown #1 and #2 69 kV Transmission Line varies from 50 to 100 feet in width. As explained in Attachment 2, PPL Electric has designed the line to fit within the existing right-of-way and meet NESC standards. No new right-of-way is required to rebuild this 0.6 mile

segment of Elliot Heights #1 and #2 138/69 kV Tap Line within the right-of-way for the de-energized Hosensack - Allentown #1 & #2 69 kV Transmission Line.

The existing Elliot Heights right-of-way is currently maintained in accordance with PPL Electric's Vegetation Management Program. Some additional tree clearing will be required within the existing right-of-way. The Hosensack – Allentown right-of-way has not been maintained since the line was de-energized. PPL Electric will clear vegetation within the extent of the right-of-way. In some areas, PPL Electric has additional tree clearing/ tree trimming rights and/or building restrictions in place to prevent encroachments and minimize the potential impacts of danger trees. In areas where any vegetation management is required, 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 minimize any potential impacts.

Based on an engineering review, PPL Electric determined that it does not require any additional right-of-way for the proposed rebuild of the Elliot Heights #1 and #2 138/69 kV Tap Line.

C. CULTURAL RESOURCES

PPL Electric conducted a review of the online Pennsylvania Historical and Museum Commission (PHMC) Bureau for Historic Preservation (BHP) Cultural Resources Geographic Information System (CRGIS) database to determine if National Register of Historic Places (NRHP)-listed or eligible historic properties are located in the Project vicinity. Based on this review, four NRHP-listed and five NRHP-eligible historic architectural resources are located within 1 mile of the proposed Project. The listed and eligible resources are identified in Table 3-1.

Table 3-1. NRHP-Listed and Eligible Resources Located within 1-Mile of the Project				
Resource Name	Resource No.	Distance from Project	Municipality	NRHP-Status
Mount Airy Historic District	092231	0.4 mile north	City of Bethlehem, Lehigh County	Listed
Fountain Hill Historic District	092654	0.8 mile east	City of Bethlehem, Northampton County	Listed
Lehigh Canal: Allentown to Hopeville Section	001014	0.7 mile northwest	Salisbury Township and the City of Allentown, Lehigh County	Listed
Lehigh Valley Silk Mills; Lipps & Sutton Silk Mill	001115	0.7 mile east	Borough of Fountain Hill, Lehigh County	Listed
Sayre, Coxe, Bethlehem Steel Wards of Saint Luke's Hospital	000849	0.6 mile east	Borough of Fountain Hill, Lehigh County	Eligible
Allentown State Hospital; Homeopathic State Hospital in Rittersville	001212	0.8 mile northwest	City of Allentown, Lehigh County	Eligible
Lehigh Valley Railroad (Allentown to Whitehall Township)	116317	0.9 mile west	Salisbury Township and the City of Allentown, Lehigh County	Eligible
Sauquoit Silk Mil (Cutter Silk Mill); Cutter Silk Mill	064496	0.9 mile east	Salisbury Township, Lehigh County	Eligible
Bishopthorpe Manor; Fountainbleau	101643	1 mile east	Salisbury Township, Lehigh County	Eligible

In addition, the proposed Project is located within 1 mile of eighteen sites with a status identifying available data that is insufficient to determine whether these sites are eligible for NRHP. As shown in Table 3-1, no previously recorded architectural resources are crossed or located within 0.5 mile of the Project.

The proposed Project is located within 1 mile of four previously recorded archaeological sites, all of which have insufficient data necessary to determine whether these sites are eligible for the NRHP. Of these four sites, only one site is located within 0.25 mile of the

proposed Project. No previously recorded archaeological resources are crossed by the Project.

PPL Electric submitted a review letter to the PHMC on June 22, 2015. On July 23, 2015, PHMC submitted a response¹, directing PPL Electric to conduct surveys for eligible historic buildings. PHMC indicated that most of the Project area has no potential for archeological resources, due to relatively steep slopes. However, PHMC has requested archeological surveys if there will be any project-related group disturbance in the short segment of the transmission line corridor situated north of the Lehigh River, where ground is relatively flat. PPL Electric will continue to consult with the PHMC to resolve any concerns. However, it is anticipated that the proposed Project will have minimal impacts to cultural resources because the Project is located in areas that contain existing electrical facilities, and the new tower structures will be placed in close proximity to the existing tower structures.

