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File #: 165209

August 13, 2018

VIA ELECTRONIC FILING

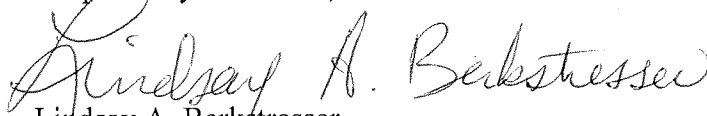
Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street, 2nd Floor North
P.O. Box 3265
Harrisburg, PA 17105-3265

**Re: Letter of Notification of PPL Electric Utilities Corporation, Filed Pursuant to 52 Pa. Code Chapter 57 Subchapter G, for Approval of the Siting and Construction of the Siegfried-East Palmerton #1 & #2 183/69 kV Transmission Lines and Associated Tap Lines Located in Lehigh and Carbon Counties, Pennsylvania
Docket No. A-2018-3001477**

Dear Secretary Chiavetta:

Enclosed for filing are the Responses of PPL Electric Utilities Corporation to the Data Requests of the Bureau of Technical Utility Services Nos. 13 – 20 in the above-referenced proceeding.

Respectfully submitted,


Lindsay A. Berkstresser

LAB/jl
Enclosures

cc: Jordan Van Order (*Via E-mail*)

**PPL Electric Utilities Corporation
Response to Data Requests of
Bureau of Technical Utility Services
Dated August 8, 2018
Docket No. A-2018-3001477**

Q-13 Reference Discovery, Response to A-1. Please provide additional evidence detailing the physical condition of the facilities proposed to be replaced including a description of the condition of the conductors, photographs of the steel and wooden transmission structures, and a description of the physical condition and photographs of the transmission structure foundations.

A-13 The conductors and overhead wires on the Siegfried-East Palmerton 1&2 lines are roughly 70-year-old Copperweld copper conductors. PPL has seen severe failures of this type of conductor in the past, both in use as energized conductor and overhead wire. Also, because of the vintage of conductor on these lines, they would be very difficult to replace when failures occur. Rebuilding the line with new standard conductor would prevent the risk of conductor failure and eliminate the difficulty involved in emergency conductor repairs.

The DiGioia Gray ("DGA") report includes information on the condition of the foundations on these lines. Their main finding was "for all concrete foundations, the protective coal tar epoxy coating is beginning to crack and delaminate". Some foundations are located below grade or even under water, which can accelerate corrosion of the steel, causing section loss and compromising the structural stability of the towers.

Please refer to the attached DGA report provided in response to A-18 as "Attachment 1" for additional detail. Refer to Photos 1 and 2 for typical steel and wood transmission structures and Photos 3 and 9 for typical foundation conditions.

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Q-14 Reference Discovery, Response to A-1. Please explain the concerns associated with the reduction in insulator insulating properties. If there are any efficiency concerns associated with the degradation, please quantify the reduction in losses associated with the replacement of the insulators.

A-14 Both the DGA report and internal PPL inspections have identified excessive contamination and corrosion on insulators on the Siegfried-East Palmerton 1&2 lines. This is likely due to the pollution from the local industrial plant.

Contamination and corrosion of insulators is a reliability concern, as it reduces the insulating capability of the insulator string, causing tracking, which may lead to flashovers and phase to ground faults that directly affect customers served from these lines.

PPL does not analyze electrical losses caused by insulator contamination.

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Q-15

Reference Discovery, Response to A-12. Please provide a list and description of the critical and non-critical deficiencies identified in 2016.

A-15

Twenty-four (24) deficiencies were identified on Siegfried-East Palmerton 1&2 during the inspection in 2016. This includes one (1) critical deficiency (broken insulator string) and twenty-three (23) non-critical deficiencies. A summary of them is shown in the tables below with the critical deficiency highlighted:

Line Name : Siegfried - East Palmerton #1
Line Number : 454
KV : 69
Division : Lehigh

Customer : PPL Electric Utilities
Project : CVI Inspection - 2017 FEG Outage Lehigh
Date Printed : Apr 26, 2016
Page # : 1

Str / Span	Location	Structure Side	Circuit	Phase	Insulator	Sub-Conductor	Shield Wire	Span Location	Component	Problem
1 Siegfried										Not Inspected (Substation)
2 East Palmerton										Not Inspected (Substation)
3 59621S51584	Insulator Assembly			T					Insulator (Jumper)	Flashed (6 of 6)
4 59323S51781	Insulator Assembly			M					Insulator (String)	Flashed (6 of 6)
5 59235N23382	Insulator Assembly			A					Insulator (String)	Flashed (6 of 6)
6 57950S52676	Structure			M					Arm (Wood)	Deterioration (Rotten)
7 59245S53445	Structure	H					A		Arm (Wood)	Deterioration (Rotten)
8 58784S53193	Structure	MR							Pole (Wood)	Woodpecker Hole(s) (Multiple Wood Pecker Holes)
9 59820N24072	Structure	ES		A			A		Switch (Switch Rack)	Contamination (Dust/Dirt)

