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August 31, 2017

VIA ELECTRONIC FILING

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

Re: Petition of PPL Electric Utilities Corporation for Approval of its Long-Term Infrastructure Improvement Plan for the Period January 1, 2018 through December 31, 2022 - Docket No. P-2017

Dear Secretary Chiavetta:

Enclosed for filing is the Petition of PPL Electric Utilities Corporation for Approval of a Long-Term Infrastructure Improvement Plan. Copies are being served on the statutory advocates and all parties of record to the Company's most recent base rate proceeding at Docket No. R-2015-2469275 as indicated on the Certificate of Service.

Respectfully submitted,


Christopher T. Wright

CTW/jl
Enclosures

cc: Certificate of Service

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing has been served upon the following persons, in the manner indicated, in accordance with the requirements of 52 Pa. Code § 1.54 (relating to service by a participant).

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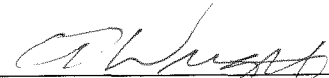
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Date: August 31, 2017



Christopher T. Wright

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

Petition of PPL Electric Utilities Corporation :
for Approval of its Long-Term Infrastructure : Docket No. P-2017-_____
Improvement Plan for the Period January 1, :
2018 through December 31, 2022 :

**PETITION OF PPL ELECTRIC UTILITIES CORPORATION
FOR APPROVAL OF A LONG-TERM INFRASTRUCTURE
IMPROVEMENT PLAN**

TO THE PENNSYLVANIA PUBLIC UTILITY COMMISSION:

Pursuant to 66 Pa.C.S. § 1352(a) and 52 Pa. Code §§ 121.1 *et seq*, PPL Electric Utilities Corporation (“PPL Electric” or the “Company”) hereby requests approval of its second Long-Term Infrastructure Improvement Plan (“LTIIIP”) for the period January 1, 2018 through December 31, 2022. A copy of the Company’s proposed second LTIIIP is provided as “**Attachment 1**” to this Petition. This second LTIIIP replaces the Company’s current LTIIIP that was approved on January 10, 2013 at Docket No. P-2012-2325034, which is set to expire on December 31, 2017. Under the second LTIIIP, the Company proposes to continue its accelerated repair, improvement, and replacement of aging infrastructure as described below in further detail in the proposed LTIIIP.

PPL Electric respectfully requests that the Pennsylvania Public Utility Commission (“Commission”) approve the second LTIIIP, as further described in this Petition for the period January 1, 2018 through December 31, 2022.

I. INTRODUCTION

1. This Petition is filed by PPL Electric, a public utility subject to the regulatory jurisdiction of the Commission.

2. PPL Electric's address is PPL Electric Utilities Corporation, Two North Ninth Street, Allentown, Pennsylvania 18101.

3. PPL Electric's attorneys are:

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PPL Electric's attorneys are authorized to receive all notices and communications regarding this filing.

4. PPL Electric furnishes electric distribution, transmission and default supply services to approximately 1.4 million customers throughout its certificated service territory, which includes all or portions of twenty-nine counties and encompasses approximately 10,000 square miles in eastern and central Pennsylvania.

5. PPL Electric is a “public utility,” an “electric distribution company” (“EDC”), and a “default service provider” as defined in Sections 102 and 2803 of the Pennsylvania Public Utility Code, 66 Pa.C.S. §§ 102, 2803.

6. On February 14, 2012, Governor Corbett signed into law Act 11 of 2012 (“Act 11”), which amended Chapters 3, 13 and 33 of Title 66 of the Code to allow, among other things, EDCs, natural gas distribution companies, water utilities, wastewater utilities and city natural gas distribution operations to establish a distribution system improvement charge (“DSIC”).

7. Act 11 provides utilities with the ability to implement a DSIC to recover reasonable and prudent costs incurred to repair, improve, or replace certain eligible distribution property that is part of the utility’s distribution system. Eligible property for EDCs is defined in Section 1351 of the statute. *See* 66 Pa.C.S. § 1351(1). As a precondition to the implementation of a DSIC, a utility must file an LTIP with the Commission that is consistent with the provisions of Section 1352 of the statute. *See* 66 Pa.C.S. § 1352(a).

8. On August 2, 2012, the Commission issued an Implementation Order establishing procedures and guidelines necessary to implement Act 11. *Implementation of Act 11 of 2012*, Docket No. M-2012-2293611 (Order entered August 2, 2012) (“*Implementation Order*”). The *Implementation Order* adopted the requirements established in Section 1352, provided additional standards that each LTIP must meet, and gave guidance to utilities for meeting the Commission’s standards.

9. On January 10, 2013, the Company’s current LTIP was approved by the Commission at Docket No. P-2012-2325034. The Company’s current LTIP expires on December 31, 2017.

10. On January 15, 2013, PPL Electric filed a petition seeking approval of a DSIC. By Orders entered May 23, 2013 and April 9, 2015, the Commission approved PPL Electric's DSIC.

11. On December 20, 2014, the Commission's LTIIIP regulations became effective. *See* 52 Pa. Code §§ 121.1 *et seq.* The LTIIIP regulations provide the elements that an LTIIIP must include to be approved. Specifically, an LTIIIP must include the following eight major elements:

- (a) Identification of types and age of eligible property owned and operated by the utility for which it is seeking DSIC recovery;
- (b) An initial schedule for planned repair and replacement of eligible property;
- (c) A general description of location of the eligible property;
- (d) A reasonable estimate of quantity of eligible property to be improved or repaired;
- (e) Projected annual expenditures and means to finance the expenditures;
- (f) A description of the manner in which infrastructure replacement will be accelerated and how repair, improvement or replacement will ensure and maintain adequate, efficient, safe, reliable and reasonable service;
- (g) A workforce management and training program designed to ensure that the utility will have access to a qualified workforce to perform work in a cost-effective, safe and reliable manner; and
- (h) A description of a utility's outreach and coordination activities with other utilities, Department of Transportation and local governments regarding the planned maintenance/construction projects and roadways that may be impacted by the LTIIIP.

52 Pa. Code § 121.3.

12. The Commission's LTIIIP regulations further provide that a utility seeking to continue its DSIC mechanism after the expiration of its LTIIIP must file a new LTIIIP with the

Commission at least 120 days prior to the expiration of the currently-effective LTIIIP. 52 Pa. Code § 121.5.

13. PPL Electric's proposed LTIIIP addresses each of the eight elements listed in the LTIIIP regulations, as summarized in this Petition.

II. PROPOSED LONG-TERM INFRASTRUCTURE IMPROVEMENT PLAN

A. PROPERTY TO BE IMPROVED, REPAIRED AND REPLACED

14. In accordance with the Commission's *Implementation Order*, the LTIIIP regulations and statute, PPL Electric has focused its LTIIIP on distribution plant that is DSIC eligible. *Implementation Order*, p. 18; 52 Pa. Code § 121.3(b).

15. All of the property PPL Electric has included in its LTIIIP meets the definition of eligible property found in Section 1351(1), which includes the following items: poles; overhead conductors; distribution substation equipment; fixtures and devices related to the eligible property such as circuit breakers, fuses, reclosers, and crossarms; unreimbursed costs related to highway relocation projects; and other related capitalized costs.

16. Nearly half of PPL Electric's distribution system was constructed 40 or more years ago as a result of the economic expansion and building boom of the 1960's and 1970's. As this equipment deteriorates due to age, environmental exposure, and added load, it has become increasingly critical to plan for the repair, upgrade, and/or replacement of these assets.

17. The LTIIIP covers a broad spectrum of distribution related equipment and facilities, which have been separated into two asset categories. These two categories are (1) distribution assets and (2) substation assets. A description of the items classified as distribution assets can be found on page 17 of the LTIIIP, while a description of those items included in the LTIIIP as substation assets is found on page 43. (*See Attachment 1, pp. 17, 43*) Within each of these categories, PPL Electric has identified specific programs to address the various elements,

equipment, and facilities that make up each of the two asset classes. Each program is described individually, with an estimated replacement schedule and estimated costs as applicable or appropriate.

18. For each individual program included in the LTIP, PPL Electric has provided the following information: a description of the program and its purpose; a description of how PPL Electric identifies equipment for replacement within each program and the appropriate course of action to improve identified equipment; the scope of the program, including a reasonable estimate of the quantity of property to be improved where applicable; the location of planned replacements where applicable; and the total amount projected to be spent by the Company annually and over the life of the five-year plan. These detailed profiles of the individual programs are provided in the LTIP. (*See Attachment 1, pp. 17-42 for distribution assets, pp. 43-53 for substation assets*)

19. Appendix A to the LTIP provides a summary of the types and average age of eligible property to be replaced. (*See Attachment 1, p. 54*)

B. SCHEDULE FOR REPAIR AND REPLACEMENT

20. The proposed LTIP covers the five-year period January 1, 2018 through December 31, 2022.

21. The estimated schedule for each individual LTIP program has been included in the program descriptions. (*See Attachment 1, pp. 17-42 for distribution assets, pp. 43-53 for substation assets*)

22. PPL Electric has estimated the number of replacements in a variety of distribution asset categories over the five-year LTIP period. In estimating its replacement schedule, a number of factors were considered. Some of the initiatives, such as animal guarding, clearly have implied end-points, where no further opportunities for improvement remain. Others, such

as System Average Interruption Duration Index (“SAIDI”) improvements, eventually experience diminishing returns over time. Finally some programs, such as pole reinforcement and replacement, will be ongoing.

23. In addition, the programs implemented by PPL Electric are subject to change, as additional analysis is done on the effectiveness of individual programs, or as new issues arise. Some programs may become obsolete, while new programs may become desirable as a result of the evolution of new technologies.

24. The effectiveness of LTIP programs will be reviewed on a regular basis and programs will be added, deleted, and/or modified, as necessary, to ensure that the expenditures are providing the desired benefits to customers at a reasonable cost. Therefore, while PPL Electric has provided an estimated schedule for when certain replacements will take place, that schedule is subject to change as a result of PPL Electric's ongoing review process and emergent resource requirements.

C. LOCATION OF ELIGIBLE PROPERTY

25. A description of the location of eligible property to be repaired and replaced has been provided on an individual program basis, and is included in the section of the LTIP that provides individual program descriptions. (*See Attachment 1, pp. 17-42 for distribution assets, pp. 43-53 for substation assets*)

D. REASONABLE ESTIMATE OF THE QUANTITY OF PROPERTY TO BE IMPROVED

26. An estimate of the quantity of eligible property to be improved or repaired, as well as the Company's basis for these estimates, have been provided on an individual program basis, and are included in the section of the LTIP that provides individual program descriptions. (*See Attachment 1 pp. 17-42 for distribution assets, pp. 43-53 for substation assets*)

E. PROJECTED ANNUAL EXPENDITURES AND MEANS TO FINANCE THE EXPENDITURES

27. The LTIP provides the Company's projected expenditures on a yearly basis for each of the individual programs for the five-year period, the total projected expenditures for each program at the conclusion of the five-year period, and the overall projected annual and total expenditures for all DSIC eligible distribution property. (See Attachment 1, p. 16) In addition, individual program expenditure information is included in the sections describing the each of the individual programs.

28. The Company intends to finance the costs of its DSIC eligible work through its usual financing mechanisms, debt and equity. In each DSIC rate filing, the Company will identify its capital structure and cost of debt, in addition using the Return on Equity as determined in its base rate case proceeding or as defined in the most recent applicable Commission Quarterly Financial Report.

29. In order to ensure that its individual programs are cost-effective investments, PPL Electric will routinely review the effectiveness of its programs. Program and project impacts on SAIDI and System Average Interruption Frequency Index ("SAIFI"), in addition to potential reductions in outage response costs, are compared to the overall program and project costs. PPL Electric utilizes a project prioritization process that defines the cost-effectiveness of programs and projects to ensure effective optimization of reliability investments.

30. PPL Electric utilizes the information from its ongoing reviews of the effectiveness of its programs to determine the most cost-effective strategy for replacing its distribution infrastructure on a going forward basis. Reliability metric performance may result in the redirection of spending to help ensure PPL Electric's ability to meet its identified reliability targets in a cost-effective manner.