D. LAND USE AND NATURAL FEATURES

Impacts to land use are anticipated to be minimal because the proposed Project will be constructed within the existing right-of-way, and no additional property will be required to complete the proposed Project. PPL Electric will use and update previously established access roads for construction to the extent practical to further reduce interference with existing land uses.

There is one AT&T cell attachment located on the Elliot Heights #1 and #2 138/69 kV Tap Line. PPL Electric will coordinate with AT&T to relocate the cell attachment during construction. No other communication towers, pipelines, or other utilities will be affected by the proposed Project. The closest airport is the Lehigh Valley International Airport, a Lehigh-Northampton Airport Authority-owned facility, located approximately 2.1 miles northwest of the right-of-way for the proposed Project. PPL Electric does not anticipate any interference with airport operations because the Project is located in an

¹ ER No. 2015-1350-077-A

area where there are existing electrical facilities and because the new facilities will be a similar height as the existing facilities. However, PPL Electric will file any required documentation with both the Federal Aviation Administration and the Pennsylvania Department of Transportation, Bureau of Aviation.

A Natural Area Inventory (NAI) has been prepared by The Nature Conservancy in association with the Pennsylvania Natural Heritage Program (PNHP) for Lehigh County (2013). The NAI includes information on the location of rare, threatened, and endangered species and the highest quality natural areas located within the County. The Project crosses one natural area that was identified within the NAI. The Lehigh Mountain NAI area consists of the north-facing forested slope of Lehigh Mountain and the adjacent Lehigh River and its floodplain, which provide a variety of habitats for several plant species of concern. The 2-mile-long portion of the existing Elliot Heights #1 and #2 138/69 kV Tap Line traverses within this NAI area. The rebuild will occur within the existing right-of-way. Therefore, no significant impacts to this NAI area are anticipated. Only one of the plant species that has been observed within this NAI area was identified during the threatened and endangered species review, which is described below in Section E. PPL Electric is coordinating with Salisbury Township to minimize any potential impacts to Lehigh Mountain. The proposed Project will not affect any other unique geological, scenic, or natural areas.

PPL Electric retained an environmental consultant to identify and delineate all wetlands and watercourses within the area of the proposed Project. The proposed Project will cross seven wetlands and seven streams, including the Lehigh River. However, it is anticipated that the Project will have minimal impacts on these streams and wetlands because the entire Project will be built within the existing ROW, and because the new tower structures will be placed in close proximity to the existing tower structures. As explained in Attachment 2, one structure will be relocated approximately 50 feet away from the existing structure in order to avoid a wetland. PPL Electric will avoid impacts to wetlands to the maximum extent practical. 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 of the terms and conditions placed on those permits. PPL Electric also will prepare any required soil erosion and sedimentation control plans and obtain National Pollutant Discharge Elimination System (NPDES) permits and will comply with any conditions placed on those permits.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric conducted an online Pennsylvania Natural Diversity Inventory (PNDI) database review on May 12, 2015². Based on this review, the Pennsylvania Game Commission (PGC), Pennsylvania Fish and Boat Commission (PFBC), and the U.S. Fish and Wildlife Service (USFWS) reported that the proposed Project will not impact any threatened and endangered species, or special concern species and resources located within the Project area.

Because Lehigh County is located within the known range of the federally threatened bog turtle (*Clemmys muhlenbergii*), PPL Electric retained a qualified bog turtle surveyor to conduct a Phase I bog turtle survey for wetlands delineated within the area of the proposed Project. Based on the survey, one wetland was identified as potential bog turtle habitat. Therefore, a Phase I survey report was submitted to the USFWS and a Phase II bog turtle survey was conducted for the single potential bog turtle wetland. No bog turtles or evidence of bog turtles was observed during the Phase II survey. PPL Electric has submitted a Phase II survey report to the USFWS.