Line Name : Siegfried - East Palmerton #2

Line Number : 457

KV : 69

Division : Lehigh

Customer : PPL Electric Utilities

Project : CVI Inspection - 2017 FEG Outage Lehigh

Date Printed : Apr 26, 2016

Page # : 1

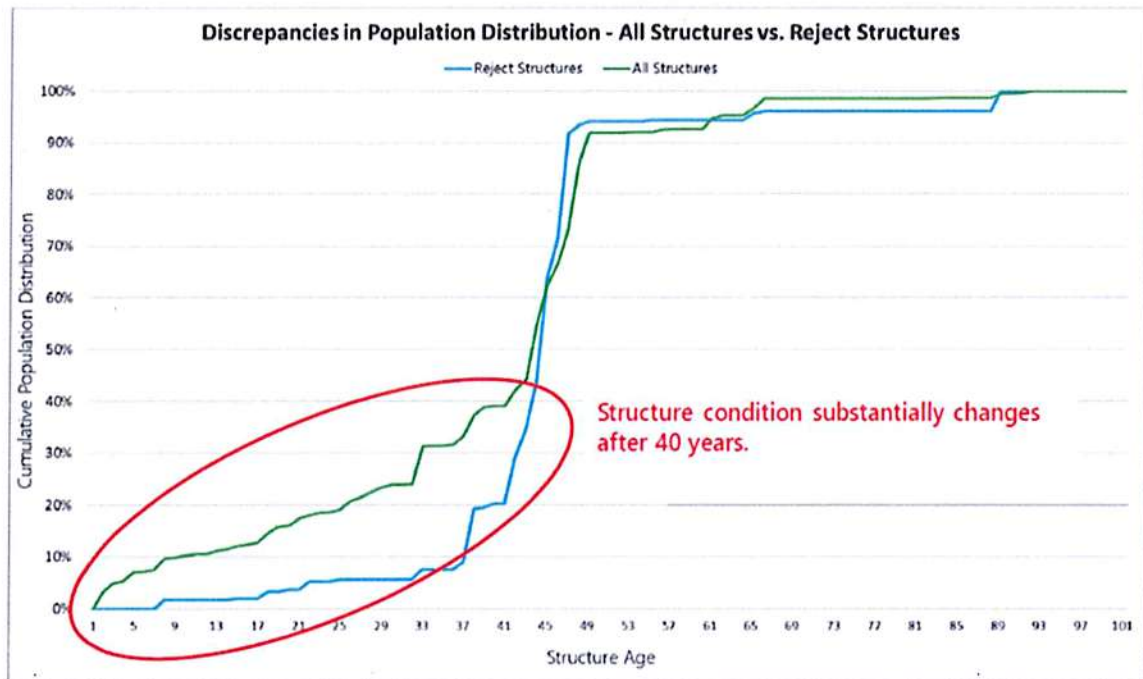
Str / Span	Location	Structure Side	Circuit	Phase	Insulator	Sub-Conductor	Shield Wire	Span Location	Component	Problem
1 Siegfried										Not Inspected (Substation)
2 East Palmerton										Not Inspected (Substation)
3 61499S51022	Insulator Assembly			M					Insulator (String)	Flashed (6 of 6)
4 58884S51960	Insulator Assembly			A					Insulator (String)	Flashed (6 of 6)
5 58634S52291	Insulator Assembly	L		B					Insulator (Skirt)	Broken (1 of 8)
6 59526N23918	Insulator Assembly			T					Insulator (String)	Flashed (6 of 6)
7 59894N24077	Insulator Assembly			A					Insulator (String)	Contamination (Dust/Dirt)
8 61846S51059	Structure			B					Arm (Wood)	Cracked
9 58352S53036	Structure			M					Arm (Wood)	Deterioration (Rotten)
0 59253S53442	Structure	H					B		Arm (Wood)	Deterioration (Rotten)
1 58243S52998	Structure	TR		A					Pole (Cap)	Cracked (Split)
2 58406S53055	Structure	MR							Pole (Wood)	Woodpecker Hole(s)
3 58458S53074	Structure	ML							Pole (Wood)	Woodpecker Hole(s)
4 58520S53095	Structure	TL							Pole (Cap)	Deterioration (Rotten)
5 58520S53095	Structure	TL							Pole (Wood)	Woodpecker Hole(s)
6 58578S53114	Structure	MR							Pole (Wood)	Woodpecker Hole(s)
7 58578S53114	Structure	TL					L		Pole (Cap)	Deterioration (Rotten)
8 58694S53155	Structure	TR					R		Pole (Cap)	Deterioration (Rotten)
9 58978S53254	Structure	ML							Pole (Wood)	Woodpecker Hole(s) (Angle Deadend Pole)

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Q-16 Reference the Letter of Notification, Attachment 1, Page 1-8. Please provide a detailed description of the methodology used to determine that the subject transmission lines have reached the end of their useful service life. Additionally, provide any service life or survival curves used in this determination.

A-16 PPL utilized available industry data regarding predicted service life of both steel and wood structures*. Based upon the age of the Siegfried-East Palmerton 1&2 lines relative to that industry data, it was determined that a field condition assessment was needed. Based on the results of the condition assessment performed, PPL determined that a rebuild of these lines was necessary.

*Industry data points to end of life for wood structures and steel structures separately. Based on research published by Osmose Utilities, the predicted service life of a wood pole in our decay zone (or deterioration zone) is approximately 44.5 years. A study published by Quanta Technology in 2012 calculates the average expected service life of a wood pole in the U.S. to be 53 years. The wood poles on these lines have exceeded both milestones. Osmose research also indicates that steel structures have an average estimated life span of 60 years or more, however the actual expected life can vary greatly based on structure type, material, design, environment, etc. Their analysis also notes that condition declines substantially at 40 years of age. Structures are at a much higher likelihood of being categorized as unserviceable ("reject") between the ages of 40 and 50.



Based on a 10,000 structure sample of steel utility transmission structures geographically constrained to the mid-Atlantic region. Intentionally constrained to avoid macro effects of geography on data sample. Larger samples will be utilized in future analyses when additional variables (beyond age) are evaluated.

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Q-17

Reference the Letter of Notification, Attachment 1, Page 1-8. Please state the approximate cost to rehabilitate the transmission lines.

A-17

The estimate to rehabilitate the entire line is approximately \$15,874,800.00. The transmission asset owner is responsible for determining whether to rehabilitate or rebuild the transmission line. Rehabilitation is not an adequate solution because it does not re-zero the condition of the poles or conductor to the same condition of reliability as rebuilding the line.

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Q-18 Reference the Letter of Notification, Paragraph 18. Please provide a copy of the engineering assessment conducted by DiGioia Gray and Associates.

A-18 Please see Attachment 1.