F. ACCELERATION OF INFRASTRUCTURE IMPROVEMENT

31. In its *Implementation Order*, the Commission noted that some utilities had already taken substantial steps toward increasing capital investment to address the issue of aging infrastructure. For those utilities, the Commission requested that the LTIIIP “reflect how the DSIC will maintain or augment acceleration of infrastructure replacement and prudent capital investment.” *Implementation Order*, p. 19.

32. As described in the LTIIIP PPL Electric has already significantly increased its capital expenditures on distribution related infrastructure over historical spend. (*See Attachment 1, p. 12, Figures 5 and 6*) From 2009 to 2012, PPL Electric more than doubled the amount it was investing in capital infrastructure. The Company continued to accelerate its capital investment from 2013 to 2017, the five-year period of the Company’s current LTIIIP.

33. Consistent with the Commission’s *Implementation Order*, PPL Electric has projected to continue its accelerated investment for eligible property for the period of 2018 through 2022. (*See Attachment 1, pp. 15-16*)

34. PPL Electric believes that repair, improvement, and replacement of aging distribution equipment and facilities will ensure that the Company can reduce the number of outages that are the result of equipment failure, which will directly improve the reliability of service provided by PPL Electric to its customers.

35. PPL Electric is aware of the direct impact the equipment included in the LTIIIP has on its reliability metrics. (*See Attachment 1, Appendix B*) PPL Electric will use these metrics to monitor the success of its LTIIIP programs. The programs included in the LTIIIP are expected to prevent the growth in failures caused by aging equipment, and will eventually reduce the number of equipment failures experienced on PPL Electric’s distribution system.

G. WORKFORCE MANAGEMENT AND TRAINING PLAN

36. The Company's workforce management and training program is described in the LTIIP. (*See Attachment 1, pp. 13-15*)

37. PPL Electric's workforce is comprised of both those employees who work directly for PPL Electric, and the workers who are hired by contractors of PPL Electric.

38. PPL Electric utilizes a wide variety of programs and tools to ensure that it has a qualified workforce.

39. As a measure to ensure the use of a qualified workforce, PPL Electric has adopted the definition of a Qualified Electrical Worker from the Occupational Safety and Health Administration ("OSHA") Regulation 29 CFR 1910.268 Electrical Power Generation, Transmission and Distribution, which is defined in the PPL Safety Rule Book and is provided to each employee. This OSHA standard is also incorporated into PPL Electric's training and qualification process for all electrical workers.

40. PPL Electric administers a rigorous, formal training and evaluation process for all of its directly employed qualified electrical workers. Training is required before an employee may perform work independently on exposed, energized electrical equipment greater than 50 volts, and these programs are unique to the job classification and work being performed by individual employees. The training is provided by experienced training professionals with developed curriculum. The extensive training may require up to five years to complete, with regular assessment and incremental qualifications throughout the duration of the training program. Retraining is conducted on a periodic basis as required by OSHA or more frequently when determined necessary.

41. In preparation for turnover associated with an aging workforce, PPL Electric developed a long range Strategic Workforce Plan ("SWP"). The SWP provides a fifteen-plus

year analysis of the projected employee turnover by job category and year, projections on worker availability, and strategies for both sourcing and recruiting, in order to ensure the long-term ability of PPL Electric to attract, hire, develop, and retain qualified workers.

42. For its contractors, PPL Electric's Contract Management department administers a standard process for soliciting contractors to perform work identified to be completed by independent contractors. Part of that process includes evaluating the qualification of contractors to perform work (both technical and financial capabilities to meet the contractual commitments, and level of qualification of employees), and may include reference checks if appropriate. Most independent contractors employ personnel through the building trades, which includes Union apprenticeship programs to help ensure that employees are qualified to perform assigned work. Employee qualification programs for non-Union independent contractors are stringently reviewed to assess the contractor's training program, such as on-the-job training and certification programs.

43. PPL Electric monitors contractor performance through several activities that may include direct job oversight through on-site supervision, monthly scorecards that evaluate such areas as job quality, safety performance, cost, and validating billing activities that meet contractual expectations.

H. OUTREACH AND COORDINATION ACTIVITIES

44. PPL Electric's outreach and coordination activities with other utilities, the Pennsylvania Department of Transportation, and local governments are described in the LTIP. (See Attachment 1, p. 13) PPL Electric has established procedures for communicating with such entities regarding projects.

III. NOTICE AND EVIDENTIARY HEARINGS

45. Pursuant to the Commission's regulations, PPL Electric is serving this Petition and the attached LTIP are being served on the statutory advocates and all parties of record to the Company's most recent base rate proceeding at Docket No. R-2015-2469275.

46. Neither Act 11 nor the Commission's regulations require hearings on proposed LTIP.

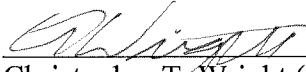
47. The regulations provide that comments to proposed LTIPs are to be filed within 30 days of the proposed LTIP, and that comments that raise material factual issues will result in the LTIP being referred to the Office of Administrative Law Judge. *See* 52 Pa. Code § 121.4(c). Accordingly, it is unknown at this time whether PPL Electric's proposed second LTIP will be subject to evidentiary hearings.

IV. CONCLUSION

WHEREFORE, PPL Electric Utilities Corporation respectfully requests that the Pennsylvania Public Utility Commission approve the second Long-Term Infrastructure Improvement Plan for the period January 1, 2018 through December 31, 2022, as set forth in this Petition and the attachment hereto.

Respectfully submitted,

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Dated: August 31, 2017

Attorneys for PPL Electric Utilities Corporation

VERIFICATION

COMMONWEALTH OF PENNSYLVANIA

COUNTY OF LEHIGH

I, Stephen J. Gelatko, Director- Distribution Asset Planning, 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 to be able to prove the same at a hearing held in this matter. I understand that the statements herein made subject to the penalties of 18 Pa. C.S. § 4904 (relating to unsworn falsification to authorities).


STEPHEN J. GELATKO

Attachment 1

PPL Electric Utilities Corporation

Long-Term Infrastructure Improvement Plan

PPL Electric Utilities Corporation

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PPL Electric Utilities Corporation

Introduction

PPL Electric Utilities Corporation (“PPL Electric” or “Company”) is submitting this Long Term Infrastructure Improvement Plan (“LTIP”) pursuant to the requirements of Subchapter B, Distribution Systems, of the Public Utility Code, 66 Pa.C.S. §§ 1350-1360, the Public Utility Commission’s (“PUC”) Implementation Order for Establishment of a Distribution System Improvement Charge, entered on August 2, 2012 at Docket No. M-2012-2293611 and the Commission’s regulations at 52 Pa. Code §§ 121.1 et seq. This LTIP addresses a broad spectrum of Distribution Asset Management initiatives that the Company will use to continue its accelerated repair, improvement and replacement of aging infrastructure under this process, and is for the five-year period beginning January 1, 2018 and ending December 31, 2022..

PPL Electric strives to operate as efficiently as possible by performing the work required to maintain system integrity and reliability. Performance indicators such as System Average Interruption Frequency Index (“SAIFI”), Customer Average Interruption Duration Index (“CAIDI”) and System Average Interruption Duration Index (“SAIDI”) show that PPL Electric has been successful in its efforts. However, an increasing trend in equipment failures, combined with an aging infrastructure, indicate that PPL Electric has reached a point where extensive and accelerated investment in the distribution system is required. As equipment failures continue to rise, PPL Electric has been experiencing a significant increase in maintenance spending beyond normal inflationary pressures. The driver is a combination of both increased corrective and planned maintenance. PPL Electric has initiated and enhanced maintenance practices and programs to repair, improve, or replace certain distribution facilities in order to ensure adequate, efficient, safe and reliable service. PPL Electric began the implementation of the identified improvements in 2009 as a result of its “Asset Optimization Strategy” initiative, discussed later in this document, and has since continued to accelerate its capital investments through its current Commission-approved LTIP.¹

Addressing aging infrastructure will require continuation of an accelerated level of investment. Such investment includes not only replacing aging equipment, but also investment in advanced equipment and communication technologies that can facilitate further system reliability improvements. If accelerated, proactive re-investment does not occur, it is expected that system reliability will degrade, while the overall cost to maintain the distribution system will continue to rise. By investing in its distribution system on an accelerated basis, PPL Electric will ensure that its system continues to be safe, reliable, and able to meet the growing needs and expectations of its customers.

PPL Electric believes that managing finite resources to produce optimal results is essential for maintaining customer satisfaction. Criteria for program inclusion into the Long-Term Infrastructure Improvement Plan is not whether any single activity produces a positive reliability result, but rather, which portfolio of accelerated activities produces the best result for a given expenditure. PPL Electric’s goal is focused on results (i.e., the reliability experienced by customers and associated rate impacts), not the rote execution of particular tasks.

Reliability Experience

The Distribution Asset Planning process employed by PPL Electric has been focused on maintaining reliability at the level that existed prior to passage of the Electricity Generation Customer Choice and Competition Act (“Customer Choice Act”). Since the 1994-1998 benchmark period, which defines PPL Electric’s reliability

¹ In 2013 the Company obtained Commission approval of its current LTIP for the period beginning January 1, 2013 through December 31, 2017, at Docket No. P-2012-2325034.

PPL Electric Utilities Corporation

performance targets, PPL Electric's service reliability has experienced annual swings, positive and negative, resulting largely from varying weather conditions. Increased and accelerated levels of funding for distribution reliability programs will help to ensure more consistent performance below the PUC benchmark. Historical benchmark performance is illustrated in Figures 1 and 2.

