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E-File

March 1, 2017

Rosemary Chiavetta, Esquire
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street
Harrisburg, PA 17120

**Re: PPL Electric Utilities Corporation
2017 Annual Asset Optimization Plan
Docket No.**

Dear Ms. Chiavetta:

Enclosed for filing on behalf of PPL Electric Utilities Corporation is its 2017 Annual Asset Optimization Plan for the above-referenced proceeding.

Copies have been provided as indicated on the Certificate of Service.

If you have any questions or need additional information, please call.

Very truly yours,


Kimberly A. Klock

Enclosures

cc: Certificate of Service

CERTIFICATE OF SERVICE

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

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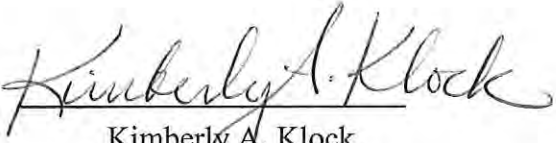
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Date: March 1, 2017


Kimberly A. Klock

PPL Electric Utilities Corporation

Annual Asset Optimization Plan

March 2017

PPL Electric Utilities Corporation

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Introduction

PPL Electric Utilities Corporation (“PPL Electric or the Company”) files this Annual Asset Optimization Plan (“AAO Plan”) in compliance with 66 Pa.C.S. § 1356. Section 1356 requires a utility with an approved distribution system improvement charge (“DSIC”) and long-term infrastructure improvement plan (“LTIIIP”) to file an AAO Plan. Consistent with the requirements of Section 1356, PPL Electric’s AAO Plan will provide:

- (1) A description that specifies all eligible property repaired, improved and replaced in the immediately preceding 12-month period pursuant to the utility's long-term infrastructure improvement plan and prior year's asset optimization plan; and
- (2) A detailed description of all the facilities to be improved in the upcoming 12-month period.

The AAO Plan is part of PPL Electric’s overall strategy to proactively repair and replace its aging distribution infrastructure in order to ensure that its system continues to be safe, reliable, and able to meet the needs and expectations of its customers. PPL Electric’s plans reflect the Company’s ongoing commitment to accelerate its investment, while managing finite resources and ensuring that its portfolio of activities are cost effective. As a result, PPL Electric’s plans for the upcoming 12-month period have been developed incorporating the lessons learned from the Company’s experience with an effective LTIIIP and DSIC.

PROCEDURAL HISTORY

On February 14, 2012, Governor Corbett signed into law Act 11 of 2012 (“Act 11”), which amends Chapters 3, 13 and 33 of the Public Utility Code. Act 11 authorizes electric distribution companies (“EDCs”), natural gas distribution companies (“NGDCs”), water utilities, wastewater utilities and city natural gas distribution operations to establish a DSIC. The DSIC allows utilities to recover reasonable and prudent costs incurred to repair, improve or replace certain eligible 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. As a precondition to the initial implementation of a DSIC, each utility must file and obtain approval of a LTIIIP that is consistent with the provisions of Section 1352 of the statute. See 66 Pa.C.S. § 1352(a). Act 11 also requires a yearly compliance filing known as an Annual Asset Optimization Plan. See 66 Pa.C.S. § 1356.

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On August 2, 2012, the Commission issued its Final Implementation Order establishing procedures and guidelines necessary to implement Act 11. The Final Implementation Order adopted the requirements established in Act 11, provided additional standards that each utility must meet in developing an LTIP and DSIC, and gave guidance to utilities for meeting the Commission's standards.

On March 14, 2013, the Commission entered a Proposed Rulemaking Order at Docket No. L-2012-2317274 in *Review of Long-Term Infrastructure Improvement Plan*. In its Order, the Commission provided proposed regulations regarding the LTIP, including information on modification of a utility's LTIP, and the annual review process for the AAO Plan. On May 23, 2014, after review of comments from interested stakeholders, the Commission issued a Final Rulemaking Order which set forth the elements an LTIP must contain and outlines the procedure and process for filing and review of LTIPs and AAOPs. The Final Rulemaking Order was published in the *Pennsylvania Bulletin* on December 20, 2014 (44 Pa.B. 7856) and the final regulations became effective upon that publication.