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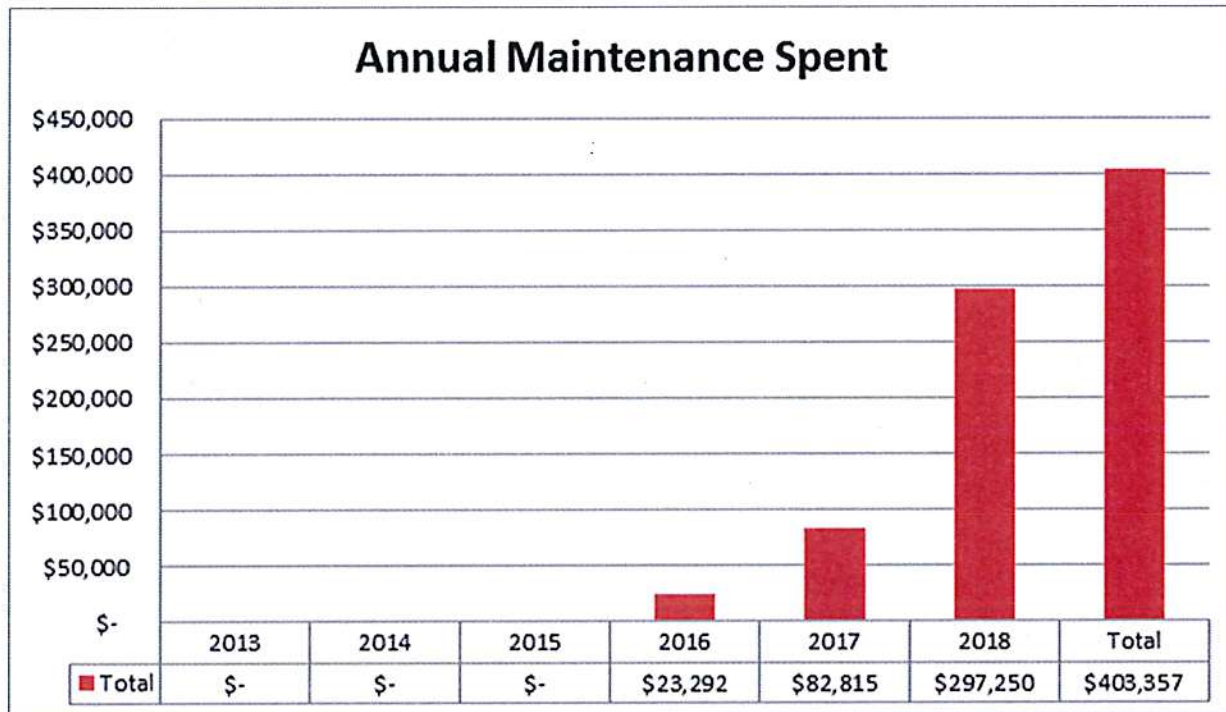
Q-19

Reference Discovery, Response to A-12. Please provide a graph of the annual maintenance expenses on the subject transmission line and state the anticipated annual maintenance expenses on the line following completion of the proposed project.

A-19

A line rebuilt to PPL Electric's current design standards should not require any maintenance activities for several years after installation, bringing maintenance costs essentially down to zero. This line will not be inspected until 8 years after installation, which should be the first maintenance activity conducted on this line after the rebuild. Cost to inspect via helicopter patrol should be less than \$5,000 for these circuits at that time.

See below graph of annual maintenance expenses from 2013-2018:



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Q-20 Reference Discovery, Responses to A-10 and A-11. Please explain whether a loss of the subject section of transmission line results in the loss of service to customers.

A-20 Yes, the loss of these transmission lines will result in a loss of service to customers. There are 11,167 customers fed from three 69/12kV substations that are sourced solely from the Siegfried-East Palmerton 1&2 lines.

Attachment 1

September 2, 2011

Project 2009-149

Mr. Joseph Marhefka
PPL Electric Utilities
2 North Ninth Street
Allentown, PA 18101-1179
MS: GENN4

***Special Inspection Report for Zone #2
Siegfried-E. Palmerton #1 and #2 69kV Transmission Lines***

Dear Mr. Marhefka;

This report contains our findings and overview of the Zone #2 Siegfried-E. Palmerton 69kV transmission lines which were recently inspected from the ground as part of the PPL Asset Optimization Strategy (AOS) Program.

Introduction and Overview

This 7 mile long transmission line corridor consists of approximately 3.5 miles of two parallel single circuit wood h-frames and 3.5 miles of double circuit towers. The corridor consists of the Siegfried-E. Palmerton #1 and #2 circuits. There are approximately 220 total structures. The sample size chosen for inspection was 10% of structures. Selection was based on structures known to have problems and at random.

The Zone #2 Siegfried-E. Palmerton #1 and #2 circuits have been in service since 1950. The Siegfried-E. Palmerton circuits are strung with the original 2/0 copperweld conductor. The two circuits were constructed in 1950 to provide service to East Palmerton. They occupy two positions on the original Hauto-Siegfried lines up until to the junction where the E. Palmerton lines leave and go northeast. In previous assessment reports, DGA recommended that Zones #1 and #3 be rebuilt. These zones encompass all structures on the Hauto-Siegfried #1 and #4 lines. The Siegfried-E. Palmerton lines are collocated with the Zone #1 Hauto-Siegfried lines and the remainder of the line is located in Zone #2, which is what this report concerns. Since Zones #1 and #3 are suggested to be rebuilt as a double circuit monopole line, it makes sense economically to rebuild the remaining 7 miles on the Zone #2 portion of the Siegfried-E. Palmerton lines. It would be prudent for PPL to rebuild these lines with a more reliable, redundant and robust double circuit steel pole line built on the centerline of the existing right of way.

Inspections

Six (6) wood pole structures and two (2) steel lattice tower structures received detailed structural inspections from the ground. Data from ground inspections is located at the end of this report.

The ground inspections included evaluation of the following items:

- Encroachments: Includes structures on the Right of Way, danger trees, vegetation on the Right of Way, fencing, debris, fire hazards and anything that can affect the operation and maintenance of the line
 - One of the inspected wood pole structures has good vehicle access from E. Palmerton Substation. This is a good condition.

- o Four of the inspected structures have good 4wd access from Mountain Road. There is a gate restricting access, but the gate has a PPL lock. These are fair conditions.
- o The remaining three structures inspected have difficult access due to a variety of reason. One has difficult access due to stream crossings. The remaining two have gated and guarded access from a quarry but with no PPL lock on the gate. These are poor conditions.
- o 1/8 structures Rating 2 – good condition.
- o 4/8 structures Rating 3 – fair condition.
- o 3/8 structures Rating 4 – poor condition.



Photo 1 – Typical wood h-frame structure



Photo 2 – Typical steel lattice tower

- Geotechnical: Includes slope stability, landslides, subsidence, erosion, questionable foundation capacity, grade changes around structure and leaning structures
 - Structure Inspection No. 69 is located in a hillside cut. A concrete retaining wall and a bench were located behind the tower to prevent sliding rocks from striking tower. These are fair conditions.
 - Structure Inspection No. 70 is located in a marsh. Leg no. 3 and 4 foundations are underwater. These are fair conditions.
 - Four wood pole h-frames were also located in marsh areas. These are fair geotechnical conditions. The marsh conditions affect pole strength more so than foundation capacity.
 - There were no detrimental geotechnical issues found at the remaining two inspection sites.
 - 2/8 structures Rating 2 – good condition.
 - 6/8 structures Rating 3 – fair condition.