The Pennsylvania Department of Conservation and Natural Resources (DCNR) indicated that the Project is located within water-hemp ragweed (*Amaranthus cannabinus*), a special concern species. According to the Lehigh County NAI and the Natural Resource Inventory for Salisbury Township (2011), this species has been found (in 1980) within a developed area along a canal, and along railroad tracks. The water-hemp ragweed grows in intertidal marshes, mudflats, and river shores, where it is subjected to daily fluctuations in water levels. No construction activity for the proposed Project will occur in water

² PNDI Project Search ID: 20150512509818

areas or other areas with fluctuating water levels. Therefore, no impacts to the water-hemp ragweed are anticipated. DCNR subsequently provided a clearance letter indicated that no impacts to the water-hemp ragweed are anticipated.



Label	Owner
1	PENNA POWER & LIGHT CO
2	PENNSYLVANIA LINES LLC
3	PENNSYLVANIA LINES LLC
4	CITY OF BETHLEHEM
5	PENNSYLVANIA LINES LLC
6	COUNTY OF LEHIGH
7	COUNTY OF LEHIGH ET AL
8	BAIZE STEPHEN JOHN
9	COUNTY OF LEHIGH
10	COUNTY OF LEHIGH ET AL
11	TELE-MEDIA BROADCASTING CO
12	DICKERT NESTOR L & LUCRETIA H
13	RINDOCK RONALD F & JAMIE
14	C-TEC CABLE SYSTEMS OF PA INC

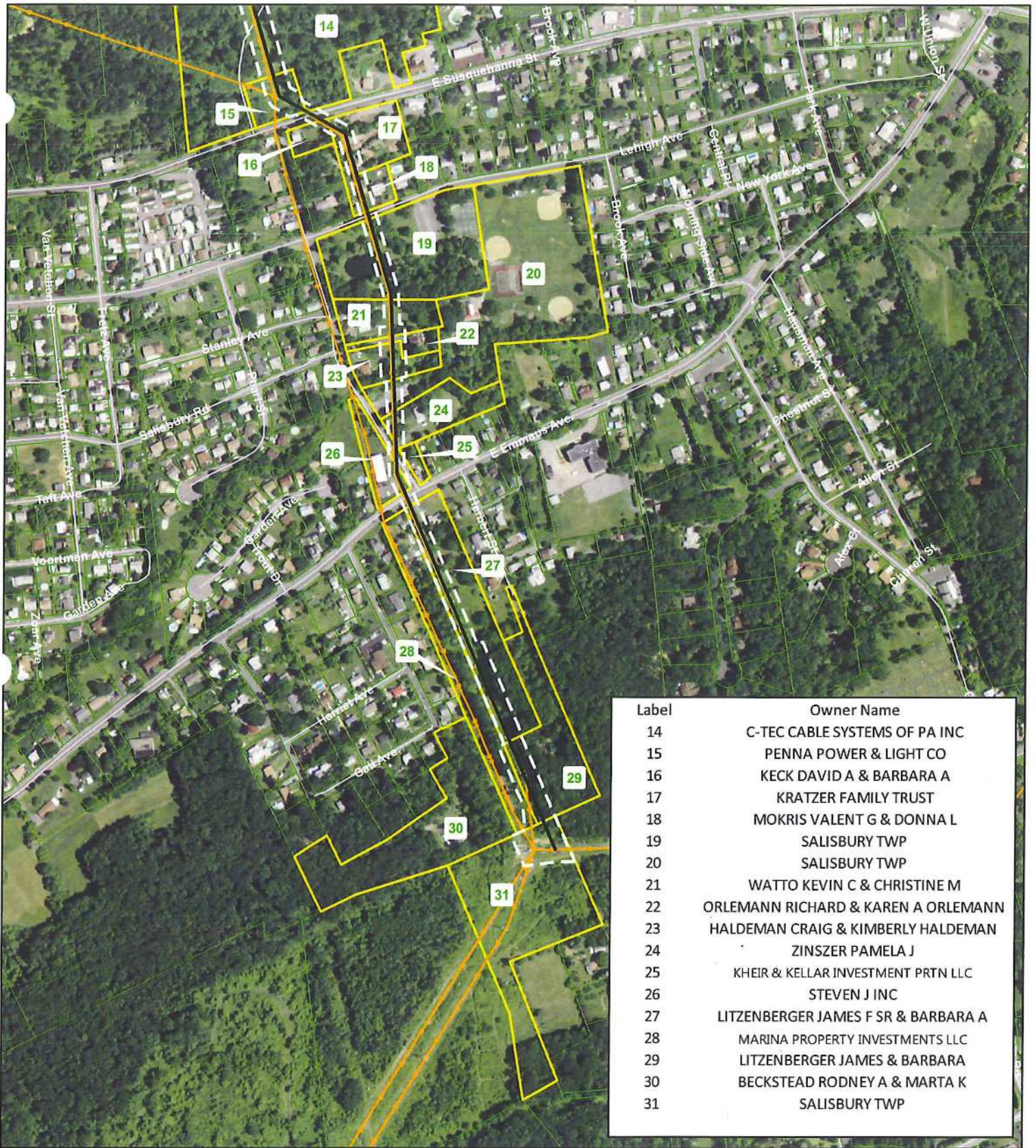
- △ Substation
- Route
- + Railroad
- Existing Transmission**
- 138kV
- ROW
- ▭ Parcel within ROW
- ▭ Parcel Boundary
- ▭ Municipality Boundary