On September 21, 2016, the Commission entered a Supplemental Implementation Order at Docket No. M-2012-2293611 in *Implementation of Act 11 of 2012*. In its Order, the Commission addressed issues regarding the implementation, operation and computation of the DSIC. Specifically, the Commission addressed the requirement of quarterly financial reports for all utilities that use the DSIC mechanism; filing and computation issues for when the DSIC is reset to zero; treatment of over/under collections, or E-factor, after the DSIC is reset to zero; computation issues for determining the DSIC rate cap; and the requirement to file an LTIP by water utilities that use the DSIC.

PPL Electric has been a long-time supporter of implementing a DSIC for EDCs, and has actively participated in the Commission's process to develop the procedures and policies surrounding the Commission's implementation of Act 11. PPL Electric was a participant in the Commission's working groups, and filed comments to both of the Commission's Tentative Implementation Orders.

BACKGROUND

PPL Electric is a public utility and an EDC as defined in Sections 102 and 2803 of the Pennsylvania Public Utility Code, 66 Pa. C.S. §§ 102, 2803. PPL Electric furnishes electric distribution, transmission, and default service electric supply services to

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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.

PPL Electric filed an LTIP, on September 18, 2012 at Docket No. P-2012-2325034. In preparing its LTIP, PPL Electric followed the guidelines established in the Commission's August 2, 2012 Final Implementation Order. The Company's LTIP was approved as filed on January 10, 2013. On January 15, 2013, PPL Electric filed a petition seeking approval of a DSIC. By Order entered May 23, 2013, the Commission approved PPL Electric's DSIC, subject to refund pending final resolution of certain issues raised by parties to the DSIC proceeding.

Within the LTIP, PPL Electric categorized its distribution system infrastructure planned for replacements into 32 asset groups and provided a description of the DSIC eligible projects. Details on each of the asset groups included factors used to identify the need for the project, average age of the asset, scope of the project including the number of units to be replaced or improved over the next five years, the approximate location by geographic region for the projects and the yearly expenditures for five years, 2013 to 2017, for each asset class. The Commission determined that the information provided by PPL Electric for the 32 asset groups met the requirements of Act 11.

EXECUTIVE SUMMARY

In developing its AAOP, PPL Electric has included all of the 32 asset groups originally included in its Commission-approved LTIP. The AAOP provides projected and actual replacement numbers for 2016, and original and revised projections for 2017. PPL Electric maintained the project description provided in the LTIP, but has added comments to describe the progress of the programs and to explain any deviations from the original projections. While some programs have been modified, due to changing circumstances, PPL Electric does not propose to eliminate any of its programs at this time.

As the table below shows, in 2016 PPL Electric has underran the original amount it projected to spend on DSIC eligible projects. The Company anticipates that it will be under the original LTIP projections in 2017.

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 performance targets, PPL Electric's service PPL Electric Utilities Corp.

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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 below.

	2012	2013	2014	2015	2016
SAIFI (Benchmark = 0.98; rolling 12-month Std. = 1.18)	1.076	0.082	0.92	0.72	0.78
CAIDI (Benchmark = 145; Rolling 12-month Std. = 174)	152	108	180	118	121
SAIDI (Benchmark = 142; Rolling 12-month Std. = 205)	164	89	165	84	94
MAIFI	4.11	3.54	3.26	4.2	6.8
Average Number of Customers Served	1,392,408	1,395,325	1,399,535	1,405,701	1,411,897
Number of Sustained Customer Interruptions (Trouble Cases)	16,384	14,400	17,388	14,973	17,473
Number of Customers Affected	1,497,660	1,140,583	1,284,603	1,007,983	1,097,142
Customer Minutes of Interruptions	228,143,195	123,601,330	230,750,454	118,547,919	132,904,740
Number of Customer Momentary Interruptions	5,716,569	4,936,544	4,559,353	5,886,251	10,246,275

Because approximately 40% of the capital dollars for distribution operations is allocated to Act 11 projects, the assumption was made that 40% of the FTE (Full Time Equivalent) positions would be used for Act 11 purposes as well. The only break down available is between PPL Electric (PPL) and contract (COC) employees; there is no further breakdown available at a field/supervisory level. The data shown below are for FTE only.