Photo 3 –Typical wood pole located in standing water

- Shield Wire Hardware: To evaluate the electrical and mechanical connection of the shield wire to the structure and to the adjacent shield wire span
 - The shield wire hardware is difficult to evaluate from the ground. There is a variety of different types of hardware being used. Most hardware that is steel has significant corrosion. U bolts on clamps are also significantly corroded.
 - Two tower structures have strain clamps and the shield wire is jumpered but not bonded to the tower. The hardware has significant surface corrosion. Structures northeast of the Lehigh River have hardware that is significantly more corroded than the rest of the corridor. This is believed to be a result of the industry in the area. These are poor conditions.
 - Structure inspection No. 64, 65, 66, 67 & 68 are all wood pole h-frames with suspension saddle clamps. The shield wire hardware is bonded to the ground lead in all cases. Hardware has surface corrosion. These are fair conditions.
 - Based solely on age, all hardware such as strain clamps and saddle clamps should be replaced. This may be problematic though due to the use of ductile iron clamps and copper or copperweld conductor. The clamps are likely difficult to remove and the wire is likely damaged.
 - 1/8 structures Rating 1 – not applicable.
 - 5/8 structures Rating 3 – fair condition
 - 2/8 structures Rating 4 – poor condition.



Photo 4 – Typical Shield Wire Saddle Clamp Connection (hardware corroded)



Photo 5 – Typical Shield Wire Strain Clamp Connection (jumped but not bonded to tower and hardware very corroded)

- Insulators & Hardware: To look for flashed or broken insulators, contamination of insulator strings, corrosion of insulator caps and related hardware
 - One inspected structure has good insulator and hardware conditions. All insulators have been replaced and hardware has very little surface corrosion.
 - The majority of structures (five) inspected have fair insulator and hardware conditions. Some surface corrosion can be seen on the insulator caps and the hardware. U bolts on clamps are difficult to evaluate, but corrosion can be seen on them.
 - Two tower structures located to the northeast of the Lehigh River have poor insulator and hardware conditions. Significant corrosion can be seen on all hardware. Similar to the shield wire hardware, this is believed to be a result of the industry in the area. These are poor conditions.
 - Based solely on age, hardware such as strain clamps and saddle clamps should be replaced. This may be problematic though due to the use of ductile iron clamps and copper or copperweld conductor. The clamps are likely difficult to remove and the wire is likely damaged.
 - 1/8 structures Rating 2 – good condition.
 - 5/8 structures Rating 3 – fair condition
 - 2/8 structures Rating 4 – poor condition.



Photo 6 – Typical suspension insulator string



Photo 7 – Heavy corrosion typical strain insulator string on lattice tower

- Steel Corrosion: Evaluate the corrosion of original galvanizing (if exposed) and the corrosion of the bare steel. Related to Paint evaluation. Does not include ground line corrosion.
 - For the two inspected steel structures, no steel corrosion was present. This was largely due to good paint coatings. These are good conditions.
 - 2/2 structures Rating 2 – good condition.
- Paint: Evaluation of paint or other above ground coatings
 - On the two towers inspected, the paint is just starting to peel off near the base of the structures. Some red paint is visible on these towers due to issues with paint coverage, but overall the paint is in fair condition.
 - 2/2 structures Rating 3 – fair condition.



Photo 8 – Fair paint conditions, only peeling at bottom of tower

- Bent or Missing Steel: Includes identifying missing or loose bolts, bent or missing steel members and the determination of the cause (i.e. equipment collision, settlement, loading, etc). Excludes problems associated with ground line corrosion.
 - Structure Inspection No. 69 has a bent redundant on Face B. This appears to be a result of a rock slide. This is a fair condition.
 - The remaining tower has no bent or missing steel or missing bolts.
 - 1/2 structures Rating 2 – good condition.
 - 1/2 structures Rating 3 – fair condition.

- Concrete Foundations: To evaluate the concrete condition, steel corrosion at the steel-concrete interface, anchor bolt conditions, concrete projection above ground line
 - o Not applicable for malone and grillage type foundations.
 - o Structure Inspection No. 69 has fair foundation conditions. Two concrete foundations have projection and the other two foundations were located below grade. No corrosion was found at the steel-concrete interface.
 - o Structure Inspection No. 70 has poor foundation conditions. Only Leg No. 3 has concrete projection above the groundline. The other three concrete foundations were located below grade and one was submerged under water. No severe condition was observed. There was no visible or detectable section loss, but the water conditions and the foundations being located below grade are not a good combination. These are poor conditions.
 - o The concrete steel interface is best located above grade to avoid corrosion problems.
 - o For all concrete foundations, the protective coal tar epoxy coating is beginning to crack and delaminate. In fair condition.
 - o 1/2 structures Rating 3 – fair condition.
 - o 1/2 structures Rating 4 – poor condition.



Photo 9 – Submerged Concrete Foundation (Structure Inspection No. 70)

- Grounding: To evaluate the presence and condition of grounding from the attachment to structural steel to the embedded ground rod or counterpoise.
 - o Continuous counterpoise was used for grounding, as evident from plan and profile drawings.
 - o Generally, most towers have at least two legs grounded and all wood poles have ground leads running down each pole. These are poor conditions due to the use of continuous counterpoise.
 - o 8/8 structures Rating 4 – poor condition.
- Vegetation by Structure: Any vegetation which negatively impacts the maintenance and operation of a structure. Includes dense vegetation that inhibits access, vines growing on tower and up legs, vegetation that impacts painting and wetland locations.
 - o Structure Inspection No. 64, 66 and 68 have very dense briars growing within and around structure. Vegetation inhibits access to structure. These are poor conditions.
 - o Structure Inspection No. 70 has many bushes and trees growing within and around structure. Vegetation inhibits access to structure. This is a poor condition.
 - o There were no detrimental vegetation issues found at the four remaining inspection sites.
 - o 4/8 structures Rating 2 – good condition.
 - o 3/8 structures Rating 3 – fair condition.
 - o 1/8 structures Rating 4 – poor condition.



Photo 10 – Poor vegetation conditions (Structure Inspection No. 70)

- Signage: To evaluate the presence and condition of all Structure Danger Signs and Structure Identification Signs.
 - One wood pole structure has faded and barely legible number signs. This is a fair condition.
 - Two towers have good, legible number signs but have faded danger signs. These are fair conditions.
 - The remaining five wood structure inspections have good number signs. These are good conditions.
 - 5/8 structures Rating 2 – good condition.
 - 3/8 structures Rating 3 – fair condition.