Elliot Heights
Figure 3-1: Aerial Map



Projected Coordinate System: PA State Plane, South.
Datum: North American Datum of 1983 (NAD83).
Projection: Lambert Conformal Conic.
Linear Unit: Feet.
Ellipsoid: Geodetic Reference System 80.

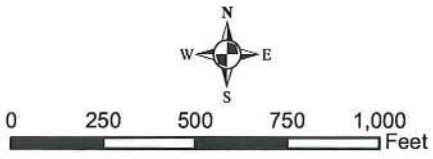




Label	Owner Name
14	C-TEC CABLE SYSTEMS OF PA INC
15	PENNA POWER & LIGHT CO
16	KECK DAVID A & BARBARA A
17	KRATZER FAMILY TRUST
18	MOKRIS VALENT G & DONNA L
19	SALISBURY TWP
20	SALISBURY TWP
21	WATTO KEVIN C & CHRISTINE M
22	ORLEMANN RICHARD & KAREN A ORLEMANN
23	HALDEMAN CRAIG & KIMBERLY HALDEMAN
24	ZINSZER PAMELA J
25	KHEIR & KELLAR INVESTMENT PRTN LLC
26	STEVEN J INC
27	LITZENBERGER JAMES F SR & BARBARA A
28	MARINA PROPERTY INVESTMENTS LLC
29	LITZENBERGER JAMES & BARBARA
30	BECKSTEAD RODNEY A & MARTA K
31	SALISBURY TWP

- △ Substation
- Route
- + Railroad
- Existing Transmission**
- 138kV
- ROW
- ▭ Parcel within ROW
- ▭ Parcel Boundary
- ▭ Municipality Boundary

Elliot Heights
Figure 3-1: Aerial Map



ppl **Louis Berger**

Projected Coordinate System: PA State Plane, South.
Datum: North American Datum of 1983 (NAD83).
Projection: Lambert Conformal Conic.
Linear Unit: Feet.
Ellipsoid: Geodetic Reference System 80.



ATTACHMENT 4

ELLIOT HEIGHTS 138/69 KV TRANSMISSION LINE REBUILD PPL DESIGN CRITERIA AND SAFETY PRACTICES

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

Engineering Design Criteria and Parameters

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

PPL 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 designs all of its transmission lines for Grade B construction. The use of Grade B design and construction specifies enhancements such as larger-minimum crossarm dimensions, larger-minimum conductor size, and increased safety factors.

Another example is the design parameters utilized to account for ice and wind loadings on the overhead ground wire (OHGW) and power conductors. The NESC standard ice and wind design magnitudes for the PPL 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 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 lines are designed to operate safely and reliably during inclement weather even more severe than assumed by the NESC. In addition, PPL transmission lines are designed with more clearance to the ground than required by the NESC. The tables below compare PPL and NESC ground clearances for lines of various voltages.

138 kV

<u>Surface Underneath Conductors</u>	<u>Vertical Clearance to Ground</u>	
	<u>NESC Standard</u>	<u>PPL Design</u>
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

<u>Surface Underneath Conductors</u>	<u>Vertical Clearance to Ground</u>	
	<u>NESC Standard</u>	<u>PPL Design</u>
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

<u>Surface Underneath Conductors</u>	<u>Vertical Clearance to Ground</u>	
	<u>NESC Standard</u>	<u>PPL Design</u>
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:

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

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

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