PPL Electric Utilities Corporation

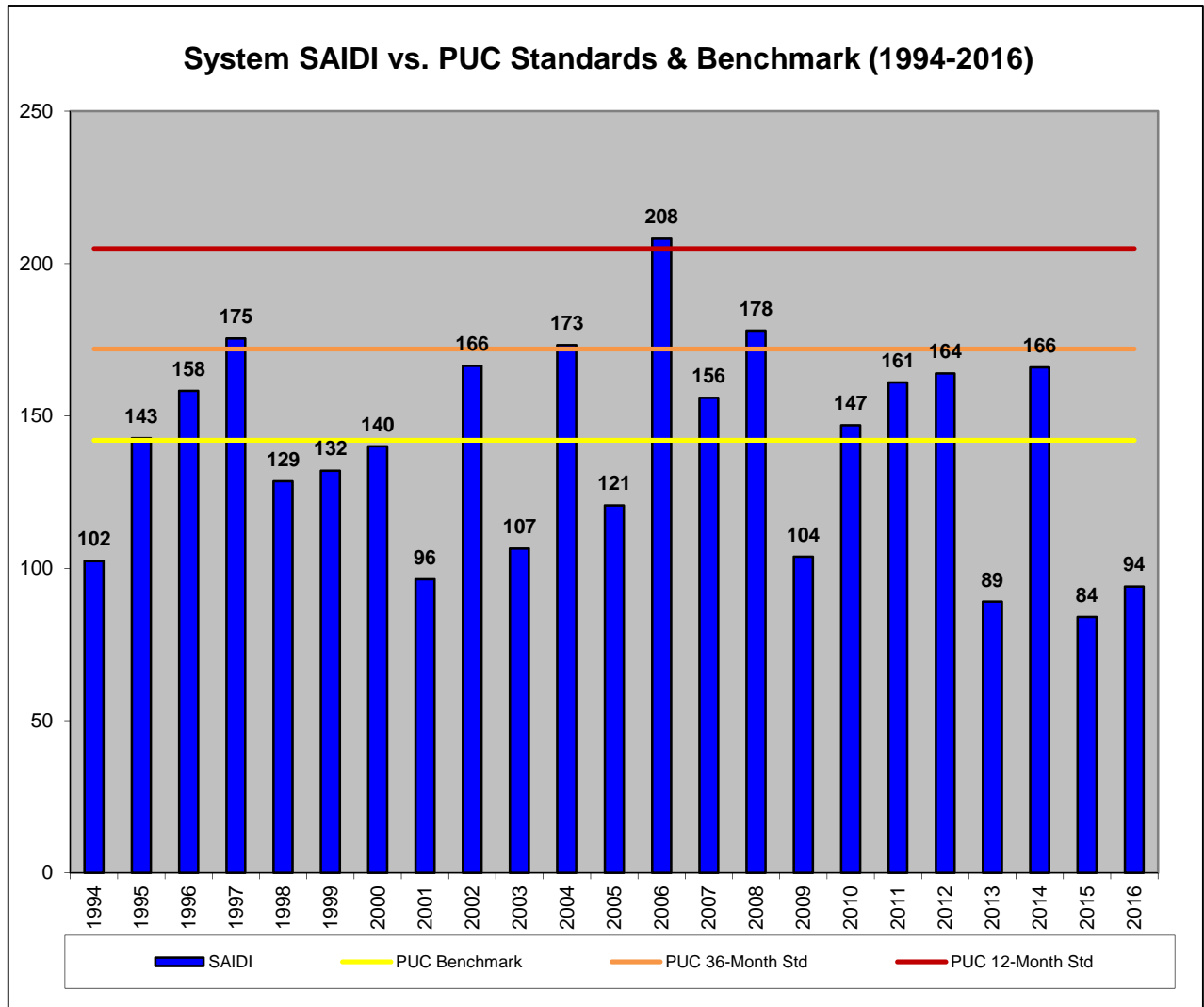


Figure 1: PPL Electric’s SAIDI Performance

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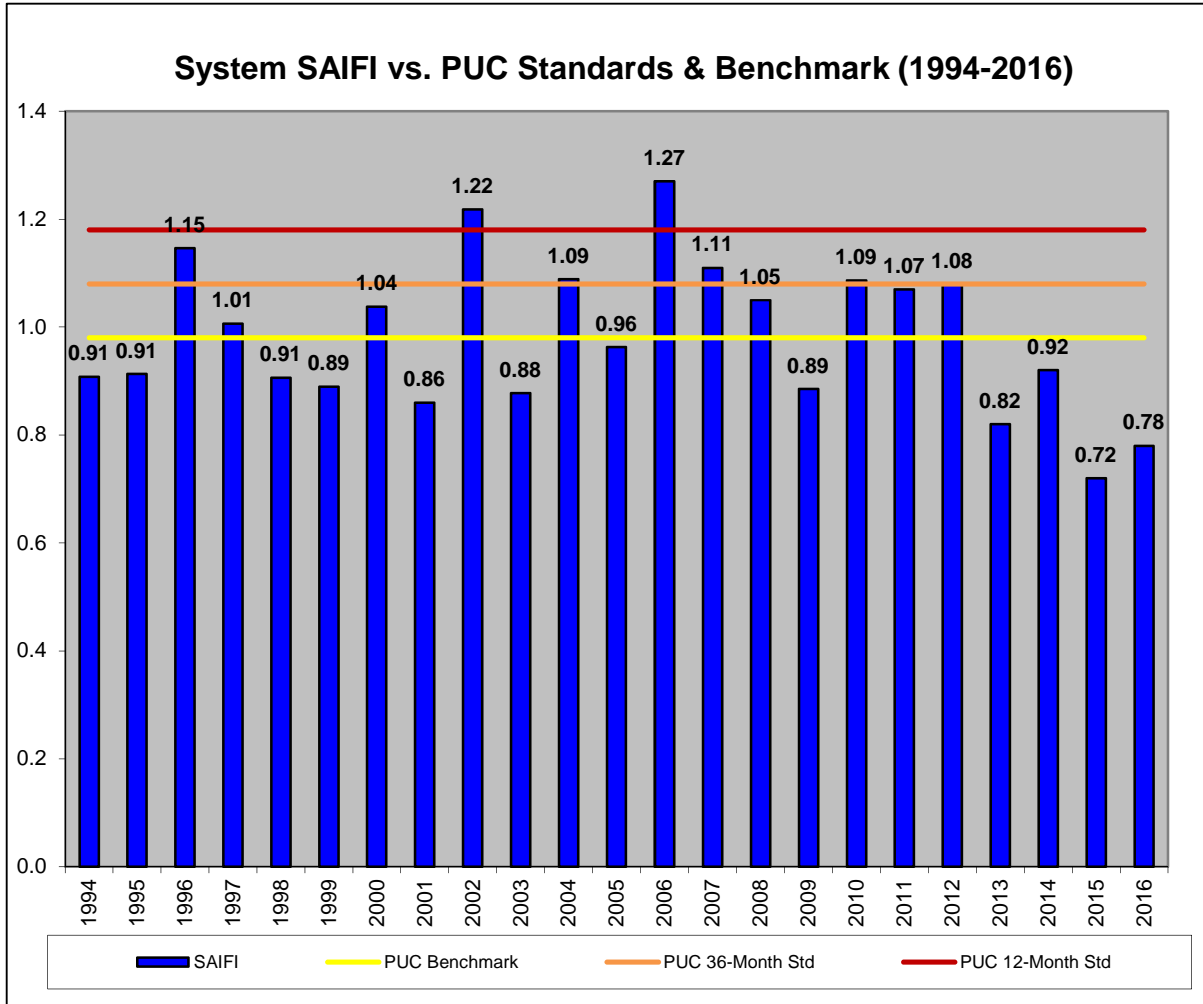


Figure 2: PPL Electric’s SAIFI Performance

PPL Electric Utilities Corporation

A significant risk to PPL Electric's ability to meet reliability benchmarks is the large portion of distribution facilities, many of which were installed in the 1960's and 1970's, that are now beyond or nearing the end of their design lifetime. See Appendix A for average age of major units of property. The resultant effect on non-storm-related equipment failures is illustrated by the chart in Figure 3(a) below.

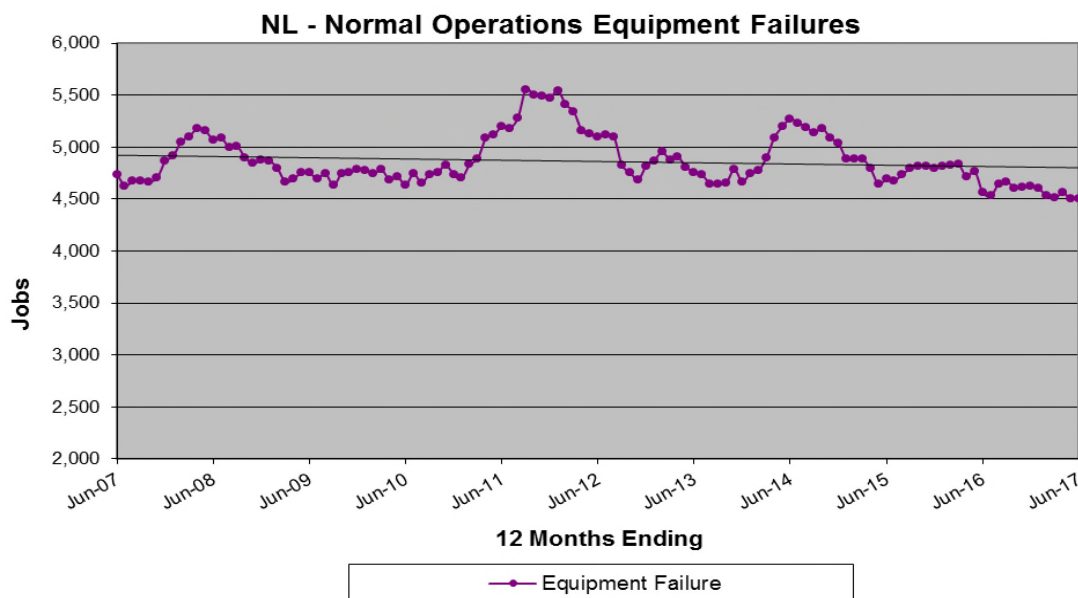


Figure 3a: Equipment Failure Service Interruption Cases

The number of no-light cases due to equipment failures is now trending downward due to investments over the past five to ten years, after having trended upward from 2001 through 2006 (see Figure 3B below). The need to remediate that equipment which is at or near end-of-life remains in order to maintain this favorable trajectory. Components contributing the most significantly to distribution equipment failures include poles/arms/attachments, overhead conductors, and substation equipment. See Appendix B for further details on asset contribution to reliability metrics.

PPL Electric Utilities Corporation

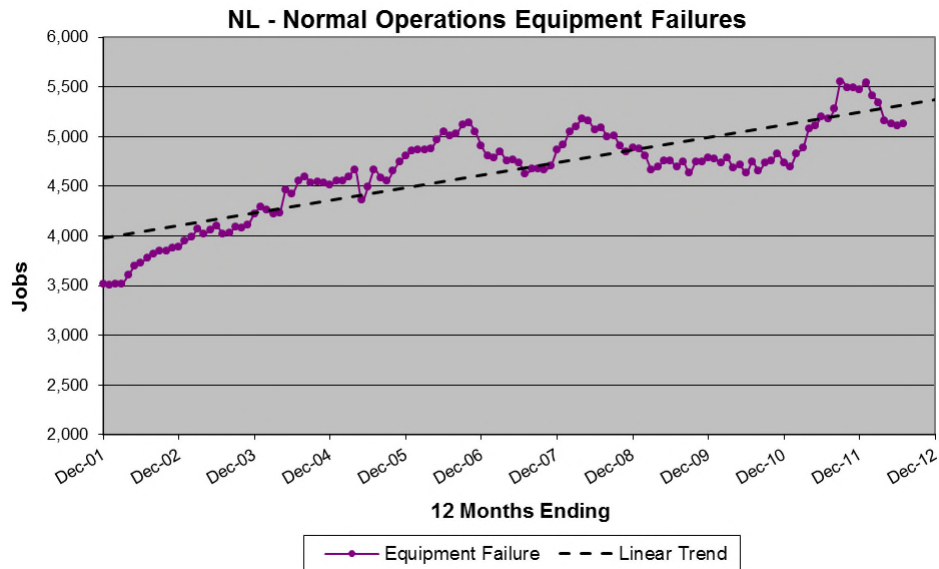


Figure 3b: Equipment Failure Service Interruption Cases 2001-2012

Response to Increasing Equipment Failure Rate

PPL Electric’s reliability investment process is forward-looking and proactive. It consists of the following:

- Analyze and identify the drivers of historical trends of causes of service outages and other power service problems.
- Forecast future reliability metrics (SAIDI, SAIFI, and CAIDI) given existing mitigation programs’ effect on the identified drivers.
- Identify new programs, policies, and activities to enhance or accelerate existing mitigation programs to avoid forecasted gaps between future reliability and benchmark targets.
- Identify, evaluate, and implement new technologies that enhance the Company’s condition monitoring strategy.
- Evaluate and adjust existing programs, policies, and activities to produce the desired future results.
- Perform targeted data analytics against our aging infrastructure utilizing real-time, or near real-time, operational data to further improve reliability performance.
- Incorporate the resulting portfolio of existing and new programs, policies, and activities in PPL Electric’s five-year business plan.

In June 2011, PPL Electric’s Reliability Principles and Practices (“P&P”) were revised to help reduce the overall impact to our customers from outages due to various causes, including but not limited to, equipment failures. The

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P&P sets forth a set of Principles that PPL Electric follows to plan, protect and operate the Electrical Distribution System (“EDS”). These Principles are implemented through a set of standard Practices that are used as guidelines in designing the EDS. These Practices are reasonable, acceptable and are in accordance with leading utility practices. More specifically, to reduce the number of customers experiencing permanent outages and outage duration over the long term, the following circuit design guidelines are used wherever practical, starting with those identified as Worst Performing Circuits (“WPCs”):

- Limit the line length to approximately 50 circuit miles;
- Limit customer count to less than 1,300 customers per circuit;
- Ensure the circuit has three-phase tie lines, and these tie lines will support the transfer of 50% of the customers for at least 95% of the hours in a year; and
- Use line automation to restore at least 50% of the customers by System Operator-controlled switching or automated switching.

Prioritization utilizing these design criteria is based on the greatest expected improvement in reliability for the entire system.

Several other mitigation initiatives have been undertaken to reduce the forecasted short-term equipment failure growth rate.