- Wood Poles: To evaluate how the wood pole structure, guys and anchors behave as a system. Look for leaning poles, mechanical damage (wood pecker holes, decay, insects, deep checking) and strength.
 - Structure Inspection No. 64, 66 and 71 have few or no woodpecker holes. No. 71 has significant checking of the pole, but does not appear to affect the pole structurally. The outer shells are in good condition. When struck with hammer, inner core sounds solid. These are fair conditions.
 - Structure Inspection No. 67 and 68 are in severe condition. The wood poles have a significant amount of woodpecker holes from the middle of pole to top of pole. There are also many patch holes. No. 67 has one direct embedment weathering steel pole directly set in standing water. These are all severe conditions.
 - Structure Inspection No. 65 is in severe condition. The poles are set in standing water and are completely water logged at the groundline. The wood is very soft and disintegrating at the groundline. Poles set in standing water is a severe condition.
 - 3/6 structures Rating 3 – fair condition.
 - 3/6 structures Rating 5 – severe condition.
- Guying: To evaluate the structural condition of the guying and the effectiveness of the guying.
 - No guying present.
 - 6/6 structures Rating 1 – not applicable.

These inspection results and the conclusions drawn from them may or may not be representative of the entire line. A 20% sample size would be desirable for each type of construction, wood or steel, on a specific transmission line.

Condition Assessment

The Zone #2 Siegfried-E. Palmerton lines were put in service in 1950. It is assumed that most insulators are from the original install and they are approaching the period in which deterioration from corrosion becomes more rapid. The conductor is 2/0 copperweld on both circuits and is over 60 years old. The conductor is at the end of its useful life.

The lightning protection afforded by the overhead ground wires, or shield wires, appears to be adequate. Very few splices and repair sleeves were found on the lines over the course of the inspection of over 14 circuit miles. Normally, when numerous repair sleeves and full tension splices exist on a line for reasons other than stringing, the most likely cause is poor lightning protection resulting in lightning strikes to the conductors, phase to phase faults or phase to ground faults.

It is assumed that most insulators are original and approximately 60 years old. Insulators this old have several drawbacks. Due to their age, they can be contaminated with pollutants. This contamination greatly reduces the insulation levels intended to be provided by the insulators. Several insulator strings on the Siegfried-E. Palmerton lines have had entire insulator strings replaced with newer porcelain bells. Insulators were most likely replaced due to flashovers, contamination, mechanical damage or failure. This is indicative of poor insulation levels causing phase to ground faults. There is evidence of galvanizing left on the insulator caps, although corrosion is actively occurring on all hardware. Corrosion of both the caps and the pin and clevis end fittings will all contribute to a reduction in strength. See Figure 1 below for a plot of service life of hardware and galvanized steel versus rated strength. Galvanizing, when not painted can have a life expectancy of anywhere from 30 to 80 years, depending on the environment. The hardware on the Siegfried-E. Palmerton lines is over 60 years old and even in a favorable environment is

approaching the age marking the period in which rapid decline in strength begins. The useful life of all original insulators and hardware is approaching its end. In the area northeast of the Lehigh River, the insulators and hardware are especially corroded. This area is very industrial, or used to be very industrial. There is evidence of a zinc processing facility on the original plan and profiles. Other industries and the remnants of past industries can be seen in this area and this is believed to have significantly contributed to the accelerated corrosion on this side of the river.

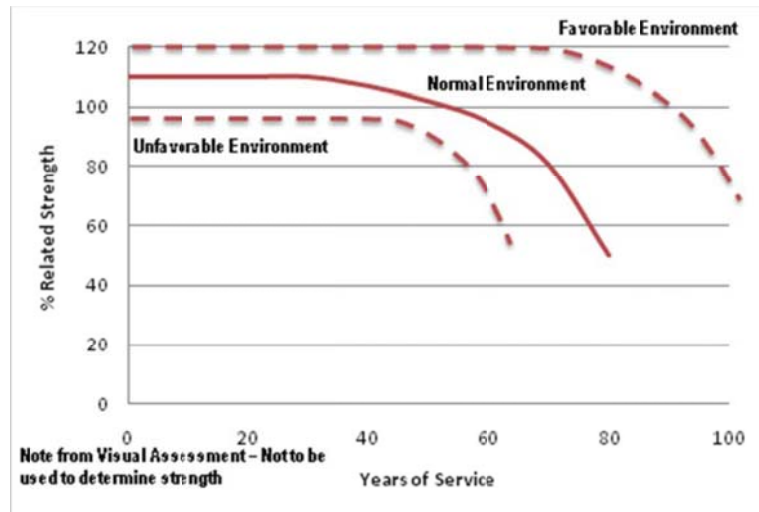


Figure 1 – Relation between Service Life and Rated Strength (Galvanized Steel) (from EPRI *Overhead Transmission Inspection and Assessment Guidelines – 2009*)

Original plans indicate that shield wires were installed in 1950 along with the conductors. In general, the shielding provided is adequate. Historically, the maximum shielding afforded by an overhead shield wire is a 30 degree cone at tangent structures. The Siegfried-E. Palmerton structures provide more coverage than the minimum 30 degrees. A more refined analysis was performed for typical structures using IEEE and EPRI guidelines. The refined shielding analysis yields the same conclusions of the 30 degree rule of thumb. In general, the shielding coverage is adequate but the structures usually lack a good path to ground. On wood pole structures, the shield wire was generally bonded to the ground lead which goes down the pole and attaches to the grounding system. The towers that were inspected had strain shield wire connections. The shield wires were jumpered at the structures but they were not bonded to the tower steel. The poles appear to have an adequate connection to the grounding system, but the towers do not. The lightning current is expected to follow a path along the shield wire, down the tower and through the tower footing resistance to the ground. When the shield wire is not bonded to the tower steel, this expected path cannot be relied upon. The shield wires should be physically bonded to select towers to provide the required electrical connection, without forming a closed loop for induced current to circulate, resulting in a resistance heating line loss.

Plans indicate that the structures were built using a continuous counterpoise instead of driven grounding rods. While counterpoise certainly decreases the ground resistance of a structure, it is not as effective in dissipating lightning strikes as a ground rod system or a radial counterpoise system. During a lightning induced surge, the counterpoise acts as an electrode and the entire length of counterpoise cannot be relied upon to ground out the surge. More numerous, smaller electrodes (driven grounding rods or radial counterpoise) are in many ways more effective than a single counterpoise running from structure to structure. In several instances along the Hauto-Siegfried-E. Palmerton Lines, the counterpoise was

exposed and destroyed near the structures or along the Right of Way. This is usually the result of farming, earth moving or erosion occurring in the area. The grounding for the line is visually no longer in a functioning state. The Siegfried-E. Palmerton lines have an adequate shielding system, but are lacking in the ability to efficiently ground out shielded lightning strikes. It is important to have good grounding performance on transmission lines.

The two towers inspected have fair paint conditions. There is still life left on the tower coatings. In the near future, the towers will require a thorough scraping, priming and repainting with quality zinc based tower paint. Galvanizing can also be observed on the base of the tower where the paint coatings have peeled off. Some corrosion can be seen up high in the tower. This is thought to be a result of the corrosive environment northeast of the Lehigh River. Most towers on the Siegfried-E. Palmerton lines are located primarily in this region. Moderate surface corrosion on tower steel is evident and with failing coatings and exposed galvanizing, corrosion will begin to increase at a more rapid rate. Reference Figure 1.

Near the ground line and below ground line, the coal tar epoxy coating is generally in good condition and protecting the steel. Based on the inspection results from the Hauto-Siegfried Inspections and other PPL inspections, steel corrosion and section loss doesn't always occur at the ground line. Careful attention also needs paid to buried concrete foundations. The interaction between the steel, concrete and the soil leads to significantly accelerated corrosion of the steel. Of the two inspected towers, both had buried concrete foundations.

Three out of six inspected wood pole structures have severe wood pole conditions. This is largely due to a significant quantity of wood pecker holes. Many direct embedment wood poles are also located in marsh, wet areas. This is also a large factor in deterioration of several poles. It is recommended that all wood poles be tested for strength and condition and an evaluation be done to determine which poles have reached the end of their life. Serious consideration needs to be given to replacing some wood poles with direct embedment steel poles to prevent the constant problem of woodpeckers destroying poles. Where there is standing water during the wet seasons, direct embedment wood or steel poles are both problematic due to the inevitable pole rot and steel corrosion that will occur.

Recommendations

The decision to rehabilitate or replace the line should be based on total life cycle costs and dependability. The life cycle cost is the present value of all rehabilitation, construction, maintenance, operation and other costs which take into account dependability considerations. Dependability is the term that addresses the availability of the line for service and the reliability of the line. If one option is less dependable than others (such as greater likelihood of failures) then a cost equivalency shall be included in the assessment. Think of it as the annual cost of insurance to keep the line both functioning and safe. The cost/dependability analysis must also define an expected life. A new line, properly designed and built to current NESC standards will likely provide a useful service life of 80 years. It is the opinion of DiGioia, Gray & Associates that combined with the conditions of Zone #1 and Zone #3, the Siegfried-E. Palmerton lines should be rebuilt. A decision to replace the existing line provides the company the opportunity to upgrade the line to current standards, as well as to install additional circuits and improved conductors to allow for future load growth.

We are pleased to have the opportunity to assist PPL Electric in the assessment of the Zone #2 Siegfried-E. Palmerton 69kV transmission lines. We hope our inspection and the information contained in this letter report will be useful in determining how to proceed with this line. Feel free to contact us to answer any questions you may have and to discuss PPL's need for future assistance on the project.

Mr. Joseph Marhefka Zone #2, Line #454 & #457, Siegfried-E. Palmerton 69kV Lines
Project 2009-149
September 2, 2011

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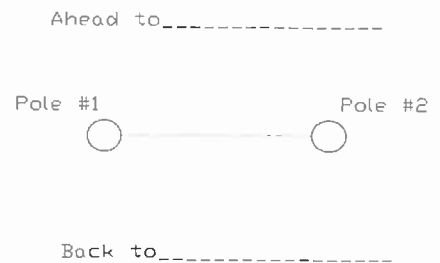
Respectfully submitted,
DiGioia, Gray & Associates, LLC

Andrew V. Zorn, PE
Project Engineer

Paul G. Cass, PE
Project Manager

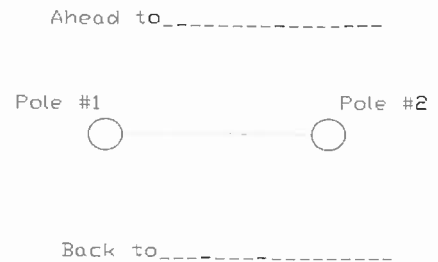
AVZ:PGC

Structure Inspection No.	64		
PPL Grid Number Pole 2	58029S52727		
PPL Grid Number Pole 1	58028S52727		
GPS Waypoint	1		
Ahead To	East Palmerton		
Back To	Siegfried		
Line Name	Line #457, Siegfried-E Palmerton #2		
Inspection Date	March 31, 2010		
Inspected By	A. Zorn and S. Konduru		
Structure Type	Wood Pole H-Frame Tangent		
Structure Material	Wood		
Foundation Type	Direct Embedment		
Insulator Type	Suspension, Porcelain		
	Rating	Condition Notes	
Encroachments	4	4wd drive access from Deer Road	stream crossing
Geotechnical	2	no issues	
Shield Wire Hardware	3	suspension, saddle clamp, hardware bonded to ground lead	shield wire hardware has surface corrosion
Insulators & Hardware	3	suspension saddle clamp, mild surface corrosion on hardware, can see galvanizing.	Galvanizing can be seen on insulator caps, have surface corrosion
Wood Poles	3	Pole 1 Circumference 47" at groundline When struck with hammer, pole sounds solid. Pole is in good condition. No splitting or woodpecker holes. Marking SWP 2-48 85-2	Pole 2 Circumference 47" at groundline When struck with hammer, pole sounds solid. Pole is in good condition. No splitting. Moderate amount of woodpecker holes from middle to top of pole, not severe.
Guying	1	Pole 1 no guying	Pole 2 no guying
Grounding	4	both poles are grounded	non-functioning due to use of continuous counterpoise
Vegetation by Str	3	very dense briars in r/w and around structure	inhibits access to structure
Signage	2	number signs good	
Notes			