- **Enhanced Pole Inspection/Treatment Program:** Beginning in 2016, the Company’s wood pole inspection and treatment program was enhanced from a partial excavation process to a full excavation process, whereby all poles that are inspected are fully excavated around the circumference of the pole to inspect and subsequently chemically treat to arrest decay and extend useful life at the same visit. The preservative treatment permits the next inspection to be at a uniform ten-year cycle. As an integral part of the ten-year pole inspection process, PPL observes, notes, and reports at-risk conditions of all pole attachments, specifically crossarms, braces, conductors, transformers, fuse cutouts, lightning arresters, reclosers, regulators, capacitors, switches, wildlife protection, vegetation encroachment, guys, anchors, ground wires, and ground rods.
- **Increased Utilization of Infrared Inspections:** PPL Electric conducted a trial of infrared inspections of multi-phase lines in 2006. The trial inspections cost \$122,500 and identified repairs costing \$100,000, saving an estimated 1,460,000-2,600,000 Customer Minutes Interrupted (“CMI”). Funding of infrared inspections and repairs was increased significantly during 2010 and has remained at a higher funding level. Infrared inspections occur on all 3-phase and 2-phase overhead lines adjacent to roadways every two years.
- **Expanded Operational Reviews (“EOR”):** EORs are performed on each feeder on a four-year cycle. The engineering review addresses both operational and reliability characteristics of each circuit. Voltage support, phase balancing, power factor maintenance and loading issues are addressed from an operational perspective. Service reliability analysis, exposure analysis, and field checks address reliability.
- **Distribution Automation Strategy:** In 2010, PPL Electric launched a “smart grid” pilot project that enables the Company to move power more efficiently, react instantaneously to changes on the delivery system, and automatically re-route power around problems that occur. After a very successful pilot in the Harrisburg region, substantial investment is planned to help ensure achievement of long term reliability

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goals. Distribution is currently realizing a ~30% reliability improvement in areas where Smart Grid has been fully deployed. Future plans include the installation of hundreds of automated electrical devices through 2021. The end-result will be a delivery system that operates more efficiently, recognizes problems immediately, and responds in seconds to restore the service for many customers who otherwise need to wait minutes or hours.

Although these programs have successfully slowed failure growth rates in the short-term, PPL Electric faces a long-term issue regarding aging infrastructure. The surge in electrical construction in the 1960's and 1970's has resulted in a large number of assets that have reached or are nearing the end of their useful lifetime. Consequently, in 2008-2009, PPL Electric conducted a major condition assessment and maintenance study of its distribution system. The result was the implementation of the Asset Optimization Strategy ("AOS"). The study found that programmatic and accelerated replacement of infrastructure would be the most cost-effective strategy to address aging infrastructure and ensure system reliability and integrity.

Asset Optimization Strategy

The purpose of the AOS study was to develop a strategy for accelerated capital replacement improvements that would combat the anticipated effects of aging infrastructure and bolster PPL Electric's ability to effectively maintain reliable electric service. With the Company entering a period where a significant number of assets are expected to reach the end of life, a plan was developed to intelligently replace assets prior to an unplanned failure that impacts customers. The plan includes replacements in kind, as well as upgrades to current standards.

Examples of AOS Projects include proactive replacement of substation equipment, Low Tension Network ("LTN") equipment, and vintage underground cable based on condition based health analysis. In 2017, Distribution Asset Management will leverage advanced analytic tools to develop and deploy new asset health dashboards that will improve our ability to predict failures of high valued asset across our system.

Accelerated Investment

Figure 4 below depicts PPL Electric's planned capital investment originally included in its 2008-2012 business plan for DSIC eligible property. This business plan was developed in 2007, prior to the AOS study.

	2008	2009	2010	2011	2012
Asset Optimization Strategy*	\$ 1,305,907	\$ 1,486,747	\$ 761,235	\$ 1,090,203	\$ 1,284,506
Improve System Reliability	\$ 10,613,221	\$ 9,237,000	\$ 8,742,719	\$ 11,219,640	\$ 11,792,252
Maintain System Reliability	\$ 30,388,745	\$ 30,148,238	\$ 31,151,354	\$ 31,939,787	\$ 33,422,736
Unreimbursed Highway Relocations	\$ 4,035,602	\$ 3,528,317	\$ 3,598,725	\$ 3,677,628	\$ 3,917,637
Total	\$ 46,343,476	\$ 44,400,302	\$ 44,254,033	\$ 47,927,258	\$ 50,417,131

*Prior to the AOS Study, there was some work budgeted under other categories that were converted to the AOS category.

Figure 4: Original 2008-2012 Capital Investment Plan

Having concluded the AOS study, PPL Electric began engineering and making large material purchases for the identified proactive and accelerated replacements during 2009, followed by a ramp up period during 2010 and full implementation of the strategy in 2011. PPL Electric has refined processes and work planning efforts in support of the sustained investment levels. Acceleration of capital investment into the distribution infrastructure for the five-

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year period of 2008 through 2012 is illustrated in Figure 5 below. PPL Electric has approximately doubled its investment in DSIC-eligible property from 2009-2012, as a result of the AOS study.

	2008	2009	2010	2011	2012
Asset Optimization Strategy	\$115,046	\$5,115,041	\$19,661,586	\$32,667,111	\$18,700,002
Improve System Reliability	\$7,177,339	\$12,470,418	\$33,186,012	\$39,598,466	\$25,882,744
Smart Grid Investment		\$100,193	\$9,299,164	\$7,320,142	\$2,118,695
Maintain System Reliability	\$33,648,603	\$34,407,064	\$46,388,673	\$47,206,474	\$50,164,857
Unreimbursed Highway Relocations	\$3,082,209	\$3,265,414	\$2,521,236	\$4,858,351	\$2,848,305
Total	\$44,023,197	\$55,358,130	\$111,056,671	\$131,650,544	\$99,714,603

Figure 5: Accelerated Capital Investment

The timely recovery of the costs associated with such a large capital appetite is key to ensuring access to the capital markets for financing. Prior to the enactment of Act 11, PPL Electric faced the possibility of requiring more frequent rate cases, perhaps as often as annual filings. The availability of the DSIC mechanism ensures the timely cost recovery of investments in DSIC-eligible property which could result in less frequent and smaller rate increase requests in the future. As shown in Figure 6 below, from 2013 through 2017, as part of the Company's Commission-approved LTIIP, PPL Electric continued to accelerate its expenditures for needed capital improvements and repairs over its previous investment. This strategy will continue in their future business planning models.

	2013	2014	2015	2016	2017*
Asset Optimization Strategy	\$22,841,590	\$19,768,844	\$26,654,632	\$19,062,759	\$30,115,857
Improve System Reliability	\$47,449,928	\$30,815,571	\$29,252,533	\$18,408,383	\$29,224,656
Smart Grid Investment	\$12,088,795	\$17,227,377	\$26,510,401	\$30,691,602	\$25,883,319
Maintain System Reliability	\$51,631,883	\$55,689,193	\$57,243,664	\$63,274,879	\$53,802,908
Unreimbursed Highway Relocations	\$3,979,635	\$4,421,113	\$2,776,572	\$2,662,419	\$3,415,634
Grand Total	\$137,991,830	\$127,922,099	\$142,437,802	\$134,100,042	\$142,442,374

Figure 6: DSIC Capital Investment

*2017 represented forecasted spend in accordance with the 2016 AAOP

Implementation of Long-Term Infrastructure Improvement Plan

The instant Long Term Infrastructure Improvement Plan is a continuation of the AOS infrastructure replacements, in addition to various other prudent capital investments to ensure the safety and reliability of the distribution system. The investments are expected to mitigate the growth in equipment failure projections in the short-term and eventually reverse the trend in the long-term. Equipment failure trends and asset-specific contributions to system-level reliability metrics are analyzed on an ongoing basis to ensure funding is invested appropriately.

PPL Electric routinely reviews the effectiveness of programs to ensure cost-effective investment. Program/project impact on SAIDI and SAIFI, in addition to potential reductions in outage response costs, are compared to the overall program/project costs. PPL Electric utilizes a project prioritization process that defines the cost-

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effectiveness of programs/projects to ensure effective optimization of reliability investments. PPL Electric currently is improving the use of ongoing asset health indices to further refine asset replacement criteria.

Ongoing review of the effectiveness of investments to address equipment failure trends will likely result in adjustments to the strategy over time. Future Long Term Infrastructure Improvement Plans will reflect such adjustments. Additionally, work plans may fluctuate throughout a given year due to the need to reallocate resources in response to changing business needs. Some examples include shifting resources for storm response activities, project construction delays caused by a backlog of material deliveries, and the redirection of investment to cure costly equipment failures. In addition, during the project engineering phase, issues such as right-of-way requirements and environmental considerations can result in scope changes that also can delay actual construction. During construction of larger projects, additional scope needs can be identified, creating the need to defer other projects. Finally, reliability metric performance can result in redirection of spending to help ensure the ability to meet targets.

Projected expenditures for the replacement of failed equipment are based on a review of historical trends while considering current failure rates and proactive mitigating measures. For such programs, it is difficult to project the specific scope and location. Therefore, PPL Electric has provided only planned expenditures based on historical trending information.

Utility Outreach

PPL Electric continues to remain engaged, seeking out opportunities with other utilities and government officials on the planning and execution of future construction projects. A forum exists with the Utility Highway Liason Committee (UHLC), with whom PennDOT, the Turnpike Commission, other utilities, and the Energy Association of Pennsylvania meet quarterly to discuss policy issues, present and future projects, and relocation projects. The Company is a regular participant. Initiatives at these forums are focused primarily on improving state and utility interactions.

Utilization of a Qualified Work Force

PPL Electric Workforce

As a measure to ensure the use of a qualified workforce, PPL Electric has adopted the definition of a Qualified Electrical Worker from the OSHA Regulation 29 CFR 1910.268 Electrical Power Generation, Transmission and Distribution, which is defined in the PPL Safety Rule Book and is provided to each employee. It is also incorporated into the training and qualification process for all electrical workers.

PPL Electric administers a rigorous, formal training and evaluation process for all qualified electrical workers. Training is required before an employee may perform work independently on exposed, energized electrical equipment greater than 50 volts. Training requirements and programs are unique to the job classification and work being performed. Curriculum documents, outlining subject areas and training durations by job classification have been developed. Training may require up to 5 years to complete and incremental qualifications, following assessment, are identified throughout the duration of the training program. Retraining is conducted on a periodic basis as required by OSHA or more frequently when determined necessary.

PPL's formal training programs are administered by the Technical Development & Improvement ("TD&I") group. The training section of the TD&I group is comprised of approximately 37 full time employees, both training professionals and craft employees. Experienced training professionals lead the design and development of the training programs with input from subject matter expertise provided by craft employees from the field. Training

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program (curriculum) content is approved by a curriculum committee which is comprised of business line managers. The basic job requirement for an instructor includes 5-years of experience performing the work and attainment of Journeyman level (or equivalent) qualifications. Craft instructors are then trained and mentored. Training delivery is governed by PPL Electric policies and procedures to ensure quality and consistency.

Training is delivered in phases. A phase typically consists of a grouping of training modules into one training period of several days to several weeks. Training consists of both classroom theory and field work to gain hands-on practical learning experience. Trainees are evaluated throughout the program. Evaluation includes written examination and/or a performance examination. Employees must successfully complete each training module before progressing to the next phase of training.

In addition, trainees in key programs must complete an additional skills assessment prior to advancement to the next step. These assessments are coordinated by the TD&I group. The employees are evaluated (graded) by a panel comprised of knowledgeable field supervisors and experienced bargaining unit craft members. This independent evaluation serves as a quality control check on the TD&I training section.

Over the next 5 years, PPL Electric will be executing a resource strategy which includes formal training classes to hire and train new employees in preparation for upcoming attrition.

Contractor Workforce

PPL Electric's Sourcing department administers a standard process for soliciting contractors to perform work identified to be completed by independent contractors. The process includes issuance of a Request for Proposal ("RFP") to various contractors. That process includes a meeting to review the technical and administrative components of the work and normally a walk-down of the project area. Responses to the RFP are evaluated based on detailed financial and technical schedules that compare respondents' capabilities. Part of the RFP evaluation process includes evaluating the qualification of contractors to perform work (both technical and financial capabilities to meet the contractual commitments, and level of qualification of employees), and may include reference checks if appropriate. Any specific required qualifications of contractors would typically be outlined in the RFP and/or contract (for example: pole installation, permit and tag authorities, line construction by specific voltage, live line work, foundations, directional bore/trenching, underground networks).