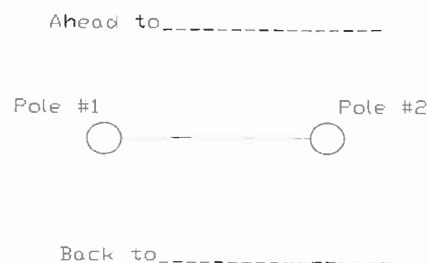
Structure Inspection No.	65		Ahead to_____ Pole #1 Pole #2  Back to_____
PPL Grid Number Pole 2	58297S53025		
PPL Grid Number Pole 1	58297S53026		
GPS Waypoint	2		
Ahead To	East Palmerton		
Back To	Siegfried		
Line Name	Line #454, Siegfried-E Palmerton #1		
Inspection Date	March 31, 2010		
Inspected By	A. Zorn and S. Konduru		
Structure Type	Wood Pole H-Frame Tangent		
Structure Material	Wood		
Foundation Type	Direct Embedment		
Insulator Type	Suspension, Porcelain		
	Rating	Condition Notes	
Encroachments	3	4wd drive access from Mountain Road	Gated with PPL lock
Geotechnical	3	wood poles located in marsh land	
Shield Wire Hardware	3	suspension, saddle clamp, hardware bonded to ground lead	shield wire hardware has surface corrosion
Insulators & Hardware	3	suspension saddle clamp, mild surface corrosion on hardware, can see galvanizing.	Galvanizing can be seen on insulator caps, have surface corrosion. Some flashover on insulators.
Wood Poles	5	Pole 1 Circumference 46" at groundline When struck with hammer, pole sounds solid above groundline. At base, pole is water logged and wood is very soft and disintegrating. Pole is in severe condition. No splitting or woodpecker holes. Marking 2-55	Pole 2 Circumference 46" at groundline When struck with hammer, pole sounds solid above groundline. At base, pole is water logged and wood is very soft and disintegrating. Pole is in severe condition. Top of pole has woodpecker hole repair patch Marking 2-55
Guying	1	Pole 1 no guying	Pole 2 no guying
Grounding	4	both poles are grounded	non-functioning due to use of continuous counterpoise
Vegetation by Str	2	no issues	
Signage	2	number signs good	
Notes	during wet season, many structures are in standing water. This is not a good condition for either direct embedment wood poles or weathering steel poles.		

Structure Inspection No.	66		
PPL Grid Number Pole 1	58458S53075		
PPL Grid Number Pole 2	58458S53074		
GPS Waypoint	3		
Ahead To	East Palmerton		
Back To	Siegfried		
Line Name	Line #457, Siegfried-E Palmerton #2		
Inspection Date	March 31, 2010		
Inspected By	A. Zorn and S. Konduru		
Structure Type	Wood Pole H-Frame Tangent		
Structure Material	Wood		
Foundation Type	Direct Embedment		
Insulator Type	Suspension, Porcelain		
	Rating	Condition Notes	
Encroachments	3	4wd drive access from Mountain Road	Gated with PPL lock
Geotechnical	3	wood poles located in marsh land	
Shield Wire Hardware	3	suspension, saddle clamp, hardware bonded to ground lead	shield wire hardware has surface corrosion, only sw on Pole 1 bonded to ground lead
Insulators & Hardware	3	suspension saddle clamp, mild surface corrosion on hardware, can see galvanizing.	Galvanizing can be seen on insulator caps, have surface corrosion. Several bells replaced on right phase. Insulator caps on right phase more corroded.
Wood Poles	3	Pole 1 Circumference 52" at groundline When struck with hammer, pole sounds solid. Pole is in good condition. No splitting. Moderate amount of woodpecker holes from middle to top of pole, not severe.	Pole 2 Circumference 44" at groundline When struck with hammer, pole sounds solid. Pole is in good condition. No splitting or woodpecker holes. Marking 17 SP 260
Guying	1	Pole 1 no guying	Pole 2 no guying
Grounding	4	both poles are grounded	non-functioning due to use of continuous counterpoise
Vegetation by Str	3	very dense briars in r/w and around structure	inhibits access to structure
Signage	2	number signs good	
Notes	during wet season, many structures are in standing water. This is not a good condition for either direct embedment wood poles or weathering steel poles.		



Structure Inspection No.	67			Ahead to_____ Pole #1 Pole #2  Back to_____
PPL Grid Number Pole 2	58520S53095			
PPL Grid Number Pole 1	58520S53096			
GPS Waypoint	4			
Ahead To	East Palmerton			
Back To	Siegfried			
Line Name	Line #457, Siegfried-E Palmerton #2			
Inspection Date	March 31, 2010			
Inspected By	A. Zorn and S. Konduru			
Structure Type	Wood Pole H-Frame Tangent (1 steel pole)			
Structure Material	Wood and Weathering Steel			
Foundation Type	Direct Embedment			
Insulator Type	Suspension, Porcelain			
	Rating	Condition Notes		
Encroachments	3	4wd drive access from Mountain Road	Gated with PPL lock	
Geotechnical	3	wood poles located in marsh land		
Shield Wire Hardware	3	suspension, saddle clamp, hardware bonded to ground lead	shield wire hardware has surface corrosion, only sw on Pole 1 bonded to ground lead	
Insulators & Hardware	3	suspension saddle clamp, mild surface corrosion on hardware, can see galvanizing.	Galvanizing can be seen on insulator caps, have surface corrosion	
Wood Poles	5	Pole 1 Circumference 49" at groundline When struck with hammer, pole sounds solid. No splitting. Significant amount of woodpecker holes from middle to top of pole, many patched holes.	Pole 2 Weathering Steel Pole Pole is in good condition, but it is located in standing water and this is a very bad condition for this type of pole to be located in. Marking LD4-65 T&B	
Guying	1	Pole 1 no guying	Pole 2 no guying	
Grounding	4	both poles are grounded	non-functioning due to use of continuous counterpoise	
Vegetation by Str	2	no issues		
Signage	2	number signs good		
Notes	during wet season, many structures are in standing water. This is not a good condition for either direct embedment wood poles or weathering steel poles.			

Structure Inspection No.	68		
PPL Grid Number Pole 2	58640S53136		
PPL Grid Number Pole 1	58640S53137		
GPS Waypoint	5		
Ahead To	East Palmerton		
Back To	Siegfried		
Line Name	Line #457, Siegfried-E Palmerton #2		
Inspection Date	March 31, 2010		
Inspected By	A. Zorn and S. Konduru		
Structure Type	Wood Pole H-Frame Tangent		
Structure Material	Wood		
Foundation Type	Direct Embedment		
Insulator Type	Suspension, Porcelain		
	Rating	Condition Notes	
Encroachments	3	4wd drive access from Mountain Road	Gated with PPL lock
Geotechnical	3	wood poles located in marsh land	
Shield Wire Hardware	3	suspension, saddle clamp, hardware bonded to ground lead	shield wire hardware has surface corrosion, only sw on Pole 2 bonded to ground lead
Insulators & Hardware	3	suspension saddle clamp, mild surface corrosion on hardware, can see galvanizing.	Galvanizing can be seen on insulator caps, have surface corrosion
Wood Poles	5	Pole 1 Circumference 49" at groundline When struck with hammer, pole sounds solid. No splitting. Significant amount of woodpecker holes from middle to top of pole, many patched holes. Severe condition. Marking US/BIU/86/SP/10/2-60	Pole 2 Circumference 53" at groundline When struck with hammer, pole sounds solid. Pole is in good condition. No splitting and onle one repaired woodpecker hole at middle of pole.
Guying	1	Pole 1 no guying	Pole 2 no guying
Grounding	4	both poles are grounded	non-functioning due to use of continuous counterpoise
Vegetation by Str	3	very dense briars in r/w and around structure	inhibits access to structure
Signage	3	number signs faded, barely legible	
Notes	during wet season, many structures are in standing water. This is not a good condition for either direct embedment wood poles or weathering steel poles. Splings growing in R/W underneath conductors.		