Most independent contractors employ personnel through the building trades, which includes Union apprenticeship programs to help ensure that employees are qualified to perform assigned work. (This approach is comparable to PPL Electric's Union labor qualification training program.) Employee qualification programs for non-Union independent contractors are stringently reviewed to assess the contractor's training program, such as on-the-job training and certification programs.

Prior to award, contractors are screened for their safety performance and, if applicable, environmental record. Contractors that do not have an acceptable record receive no further consideration. In the event that a contractor working for PPL Electric incurs safety incidents and/or does not take appropriate safety measures, the contractor is terminated and prohibited from performing work for PPL Electric in the future.

PPL Electric has instituted a contractor orientation program that provides new contractors an opportunity to understand company expectations for performing work safely, mindful of public and private landowner considerations and administrative concerns (such as billing). PPL Electric also sponsors a monthly meeting, with all contractors required to attend, to review safety issues and other relevant topics.

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PPL Electric sponsors a training program that allows the contractors' employees to become qualified in PPL Electric's permit-and-tag system. Contractor employees who successfully complete the training program can be permit holders on PPL Electric's system.

PPL Electric monitors the contractors' performance through several activities that may include direct job oversight through on-site supervision, monthly scorecards that evaluate such areas as job quality, safety performance, cost, and validating billing activities that meet contractual expectations. If safety concerns are identified at a job site, any person has the ability and express duty to cease work until the concerns have been appropriately addressed, and a safety review team could be assembled to formally request a contractor to respond to safety concern. Safety violations could result in immediate contractor termination.

Before final acceptance of the contractor's work, a project Construction Supervisor completes a "Project Quality Evaluation Form" that verifies pass or fail for applicable areas of the job (which may include inspection of grounding, trench, foundations, final grade, structural components, poles/towers, conduits, electrical equipment, primary conductor, wiring, designations, and final completion of the Acceptance of Facilities form). Any failures are described along with description and dates of corrections to resolve the areas of concern before final acceptance of the contractor's quality of work.

Summary

As a result of the economic expansion and building boom of the 1960's and 1970's, nearly half of PPL Electric's distribution system was constructed 40 or more years ago. As this equipment deteriorates due to age, environmental exposure, and added load, it becomes increasingly critical to plan for the repair, upgrade, and/or replacement of these assets through the initiatives described above. In the absence of these initiatives, the efficiency, safety, and reliability of the electric distribution system is expected to be increasingly compromised. PPL Electric believes that the expenditures for these initiatives constitute a prudent and reasonable investment for managing its distribution assets and that each of the listed programs will successfully achieve one or more of the following benefits:

- Maintaining public and employee safety
- Reducing service outage durations and number of customers affected
- Reducing service outage restoration times
- Reducing service outage locating and repair times
- Controlling service outage repair costs
- Limiting failure-related damages and related costs, and
- Improving/maintaining power quality (voltage, flicker, etc.)

To achieve these results, PPL Electric anticipates the need for the following total capital expenditures over the 2018-2022 period. Note that planned expenditures for certain initiatives can fluctuate yearly due to the various factors identified previously. The Company intends to finance the costs of its DSIC eligible work through its usual financing mechanisms, debt and equity. In each DSIC rate filing, the Company will identify its capital structure and cost of debt, in addition using the Return on Equity as determined in its base rate case proceeding or as defined in the most recent applicable PUC Quarterly Financial Report.

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LTIP	2018	2019	2020	2021	2022	5 YR Total
Copper Weld Copper	\$0.76	\$1.82	\$2.50	\$2.54	\$2.04	\$9.66
Cross-Yard 12 kV Underground Tie	\$1.72	\$1.65	\$3.03	\$2.99	\$2.05	\$11.44
C-Truss Distribution Poles	\$4.25	\$4.46	\$4.43	\$4.48	\$5.05	\$22.68
Customers Experiencing Multiple Interruptions	\$2.78	\$3.29	\$4.36	\$4.35	\$3.81	\$18.58
Distribution Animal Guarding	\$0.70	\$0.77	\$0.76	\$0.75	\$0.77	\$3.76
Distribution Automation Development	\$12.07	\$17.65	\$21.11	\$18.13	\$6.02	\$74.98
Distribution Failed Equipment	\$16.90	\$16.90	\$17.70	\$17.69	\$17.90	\$87.09
Distribution Pole Replacements	\$17.45	\$17.82	\$18.13	\$18.46	\$19.09	\$90.95
Distribution Reliability Preservation	\$6.58	\$8.09	\$11.12	\$11.10	\$11.23	\$48.12
Distribution Substation Circuit Breakers	\$6.90	\$6.04	\$5.90	\$5.78	\$4.65	\$29.27
Distribution Substation DC Equipment	\$0.19	\$0.26	\$0.25	\$0.25	\$0.27	\$1.22
Fiber Wrap Distribution Poles	\$2.05	\$2.15	\$2.14	\$2.15	\$2.43	\$10.91
Improve System Reliability Projects	\$2.14	\$28.36	\$30.66	\$65.50	\$45.12	\$171.78
Line Cutouts	\$1.51	\$1.51	\$1.51	\$1.51	\$1.02	\$7.07
Low Tension Network Primary Cable, Equipment and Structures	\$2.77	\$5.69	\$5.65	\$5.79	\$3.09	\$22.99
LTN AUTOMATION	\$0.00	\$3.43	\$3.41	\$4.67	\$0.00	\$11.51
Miscellaneous Substation Equipment	\$1.36	\$1.97	\$2.23	\$2.23	\$2.06	\$9.85
New Hydraulic Reclosers	\$0.02	\$0.23	\$0.23	\$0.23	\$0.25	\$0.96
Protection and Control	\$1.90	\$2.16	\$4.98	\$5.05	\$5.18	\$19.27
Reliability Preservation Emergent	\$1.80	\$1.77	\$2.03	\$1.74	\$1.74	\$9.08
Replace Deteriorated/Failed Low-Tension Network Equipment and Structures	\$0.86	\$0.86	\$1.21	\$1.21	\$0.81	\$4.95
Replace Deteriorated/Failed Area Supply Substation Equipment	\$2.53	\$2.52	\$3.02	\$3.02	\$2.48	\$13.57
Replace Failed 12kV Underground Getaway Cable	\$1.32	\$1.52	\$1.51	\$1.51	\$1.53	\$7.39
Replace Failed Underground Cable	\$14.19	\$14.19	\$14.70	\$14.69	\$14.86	\$72.62
Substation 69/12 kV Transformer Replacement	\$5.87	\$5.04	\$4.07	\$4.08	\$4.39	\$23.45
Substation Animal Guarding	\$0.51	\$0.51	\$0.51	\$0.51	\$0.26	\$2.31
Underground Cable Replacement and Life Extension	\$7.89	\$7.98	\$8.35	\$8.33	\$7.40	\$39.95
Underground Getaway Cable Replacements and Life Extension	\$5.05	\$5.30	\$7.05	\$7.05	\$6.10	\$30.55
Unreimbursed Highway Relocations	\$5.21	\$4.60	\$4.57	\$4.56	\$3.85	\$22.78
Volt Var Optimization	\$2.72	\$2.97	\$8.64	\$4.79	\$5.25	\$24.36
Grand Total	\$129.99	\$171.52	\$195.76	\$225.15	\$180.70	\$903.13
	<i>In Millions</i>					

Almost all of the aforementioned initiatives take advantage of new technologies that did not exist when the associated assets were originally placed into service, and many of these technologies are very recent innovations. These technologies are expected not only to restore the assets to their original level of performance, but, in many cases, provide performance well beyond what previously was achievable in order to ensure and maintain adequate, efficient, safe, and reliable service.

Some of the initiatives, such as animal guarding, clearly have implied end-points, where no further opportunities for improvement remain. Others, such as Distribution Automation, eventually experience diminishing returns over time. Other initiatives, such as pole reinforcement and replacement, will be ongoing. Finally, some programs may become obsolete, while new programs may become desirable as a result of the evolution of new technologies. Because of these and other variables, the effectiveness of these programs is reviewed annually and programs are added, deleted, and/or modified, as necessary, to ensure that the expenditures are providing the desired benefits to customers at a reasonable cost.

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Distribution Assets

The following pages detail 5-years projections for Long-Term Infrastructure Improvements initiatives that apply to distribution line assets. These assets include, but are not limited to, the following:

- Structures
 - Poles
 - Crossarms
 - Vaults
 - Manholes
- Overhead Conductors and Hardware
- Underground Cables and Hardware
- Switching Devices
 - Air Break Switches
 - Disconnect Switches
 - Switching Cabinets
- Protective Devices
 - Fuses
 - Reclosers
 - Network Protectors
 - Lightning Arresters
- Transformers
 - Overhead
 - Pad-Mounted
 - Submersible
 - Low Tension Network

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Distribution Pole Replacements

Program Description and Purpose

Replacement of distribution wood poles identified as non-restorable (cannot be reinforced) during the annual inspect and treat program or during a spot inspection in an effort to improve public and employee safety, as well as service reliability. This program contributes to storm hardening efforts and aims to improve public and employee safety, as well as service reliability, by reducing potential pole failures.

Identification/Justification Process

PPL Electric inspects approximately 90,000 poles per year. Historical data suggests an approximate 5% rejection rate from the population of yearly inspections; of those rejected, 70% are candidates for reinforcement while 25% are candidates for replacement. Replacing rejected poles avoids property damage and risk of accidental injury, and it mitigates the costs associated with extended service outages. Replacement rates are expected to fall as a result of PPL Electric's pole treatment program. The average age of an in-service wooden distribution pole is 38 years.

Scope

The scope of the program is a direct correlation to the number of wood pole inspections.

Planned Replacements in Units					
2018	2019	2020	2021	2022	Total Scope
2900-3200	2900-3200	2900-3200	2900-3200	2900-3200	14500-16000

Locations

Specific locations are a direct correlation to the wood pole inspection plan. Inspection locations are identified yearly primarily as a function of previous inspection dates, as well as ensuring cost-effectiveness of the program and minimizing inspection crew movements.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$17.45	\$17.82	\$18.13	\$18.46	\$19.09	\$90.95

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C-Truss Distribution Poles

Program Description and Purpose

Steel reinforcement (C-Trussing) of deteriorated distribution wood poles in order to restore the pole's original strength, ensure public safety, and maintain reliable electric service through the reduction of potential pole failures. This program contributes to storm hardening efforts by reducing potential pole failures.

Identification/Justification Process

PPL Electric inspects approximately 90,000 poles per year. Historical data suggests an approximate 10% rejection rate from the population of yearly inspections, of which historically 75% are candidates for steel reinforcement. When applicable, this method achieves a significant savings over pole replacement.

Scope

Planned Reinforcements in Units					
2018	2019	2020	2021	2022	Total Scope
5260-5815	5260-5815	5260-5815	5260-5815	5260-5815	26300-29075

Locations

Locations identified for C-trussing are a direct correlation to the number of wood pole inspections.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$4.25	\$4.46	\$4.43	\$4.48	\$5.05	\$22.68

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Fiber Wrap Distribution Poles

Program Description and Purpose

Fiber reinforcement of deteriorated distribution wood poles to improve the pole's strength, ensure public safety and maintain reliable electric service through the reduction of potential pole failures. Fiber wrapped poles are restored to 85% original strength. Fiber wrap is a reinforcement method by which a standing pole in Pennsylvania Department of Transportation (PennDOT) right of way is wrapped and cured in fiber reinforcement materials. This program contributes to storm hardening efforts and aims to improve public and employee safety, as well as service reliability, by reducing potential pole failures.

Identification/Justification Process

Fiber wrap candidates are selected from a pool of restorable poles in PennDOT's right-of-way on the basis of the condition of pole, the age of pole and the cost of replacement. Historically, reinforcement of poles within PennDOT right-of-way was not practiced and all poles that did not pass inspection were replaced. In an effort to increase cost-effectiveness, PPL Electric began fiber wrap reinforcement during 2012 and reduced the number of pole replacements from 30% of rejected poles to 25%. Shifting capital from replacement to fiber wrap allows capital to be invested in more effective areas.

Scope

Planned Fiber Wrap in Units					
2018	2019	2020	2021	2022	Total Scope
585-645	585-645	585-645	585-645	585-645	2925-3225

Locations

Locations identified for fiber wrap are a direct correlation to the wood pole inspection plan.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$2.05	\$2.15	\$2.14	\$2.15	\$2.43	\$10.91

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Line Cutouts

Program Description and Purpose

Replacement of porcelain cutouts on the 12kV system to avoid tracking along freeze/thaw cycle cracks, which can eventually lead to pole top fires.

Identification/Justification Process

Porcelain cutouts are identified via regularly scheduled line patrols (EOR, WPC, pole inspections). Locations are then prioritized via system exposure and historical locational propensity to pole top fire events.

Scope

Planned Cutouts in Units					
2018	2019	2020	2021	2022	Total Scope
400-500	400-500	400-500	400-500	400-500	2000-2500

Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	375-460
Northeast	375-460
Central	375-460
Susquehanna	375-460
Harrisburg	375-460
Lancaster	375-460

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$1.51	\$1.51	\$1.51	\$1.51	\$1.02	\$7.07

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Volt Var Optimization

Program Description and Purpose

Installation of capacitors on the 12 kV system to achieve a near unity power factor on the high side of the distribution substation transformers ensuring required overall power quality.

Identification/Justification Process

Capacitors are installed on the 12 kV system using VAR requirements that are identified annually by PPL Electric's distribution planning resources. PJM requires a minimum power factor of 0.97 as measured at the transmission/distribution interface point. Scope is determined by voltage and MVAR requirements to support any system shortages. Regional splits are analyzed annually based on need.

Scope

Planned Installations in Units					
2018	2019	2020	2021	2022	Total Scope
300-350	325-375	1000-1050	250-300	250-300	2125-2375

Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	400-440
Northeast	220-260
Central	280-320
Susquehanna	250-290
Harrisburg	420-460
Lancaster	520-560

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$2.72	\$2.97	\$8.64	\$4.79	\$5.25	\$24.36

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New Hydraulic Reclosers

Program Description and Purpose

Proactive installation of new hydraulic reclosers to improve reliability performance by increasing circuit sectionalizing ability. Reclosers minimize the number of customers affected by a sustained outage.

Identification/Justification Process

Locations are requested by regional reliability engineers and prioritized annually based on anticipated SAIDI savings. A gradual scope reduction is assumed in the outer years as a result of saturation of reclosers and other distribution automation equipment.

Scope

Planned Installations in Units					
2018	2019	2020	2021	2022	Total Scope
3-5	15-20	15-20	15-20	15-20	63-85

Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	10-15
Northeast	10-15
Central	10-15
Susquehanna	10-15
Harrisburg	10-15
Lancaster	10-15

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$0.02	\$0.23	\$0.23	\$0.23	\$0.25	\$0.96

PPL Electric Utilities Corporation

Distribution Animal Guarding

Program Description and Purpose

Proactive installation of animal guards on existing distribution overhead transformers and air break switches to improve circuit reliability. Animal guards help prevent animal-related contacts which cause service interruptions.

Identification/Justification Process

Air break switches have animal guarding installed as part of their inspection process. Transformers are identified both by opportunistic installation of guarding during other non-related work, and by on-the-spot or follow-up orders after responding to animal-caused outages.

Scope

Planned Animal Guards					
2018	2019	2020	2021	2022	Total Scope
300-400	300-400	300-400	300-400	300-400	1500-2000

Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	250-350
Northeast	250-350
Central	250-350
Susquehanna	250-350
Harrisburg	250-350
Lancaster	250-350

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$0.70	\$0.77	\$0.76	\$0.75	\$0.77	\$3.76

PPL Electric Utilities Corporation

Distribution Failed Equipment

Program Description and Purpose

Replacement or repair of failed or deteriorated capital units of distribution equipment, excluding underground cable, in order to maintain adequate service reliability.

Identification/Justification Process

Candidates are identified via inspections, both planned and ad-hoc, as well as actual outages and power service problems. Budget allocations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures. Examples include, but are not limited to, failed reclosers, poles, capacitor banks, and air breaks.

Scope & Locations

Scope and locations are determined as equipment fails.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$16.90	\$16.90	\$17.70	\$17.69	\$17.90	\$87.09

PPL Electric Utilities Corporation

Replace Failed Underground Cable

Program Description and Purpose

Replacement of failed underground residential primary cables in order to maintain adequate service reliability.

Identification/Justification Process

Candidates are identified via actual failures. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures.

Scope & Locations

Scope and locations are determined as cable fails.

Planned Expenditures(in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$14.19	\$14.19	\$14.70	\$14.69	\$14.86	\$72.62

PPL Electric Utilities Corporation

Replace Failed 12 kV Underground Getaway Cables

Program Description and Purpose

Replacement of failed 12 kV underground getaway cables in order to maintain adequate service reliability. Getaway failures can result in long duration outages. Getaway cables connect substations to outgoing feeders beyond the substation perimeter.

Identification/Justification Process

Candidates are identified via actual failures and cables with severely poor testing results. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures.

Scope & Locations

Scope and locations are determined as cable fails or fails testing.

Planned Expenditures(in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$1.32	\$1.52	\$1.51	\$1.51	\$1.53	\$7.39

PPL Electric Utilities Corporation

Replace Deteriorated/Failed Low Tension Network Equipment and Structures

Program Description and Purpose

Replacement or repair of deteriorated and failed equipment related to low-tension networks, including submersible transformers, network protectors, manholes, and vault tops in order to maintain adequate service reliability. Low-tension networks are low voltage underground distribution facilities found in urban areas.

Identification/Justification Process

Candidates are identified via actual failures, inspections, testing, or work on the system. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures.

Scope & Locations

Scope and locations are determined as cable fails.

Planned Expenditures(in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$0.86	\$0.86	\$1.21	\$1.21	\$0.81	\$4.95

PPL Electric Utilities Corporation

Underground Cable Replacement and Life Extension

Program Description and Purpose

Programmatic replacement and/or treatment of deteriorated underground cable to maintain reliable electric service. Specifically for underground residential developments (“URD”), PPL Electric’s course of action is to treat the entire URD, where possible.

Identification/Justification Process

Candidates are selected based on history of cable failures. Once the initial failure is treated, remaining cable sections of the same vintage in the area are tested. Test results drive the decision to either replace the cable or treat it with a compound to restore cable insulation, known as cable curing. The profile of URD cable varies across URDs, thus making it difficult to predict whether cable curing or replacement will be the prevalent course of action in a given URD. On a system-wide basis, however, historical experience indicates that of the total number of cables in troubled URD locations, typically 35% can be cured, 25% require replacement, and 40% do not require immediate remediation.

Regional allocation of cable remediation is based on historical regional percent contribution to system-wide cable failures.

Scope

Planned Scope In Cable Segments						
Treatment	2018	2019	2020	2021	2022	Total Scope
Replacement After Test	220-280	220-280	220-280	220-280	220-280	1100-1400
Cure	600-680	800-900	800-900	800-900	850-950	3850-4330
Proactive Replacement	150-175	150-175	150-175	150-175	150-175	750-875

Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	1211-1339
Northeast	797-881
Central	524-580
Susquehanna	553-611
Harrisburg	1383-1529
Lancaster	1302-1440

PPL Electric Utilities Corporation

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$7.89	\$7.98	\$8.35	\$8.33	\$7.40	\$39.95

PPL Electric Utilities Corporation

Low Tension Network Primary Cable, Equipment and Structures

Program Description and Purpose

Programmatic replacement of deteriorated equipment related to low-tension networks, including: paper insulated lead cable (PILC), submersible transformers, network protectors, manholes, and vault tops. The purpose of this program is to ensure public safety and service reliability through the replacement of underground facilities that have reached the end of their expected life or show signs of premature age from prolonged exposure to corrosive environments.

Identification/Justification Process

Vintage PILC cable has a documented history of problems and was deemed prudent to replace entirely. Replacement and repair of manhole and vault tops is determined by regular inspection. Transformer and network protector replacements are determined through inspection and age, where assets exceeding 40 years in service are considered highest priority.

Scope

	Planned Replacements in Units (in Work Orders)					
	2018	2019	2020	2021	2022	Total Scope
Lead Cable	0-5	1-5	1-5	1-5	1-5	4-25
LTN Equipment	15-30	15-30	15-30	15-30	15-30	75-150

Locations (Approximate total over 5 year plan)

Region	LTN Equipment	Cable
Lehigh	25-65	0-7
Northeast	25-65	0-7
Central	25-65	0-7
Susquehanna	25-65	0-7
Harrisburg	25-65	0-7
Lancaster	25-65	0-7

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$2.77	\$5.69	\$5.65	\$5.79	\$3.09	\$22.99

PPL Electric Utilities Corporation

LTN Automation

Program Description and Purpose

The purpose of the program is to install remote monitoring and control equipment in all Low Tension Network (LTN) vaults. This will allow for safer operation of LTNs, a reduction in maintenance costs, a reduction in failed equipment requiring replacement, and better data for asset planning and investment.

Identification/Justification Process

Rollout of this program began in the Leigh and Harrisburg regions. By the completion of this program, all LTN vaults will receive automation.

Scope

Planned Replacements in Units					
2018	2019	2020	2021	2022	Total Scope
0-1	1-2	1-2	2-3	0-1	4-9

Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	0
Northeast	1
Central	1
Susquehanna	1
Harrisburg	0
Lancaster	1

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$0.00	\$3.43	\$3.41	\$4.67	\$0.00	\$11.51

PPL Electric Utilities Corporation

Underground Getaway Cable Replacements and Life Extension

Program Description and Purpose

Programmatic replacement of aging 12 kV underground getaway cables, with an emphasis on conversion to overhead design, to prevent service outages and reduce outage durations for improved reliability.

Identification/Justification Process

Getaways are selected on a basis of failure history, cable test results, and age. Cables that are older than 40 years and serve a large number of customers, are given highest priority. The average age for UG cables identified for replacement is 38 years. PPL Electric also plans to incorporate treatment methods for getaways that are currently implemented for URD cables on the distribution system.

Scope

Planned Replacements in Units					
2018	2019	2020	2021	2022	Total Scope
30-35	30-35	40-50	40-50	35-45	175-215

Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	39-44
Northeast	23-26
Central	28-31
Susquehanna	22-25
Harrisburg	46-52
Lancaster	33-37

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$5.05	\$5.30	\$7.05	\$7.05	\$6.10	\$30.55

PPL Electric Utilities Corporation

Copper Weld Copper Replacement

Program Description and Purpose

Programmatic replacement of overhead #6 Copper, and #6, #6A and #7A Copper Weld overhead conductor to improve reliability of service by reducing potential for long-duration conductor failures. Such vintages of conductor are known to anneal and are often found in heavily wooded areas of the service territory where relocation, along with reconductoring, help to ensure future outages can be restored more quickly. PPL Electric currently is evaluating expanding this program to include other types of vintage cables/conductors.

Identification/Justification Process

Circuits are prioritized by an algorithm that weighs the amount of copper on the line and historic customer service interruptions.

Scope

Planned Projects					
2018	2019	2020	2021	2022	Total Scope
2-4	3-5	3-5	3-5	3-5	14-24

Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	2-3
Northeast	2-3
Central	2-4
Susquehanna	2-4
Harrisburg	2-4
Lancaster	2-4

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$0.76	\$1.82	\$2.50	\$2.54	\$2.04	\$9.66

PPL Electric Utilities Corporation

Customers Experiencing Multiple Interruptions

Program Description and Purpose

Improve reliability for customers experiencing multiple interruptions (“CEMI”) and customers experiencing multiple momentary interruptions (“CEMMI”) via upgrades to their circuits. The purpose of the program is to prevent future outages from occurring and to increase communication with customers who experience five or more service outages within a one year period, or two or more momentary interruptions per month on average for a year.