Structure Inspection No.	69		
PPL Grid Number	59231N23586		
GPS Waypoint	7		
Ahead To	East Palmerton		
Back To	Siegfried		
Line Name	Line #454, Siegfried-E Palmerton #1		
	Line #457, Siegfried-E Palmerton #2		
Inspection Date	March 31, 2010		
Inspected By	A. Zorn and S. Konduru		
Structure Type	Steel Lattice Tower Angle		
Structure Material	Galvanized, Painted		
Foundation Type	Concrete unknown		
Insulator Type	Strain, Porcelain		

Ahead to _____

Leg #3 Leg #2

Leg #4 Leg #1

Back to _____

	Rating	Condition Notes	
Encroachments	4	access from quarry	gated and guarded access, with no PPL lock
Geotechnical	3	tower located in rock slide zone	bench was cut in to hill behind tower
Shield Wire Hardware	4	strain clamp, jumpered but not bonded to tower	hardware has significant corrosion
Insulators & Hardware	4	strain clamp, one jumper loop insulator string has been replaced	all hardware has significant corrosion including insulator caps
Steel Corrosion	2	none	
Paint	3	paint is just starting to peel near base of tower	galvanizing is visible on bottom half of tower
Bent Missing Steel	3	bent redundant on Face B	appears to be result of rock collision
Concrete Foundations	3	Leg No. 3 has concrete projection	Leg No. 2 dug -no surface corrosion -no section loss -coal tar epoxy in good condition
		Leg No. 4 has concrete projection	Leg No. 1 concrete fdn was buried
Grounding	4	Leg No. 3 & 4 were grounded	non-functioning due to use of continuous counterpoise
Vegetation by Str	2	no issues	
Signage	3	number signs good	danger signs faded, barely legible
Notes			

Structure Inspection No.	70		
PPL Grid Number	59233N23682		
GPS Waypoint	6		
Ahead To	East Palmerton		
Back To	Siegfried		
Line Name	Line #454, Siegfried-E Palmerton #1		
	Line #457, Siegfried-E Palmerton #2		
Inspection Date	March 31, 2010		
Inspected By	A. Zorn and S. Konduru		
Structure Type	Steel Lattice Tower Angle		
Structure Material	Galvanized, Painted		
Foundation Type	Concrete unknown		
Insulator Type	Strain, Porcelain		

Ahead to _____

Leg #3 Leg #2

Leg #4 Leg #1

Back to _____

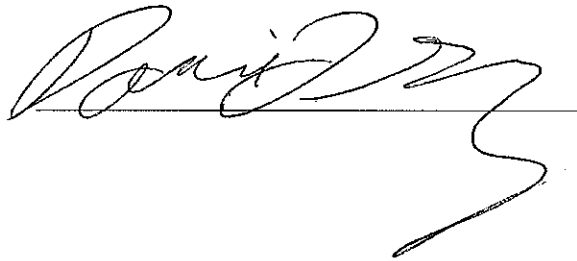
	Rating	Condition Notes	
Encroachments	4	access from quarry	gated and guarded access, with no PPL lock
Geotechnical	3	tower located in marsh land, legs 3 and 4 foundations were underwater	
Shield Wire Hardware	4	strain clamp, jumpered but not bonded to tower	hardware has significant corrosion
Insulators & Hardware	4	strain clamp	all hardware has significant corrosion including insulator caps
Steel Corrosion	2	none	
Paint	3	paint is just starting to peel near base of tower	galvanizing is visible on bottom half of tower
Bent Missing Steel	2	none	
Concrete Foundations	4	Leg No. 3 has concrete projection, concrete was breaking off.	Leg No. 2 dug -no surface corrosion -no section loss -coal tar epoxy in good condition
	4	Leg No. 4 concrete fdn was submerged in water, no section loss visible or detectable, but water condition is bad	Leg No. 1 concrete fdn was buried
Grounding	4	Leg No. 3 & 4 were grounded	non-functioning due to use of continuous counterpoise
Vegetation by Str	4	many bushes and trees growing in and around structure	inhibits access to structure
Signage	3	number signs good	danger signs faded, barely legible
Notes			

Structure Inspection No.	71		Ahead to _____ Pole #1  Back to _____
PPL Grid Number	60332N24305		
GPS Waypoint	8		
Ahead To	East Palmerton		
Back To	Siegfried		
Line Name	Line #454, Siegfried-E Palmerton #1		
Inspection Date	March 31, 2010		
Inspected By	A. Zorn and S. Konduru		
Structure Type	Wood Pole Tangent		
Structure Material	Wood		
Foundation Type	Direct Embedment w/ corrugated pipe can		
Insulator Type	Post, Porcelain		
	Rating	Condition Notes	
Encroachments	2	vehicle access from East Palmerton Substation	no issues
Geotechnical	2	no issues	
Shield Wire Hardware	1	no sw	
Insulators & Hardware	2	good condition, insignificant surface corrosion	
Wood Poles	3	Pole 1 Circumference 51" at groundline When struck with hammer, pole sounds solid. No woodpecker holes, significant splitting near base of pole, +4" deep Marking C-90 1-85	
Guying	1	Pole 1 no guying	
Grounding	4	Pole is grounded	non-functioning due to use of continuous counterpoise
Vegetation by Str	2	no issues	
Signage	2	number signs good	
Notes			

VERIFICATION

I, DAVID L. GLADEY, being the Director of Asset Management at PPL Electric Utilities Corporation, hereby state that the facts above set forth are true and correct to the best of my knowledge, information and belief and that I expect PPL Electric Utilities Corporation to be able to prove the same at a hearing held in this matter. I understand that the statements herein are made subject to the penalties of 18 Pa.C.S. § 4904 relating to unsworn falsification to authorities.

Date: 8/13/18

A handwritten signature in black ink, appearing to read "David L. Gladey", is written over a horizontal line. The signature is stylized with a large, sweeping flourish at the end.