Identification/Justification Process

Projects are identified by regional distribution planners and regional reliability supervisors once a circuit has customers who exceed a threshold of five or more service interruptions within a calendar year, or are downstream of devices that momentarily interrupt customers more than set thresholds for various time frames. Projects are vetted at cross-functional task force meetings (both for CEMI and CEMMI) for approval and ranked systematically based on historical CEMI performance, year-to-date CEMI performance, cost per customer benefit, and expected reliability improvements. CEMMI projects are ranked based on cost and number of customers affected, along with severity of issue. Examples include, but are not limited to, reconductoring lines, replacing and/or relocating protective equipment with new equipment, and building new tie lines to improve switching capabilities. It should be noted that sizes of projects vary significantly which can result in material swings in the number of planned projects.

Scope

Planned Projects						
Program	2018	2019	2020	2021	2022	Total Scope
CEMI	10-30	20-40	20-40	20-40	20-40	90-190
CEMMI	125-140	125-140	125-140	125-140	125-140	625-700

Locations

Locations are identified based upon emergent reliability needs.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$2.78	\$3.29	\$4.36	\$4.35	\$3.81	\$18.58

PPL Electric Utilities Corporation

Distribution Reliability Preservation

Program Description and Purpose

Upgrades to the distribution system as justified by regional reliability supervisors to improve reliability. Improvements are targeted towards WPCs, circuits with a history of customer complaints, or recommendations as a result of EORs. EORs are detailed reliability and operational analysis performed on 25% of a region's distribution circuits per year.

These projects are outside the scope of the Worst Performing Circuit program because they are smaller in nature and can be more quickly engineered and constructed.

Identification/Justification Process

Regional reliability supervisors identify and submit requests for small-scale circuit improvement projects. Projects under \$50,000 are directly identified by the regions, approximately 60% of the budget is allotted towards these small improvements. Projects over \$50,000 are ranked utilizing PPL Electric's investment prioritization tool to ensure funds are directed towards the most cost-effective projects. The number of projects and locations may vary depending on areas with reliability concerns. Examples include, but are not limited to, installation of fuses, fault indicators, reconductoring of vintage conductor, upgrading conductor to reduce impact of vegetation related service outages, and relocating sections of lines that may be inaccessible or prone to vegetation related service outages.

It should be noted projects vary significantly in size, which can result in material swings in the number of planned projects.

Scope

Planned Projects					
2018	2019	2020	2021	2022	Total Scope
15-35	20-40	35-55	35-55	35-55	140-240

Locations

Locations are identified based upon emergent reliability needs.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$6.58	\$8.09	\$11.12	\$11.10	\$11.23	\$48.12

PPL Electric Utilities Corporation

Reliability Preservation Emergent

Program Description and Purpose

Remediation of issues primarily associated with secondary voltage and emergent small-scale customer reliability needs in order to improve reliability.

Identification/Justification Process

Work is identified by line crews, as well as through customer calls, and is completed to avoid potential service outages, power quality concerns and safety issues. Examples include, but are not limited to, modifying capacitance to address voltage concerns, installing fusing to aid in sectionalizing, installing animal guards after multiple animal caused outages, and replacing transformers to resolve transformer overload. Budget recommendations are based on historical trends of hours charged.

Scope & Locations

Scope and locations are determined as emergent needs arise.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$1.80	\$1.77	\$2.03	\$1.74	\$1.74	\$9.08

PPL Electric Utilities Corporation

Distribution Automation Deployment

Program Description and Purpose

Upgrade existing air breaks, vacuum circuit reclosers (“VCRs”), and SCADA (“Supervisory Control and Data Acquisition”) at distribution substations, and identify new locations to install automated air breaks and VCRs to improve circuit reliability. This will allow for automatic sectionalizing and restoration of customers during service outage conditions. This plan meets the recommendation the Commission issued on August 7, 2012 regarding outage mitigation techniques during storm events.

Recloser Replacements:

Prior to 2014, PPL Electric inspected and refurbished all reclosers (single and three-phase) on an eight-year cycle, pursuant to PUC Inspection and Maintenance Standard 52. Pa. Code § 57.198 (n)(7). In 2015, to improve reliability and move the company toward condition based maintenance, PPL Electric Utilities began replacing all three-phase reclosers with electronic vacuum devices on a ten year cycle. This plan was approved by the PUC in January 2014, and was filed as part of PPL Electric’s 2016-2017 Inspection and Maintenance Plan filing.

Identification/Justification Process

Areas selected for deployment:

- Have concentrations of distribution feeders that have been identified as WPCs.
- Have the operational flexibility to allow transfers and restoration of customers when service outages occur.
- Have significantly contributed to system SAIDI and SAIFI.

Customer Benefits:

- 500,000 customers (36%) will be covered under the distribution automation deployment.
- Significant reductions in system SAIDI and SAIFI.
- Reduction of the number of customers experiencing long duration service interruptions. Distribution automation will sectionalize the service interruption to the smallest possible area in under five minutes.
- Major Event improvements:
 - Fewer resources needed for switching (trouble crews can focus on cutting loops and performing repairs).
 - Reduction in call volume due to automatic restoration of customers.

Approximately 16-28 distribution substations will be upgraded per year and approximately 223-532 distribution devices will be upgraded per year.

PPL Electric Utilities Corporation

Scope

Planned Distribution Device Upgrades						
Voltage	2018	2019	2020	2021	2022	Total Scope
12 kV	300-350	300-350	300-350	300-350	150-200	1350-1600

Distribution devices include reclosers, air breaks, and communication infrastructure.

Locations (Approximate total over 5 year plan)

Region	Distribution Devices
Lehigh	225-275
Northeast	225-275
Central	225-275
Susquehanna	225-275
Harrisburg	225-275
Lancaster	225-275

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$12.07	\$17.65	\$21.11	\$18.13	\$6.02	\$74.98

PPL Electric Utilities Corporation

System Reliability Improvement Projects ISR Projects

Program Description and Purpose

Large-scale improvements to distribution circuits with a history of poor reliability. This program addresses long-term projects, primarily aimed at WPCs. However, other proactive long-term projects with proven reliability benefit are included.

Identification/Justification Process

Each quarter, distribution planners and regional reliability supervisors meet to propose projects to improve WPCs. Projects are approved by distribution planning supervisors and vetted against other projects for scheduling based on historical reliability, potential benefit, and cost. Projects may span multiple years and are listed in the years they are planned to go in service. Scope is expected to increase in outer years as circuits and projects are identified. Examples include, but are not limited to, circuit reconfigurations with new tie lines, new lines and terminals, or the installation of substations for increased reliability.

Additionally, PPL Electric monitors large customer impact outages on a daily basis. A circuit that begins to show reliability deterioration and notable impact on reliability metrics requires a root cause analysis. Such analysis can result in the identification of a long-term project.

Note that the projects vary significantly in size, which can result in material swings in the number of planned projects.

Scope

Planned Projects					
2018	2019	2020	2021	2022	Total Scope
2-4	5-10	5-10	30-50	10-20	52-94

Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	8-20
Northeast	8-20
Central	8-20
Susquehanna	8-20
Harrisburg	8-20
Lancaster	8-20

PPL Electric Utilities Corporation

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$2.14	\$28.36	\$30.66	\$65.50	\$45.12	\$171.78

PPL Electric Utilities Corporation

Unreimbursed Highway Relocations

Program Description and Purpose

Unreimbursed customer requested relocations of PPL Electric distribution facilities in support of highway and bridge projects throughout service territory.

Identification/Justification Process

The customers (project sponsors) include PennDOT, the PA Turnpike Commission, and various counties and municipalities. PPL Electric and the project sponsor execute a reimbursement agreement, and PPL Electric is reimbursed for its work based on the "pole count method", as defined in PennDOT's DM-5 manual. Historically, reimbursement for distribution projects is approximately 35%.

To accommodate highway relocations and other municipal projects, approximately 70-120 projects per year are placed in service. PPL Electric typically is notified of distribution relocation work 12 months or less before the start of requested utility relocation activities.

Scope & Locations

Scope and locations are determined as requests are received.

Planned Expenditures (in millions)

PPL Electric's expenditures to complete highway relocation projects are the net of total expenditures minus the project sponsor's reimbursements.

Planned Expenditures "Net Spend"					
2018	2019	2020	2021	2022	Total
\$5.21	\$4.60	\$4.57	\$4.56	\$3.85	\$22.78

PPL Electric Utilities Corporation

Substation Assets

The following pages detail 5-year projections for Long-Term Infrastructure Improvements initiatives that apply to distribution substation assets. These assets includes, but are not limited to, the following:

- Structures
 - Enclosures
 - Fences
- Overhead Conductors and Hardware
- Underground Cables and Hardware
- Switching Devices
 - Air Break Switches
 - Disconnect Switches
- Protective Devices
 - Circuit Breakers
 - Fuses
 - Reclosers
 - Lightning Arresters
- Transformers
 - Power
 - Station Service
 - Instrument

PPL Electric Utilities Corporation

Distribution Substation Circuit Breakers

Program Description and Purpose

Programmatic replacement of substation circuit breakers (“CBs”) based on age and other factors to ensure reliable service. This program includes the replacement of 12 kV circuit breakers, as well as 69 kV circuit breakers that are classified as distribution facilities and equipment.

Identification/Justification Process

Candidates for replacement are identified based on age, operating issues, availability of spare/repair parts, and the availability of vendor technical support. Once identified, replacement of these facilities are coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window.

The average age of the 12 kV circuit breakers that have been identified for replacement through 2017 is 48 years; the life expectancy is 50 years.

The specific type of 12 kV circuit breakers that have been targeted in this replacement program are the GE type FKD and FK oil CBs, Allis Chalmers type OZ and FZO oil CBs, Federal Pacific type AF and JCE oil CBs, McGraw Edison type VAC vacuum CBs, IT type VBK vacuum CBs, and GE type VIB vacuum CBs.

The average age of the 69 kV circuit breakers that have been identified for replacement through 2017 is 47 years; the life expectancy is 50 years.

The specific type of 69 kV circuit breakers that have been targeted for replacement in this program are the Allis Chalmers type FZO oil CBs and the GE type FK oil CBs.

Scope

Voltage	Planned Projects					Total Scope
	2018	2019	2020	2021	2022	
12 kV	30-35	26-31	26-31	26-31	26-31	134-159
69 kV	0-2	0-2	0-2	0-2	0-2	0-10

Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	25-30
Northeast	16-19
Central	18-22
Susquehanna	18-22
Harrisburg	29-35
Lancaster	26-31

PPL Electric Utilities Corporation

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$6.90	\$6.04	\$5.90	\$5.78	\$4.65	\$29.27

PPL Electric Utilities Corporation

Substation 69/12 kV Transformer Replacement

Program Description and Purpose

Programmatic replacement of distribution substation transformers to maintain reliable service.

Identification/Justification Process

Candidates for replacement are identified based on age and/or maintenance condition, both indicators of potential failure. Once identified, replacement of these facilities is coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window. Replace approximately 5 per year, averaged over a five-year period.

The average age of assets identified for replacement is 52 years; 13 of these are beyond their expected life. These assets are of vintages between 1947 and 1973, manufactured by Westinghouse, U S Transformer, RTE-Asea, Moloney, Hevi-Duty, General Electric and Allis Chalmers.

Scope

Planned Projects					
2018	2019	2020	2021	2022	Total Scope
3-5	3-5	3-5	3-5	3-5	15-25

Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	1-2
Northeast	1-3
Central	4-7
Susquehanna	4-7
Harrisburg	1-3
Lancaster	1-3

Planned Expenditures (in millions)

Planned expenditures fluctuate due to timing of long lead material purchases.

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$5.87	\$5.04	\$4.07	\$4.08	\$4.39	\$23.45

PPL Electric Utilities Corporation

Protection and Control

Program Description and Purpose

Programmatic replacement of protection and control equipment to maintain reliable distribution service to customers. Replacement of relays with modern microprocessor relays will enhance the ability for self-diagnostics, as well as continuous monitoring of the health of the device. Replacement of obsolete SCADA protocols and equipment will enable relays to perform properly.

Identification/Justification Process

Candidates for replacement are identified based on obsolescence, availability of vendor support, and age. Once identified, replacement of these facilities is coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window. The specific type of relays that have been targeted for early replacement in this program are the Agastat 2400 Series, Westinghouse COI, General Electric IAC, General Electric CFF, General Electric NLR, ABB DPU 245/445, and Westinghouse COM.

Scope

Planned Projects					
2018	2019	2020	2021	2022	Total Scope
72-80	94-100	194-199	196-201	195-200	751-780

Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	170-177
Northeast	181-188
Central	137-143
Susquehanna	102-106
Harrisburg	72-75
Lancaster	155-162

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$1.90	\$2.16	\$4.98	\$5.05	\$5.18	\$19.27

PPL Electric Utilities Corporation

Cross-Yard 12 kV Underground Ties

Program Description and Purpose

Programmatic replacement of underground substation cables to maintain reliable service.

Identification/Justification Process

Candidates for replacement are identified based on age and/or maintenance condition, both indicators of potential failure. Assets with an age significantly greater than 29 years are deemed good candidates for replacements. In addition, assets with unfavorable test results, which indicate the likelihood of failure, are prioritized for replacement. Currently, there is an average of 23 replaced per year over a five-year period. The average age of assets identified for replacement is 40 years. These assets were installed between 1960 and 1989; 124 of these assets are over 40 years old.

Scope

Planned Projects					
2018	2019	2020	2021	2022	Total Scope
20-25	20-25	40-45	40-45	25-30	145-170

Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	12-15
Northeast	41-48
Central	23-27
Susquehanna	12-14
Harrisburg	19-22
Lancaster	37-44

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$1.72	\$1.65	\$3.03	\$2.99	\$2.05	\$11.44

PPL Electric Utilities Corporation

Replace Deteriorated/Failed Area Supply Substation Equipment

Program Description and Purpose

Replacement of failed or deteriorated equipment at area supply substations with in-kind equipment to maintain safe and reliable service.

Identification/Justification Process

Candidates are identified via actual failures, inspections, testing or work on the system. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures.

Scope & Locations

Scope and locations are determined as equipment fails.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$2.53	\$2.52	\$3.02	\$3.02	\$2.48	\$13.57

PPL Electric Utilities Corporation

Repair Failed 138/69/12 kV Transformers

Program Description and Purpose

Repair of failed distribution substation power transformers to “like new” condition to maintain safe and reliable service in a more cost-effective manner than the purchase of new units. Program only includes costs associated with the overhaul of the failed unit.

Identification/Justification Process

Budget projections include a failure rate of three transformers per year based upon a ten-year rolling average. Individual units are selected based upon the cost-effectiveness of rebuilding the unit when compared to scrapping.

Scope & Locations

Scope and locations are determined as equipment fails.

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
0	0	0	0	0	0

PPL Electric Utilities Corporation

Distribution Substation DC Equipment

Program Description and Purpose

Programmatic replacement of distribution substation DC equipment to maintain reliable service. This program includes the replacement of 24V, and 48V batteries, as well as battery chargers.

Identification/Justification Process

Candidates for replacement are identified based on age, operating issues, and availability of spare parts. Once identified, replacement of these facilities are coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window. Currently, there is an average of 25 pieces of DC equipment scheduled to be replaced per year over the next five-year period. The average age of the DC equipment scheduled to be replaced through 2017 is 31 years; life expectancy of this type of equipment is 20 years. Of the devices being replaced, 80 devices will be beyond their expected life by the time of replacement.

Scope

Planned Projects					
2018	2019	2020	2021	2022	Total Scope
15-22	15-22	15-22	15-22	15-22	75-110

Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	19-23
Northeast	42-50
Central	13-16
Susquehanna	2-3
Harrisburg	18-22
Lancaster	9-11

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$0.19	\$0.26	\$0.25	\$0.25	\$0.27	\$1.22

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Miscellaneous Substation Equipment

Program Description and Purpose

Programmatic replacement of older substation equipment, including air breaks, potential transformers (“PTs”), capacitance-coupled voltage transformers (“CCVTs”), circuit switchers, lightning arresters, voltage regulators, and DC panels in order to prevent future maintenance concerns and to maintain reliable service.

Identification/Justification Process

Candidates for replacement are identified based on age and/or maintenance condition, both indicators of potential failure. Once identified, replacement of these facilities is coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window. Currently, there is an average of 44 pieces of equipment scheduled to be replaced per year over the next five-year period. The average age of assets identified for replacement is 47 years. These assets are of vintages between 1947 and 2000. Approximately 194 of these assets are projected to have exceeded their expected life by the time they are replaced.

Scope

Planned Projects					
2018	2019	2020	2021	2022	Total Scope
22-26	46-50	46-50	46-50	38-42	198-218

Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	39-44
Northeast	23-26
Central	44-49
Susquehanna	13-15
Harrisburg	2-3
Lancaster	73-81

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$1.36	\$1.97	\$2.23	\$2.23	\$2.06	\$9.85

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Substation Animal Guarding

Program Description and Purpose

Improvements to existing distribution substation equipment via the proactive installation of animal guards. Guarded equipment includes transformer bushings, circuit breakers, fuse/disconnect switches, bus supporting insulators, surge arresters, station service transformers, PTs, and cable terminators.

Identification/Justification Process

Distribution substations are regionally prioritized based on historical animal-related service outages, number of customers served, substation load, and substation type. High priority substations are animal guarded first with the lower priority substations guarded in outer years.

Scope

Planned Installations in Units					
2018	2019	2020	2021	2022	Total Scope
1-3	0-2	0-2	0-2	0-2	1-11

Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	0-2
Northeast	1-2
Central	1-2
Susquehanna	0-1
Harrisburg	0-2
Lancaster	1-4

Planned Expenditures (in millions)

Planned Expenditures					
2018	2019	2020	2021	2022	Total
\$0.51	\$0.51	\$0.51	\$0.51	\$0.26	\$2.31

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Appendix A : Average Age of Major Units of Property

The below chart is a summary of key distribution assets, targeted for planned replacement and proactive installation.

Average Age of Major Units of Distribution Property		
Utility Account	Description	Avg Asset Age*
362.0 - Station Equipment	DC System Equipment	15
362.0 - Station Equipment	Substation Animal Guards	8
362.0 - Station Equipment	Power Circuit Breakers	31
362.0 - Station Equipment	Power Transformers	38
362.0 - Station Equipment	Protection and Control Equipment	47
364.4 - Poles and Fixtures	Distribution Wood Poles	40
365.0 - Overhead Conductors, Device	Distribution Animal Guards	4
365.0 - Overhead Conductors, Device	OH Primary Conductor	46
365.0 - Overhead Conductors, Device	Air Break Switches	11
365.0 - Overhead Conductors, Device	Automatic Switches (Primarily OCRs/VCRs)	11
365.0 - Overhead Conductors, Device	Disconnect Switches	47
366.0 - Underground Conduit	UG Primary Conductor (includes Getaways and Cross Yard Ties)	34
366.0 - Underground Conduit	Equipment Foundation, Man Holes, Transformer Vaults	23
368.4 - Submersible or Padmt Type	UG Transformers (includes LTN Transformers & Network Protectors)	23
* Note that the average age of several classifications is skewed by recent increased installations. For example, automatic switches and animal		

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Appendix B : Asset Contribution To Reliability Metrics

The below table provides a summary of customers interrupted and Customer Minutes Interrupted (“CMI”) by failed component. Note that both transmission and distribution substation outages are included in the Substation component asset type.

Outage Contribution By Component - Equipment Failure Cause - Non Major Events												
Component Asset Type	Component Desc	2012		2013		2014		2015		2016		
		# Customers (Permanent)	CMI (Permanent)	# Customers (Permanent)	CMI (Permanent)	# Customers (Permanent)	CMI (Permanent)	# Customers (Permanent)	CMI (Permanent)	# Customers (Permanent)	CMI (Permanent)	
Distribution	OH-Capacitor Bank	2,189	119,903	1,344	146,513	4,976	458,401	1,735	93,922	1,600	83,912	
	OH-Lightning Arrester	7,287	1,346,042	2,184	337,493	5,941	912,371	6,498	684,672	5,139	612,653	
	OH-Other Equipment(explain)	5,824	902,017	8,903	642,349	7,977	823,273	8,110	762,681	2,547	329,044	
	OH-Pole/Arms Attachments	40,294	5,037,861	44,010	3,878,192	52,799	7,071,597	51,027	5,579,971	45,151	6,004,224	
	OH-PRI Splices and Connectors	9,990	1,465,477	1,811	182,455	11,616	1,711,251	8,275	1,316,038	10,072	835,901	
	OH-Primary/Neutral	155,182	20,735,933	110,920	11,403,222	135,265	18,154,581	56,987	6,954,675	86,286	10,705,378	
	OH-SEC Splices and Connectors	1,136	78,534	1,442	65,573	2,779	275,914	1,214	87,138	1,304	95,760	
	OH-Secondaries/Services	2,577	267,659	3,701	308,702	4,014	486,552	2,361	243,079	2,771	270,239	
	OH-Switch/Automatic	17,114	1,662,503	13,755	1,541,246	22,601	1,977,567	21,615	2,144,995	23,817	2,407,415	
	OH-Switch/Manual/AB/Disc/OS/LBD	10,452	1,489,230	13,835	1,072,340	10,504	1,054,227	15,794	1,260,374	9,751	1,024,191	
	OH-Tap Fuse/Cutout	9,604	1,470,105	8,188	1,154,087	12,919	1,693,432	9,242	1,143,457	11,491	1,048,759	
	OH-Transformer	13,078	1,756,699	12,787	1,718,849	11,332	1,725,239	10,490	1,553,114	8,980	1,303,702	
	OH-Transformer Fuse/Cutout	16,072	2,086,304	20,127	2,222,051	23,293	2,766,684	19,823	2,345,677	17,583	1,965,905	
	UG-Elbows	67	19,936	111	41,211	136	34,463	221	39,743	153	41,148	
	UG-Lightning Arrester	12	3,831	32	5,945	69	12,333	85	19,657	48	10,038	
	UG-Load Break Junctions	37	10,963	28	3,457	28	10,973	161	42,043	56	6,401	
	UG-Low Tension Network	1	1,538			10	2,893			1	86	
	UG-Other Equipment(explain)	284	70,130	267	22,549	131	22,973	836	296,418	46	6,902	
	UG-Pads/Vaults/MHs & Splice Boxes	41	10,461	181	45,952	124	26,175	242	64,941	101	9,017	
	UG-PRI Splices and Connectors	338	88,619	360	102,741	96	19,748	2,718	363,456	171	37,668	
	UG-Primary Cable/Neutral	16,728	4,290,588	14,265	2,682,304	19,486	4,776,145	17,275	3,285,692	24,721	3,414,041	
	UG-Riser Pole Equip & Devices	2,010	192,486	428	55,977	3,395	527,705	889	209,910	5,050	242,863	
	UG-SEC Splices and Connectors	3	843	34	2,806	28	4,237	5	359	11	1,118	
	UG-Secondaries/Services	226	64,598	302	86,227	428	138,911	372	84,825	129	25,745	
	UG-Switchgear	169	10,245	909	100,790	1,566	164,350	1,271	246,905	1,015	151,369	
	UG-Transformer/Transformer Fuse	1,926	472,567	1,621	371,035	1,636	444,280	1,950	513,487	1,638	368,796	
	Substation	SUB-Circuit Breaker	75,565	3,594,404	30,673	2,113,813	13,491	972,821	20,472	956,829	48,462	1,830,224
		SUB-Control/Relay	8,222	479,127	7,714	334,935	183	15,248			4,919	231,760
		SUB-Insulator	3,796	155,819							5,353	178,099
		SUB-Lightning Arrester			13,002	417,904	128	17,293	1	77	130	15,222
		SUB-Power Fuse	4,088	159,877	180	27,200	27	12,795	3,149	266,509	4,480	148,913
		SUB-Power Wiring					1,813	205,150				
SUB-Structure								335	11,445			
SUB-Switch/Automatic		2,676	119,863	7,972	123,951	20,849	2,121,410	1,363	55,084	3,218	102,216	
SUB-Switch/Manual/AB/Disc/LBD		14	838	1,361	71,515	2,594	331,214			1,964	42,677	
Sub-Transformer						2,459	180,278					
SUB-Transformer		12,440	830,058	9,391	941,740	9,676	905,741	1,671	162,884	6,479	315,170	
Total			419,442	48,995,056	331,838	32,225,126	384,369	50,058,225	266,187	30,790,059	334,637	33,866,557

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