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Year	PPL	COC	Total
2016	264	98	362
2017	267	100	367

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Infrastructure Initiative	2016 LTIP	2016 Actuals	2017 LTIP	2017 Forecast
12 kV Underground Getaway Cables	\$6.13	\$3.66	\$0.01	\$2.40
Capacitors	\$0.36	\$3.43	\$2.03	\$3.07
Circuit SAIDI Improvement	\$11.21	\$0.50	\$3.33	\$0.00
Copper Weld Copper	\$6.11	\$1.06	\$0.40	\$0.00
Cross-Yard 12 kV Underground Tie	\$1.11	\$0.68	\$0.51	\$0.56
C-Truss Distribution Poles	\$1.60	\$3.63	\$6.21	\$3.28
Customers Experiencing Multiple Interruptions	\$3.42	\$1.12	\$6.32	\$2.15
Distribution Animal Guarding	\$0.84	\$0.42	\$1.00	\$0.67
Distribution Automation Development	\$22.74	\$30.69	\$5.61	\$18.43
Distribution Failed Equipment	\$14.01	\$13.74	\$0.86	\$15.72
Distribution Pole Replacements	\$4.43	\$7.02	\$4.50	\$8.28
Distribution Reliability Preservation	\$9.62	\$5.88	\$2.86	\$5.33
Distribution Substation Circuit Breakers	\$4.27	\$10.15	\$1.73	\$3.36
Distribution Substation DC Equipment	\$0.39	\$0.19	\$24.43	\$0.15
Fiber Wrap Distribution Poles	\$1.62	\$4.77	\$0.39	\$4.65
Improve System Reliability Projects	\$15.95	\$9.22	\$3.68	\$13.01
Low Tension Network Primary Cable, Equipment and Structures	\$4.64	\$2.03	\$3.64	\$1.45
Miscellaneous Substation Equipment	\$0.99	\$0.20	\$1.13	\$0.34
New Hydraulic Reclosers	\$0.50	\$0.18	\$4.64	\$0.08
Protection and Control	\$1.00	\$0.19	\$0.26	\$1.22
Recloser Replacements	\$4.77	\$4.89	\$4.92	\$2.35
Reliability Preservation Emergent	\$1.59	\$1.54	\$9.81	\$1.97
Repair Failed 138/69 12 kV Transformers	\$0.01	\$0.00	\$14.57	\$0.00
Replace Deteriorated/Failed Low-Tension Network Equipment and Structures	\$1.37	\$0.99	\$1.19	\$1.23
Replace Deteriorated/Failed Area Supply Substation Equipment	\$1.15	\$3.00	\$9.23	\$2.45
Replace Failed 12kV Underground Getaway Cable	\$0.49	\$1.43	\$10.40	\$1.56
Replace Failed Underground Primary Cable	\$3.62	\$6.67	\$2.00	\$5.13
Replace Failed Underground Secondary Cable	\$1.96	\$5.59	\$2.68	\$5.46
Substation 69/12 kV Transformer Replacement	\$5.27	\$0.89	\$1.70	\$0.11
Substation Animal Guarding	\$2.57	\$1.08	\$1.39	\$1.70
Underground Residential Development Cable Replacement and Life Extension	\$10.16	\$6.58	\$1.50	\$6.35
Unreimbursed Highway Relocations	\$3.14	\$2.66	\$16.30	\$4.39
Grand Total	\$147.04	\$134.10	\$149.23	\$116.85

**Dollars in Millions*

Almost all of the initiatives shown in the above table 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

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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 Circuit SAIDI improvements, 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 on a regular basis – at least every two years – 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 set forth actual results for calendar year 2016 and revised projections for calendar year 2017. 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 30% are candidates for replacement. PPL Electric is in the process of incorporating additional reinforcement technologies that are projected to reduce the replacement rate to approximately 15%. 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 35 years.

Scope

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

Replacements in Units	2016	2017
Original LTIP	600-800	600-800
Future YR Adjusted / Current YR Actual	1640-1815/ 1,521	1710- 1890

Locations

Specific locations are a direct correlation to the wood pole inspection plan. Inspection locations are identified yearly by reviewing potential SAIFI impacts of geographic areas, as well as ensuring cost-effectiveness of the program and minimizing inspection crew movements.

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$4.43M	\$4.64M
Future YR Adjusted / Current YR Actual	\$11.21M / \$7.02M	\$8.28M

Comments:

In 2016, the overall inspection failure rate increased to 10.3%, as the Company instituted a more thorough inspection process. 88.1% of all failures were able to be successfully reinforced, including 20.7% via Fiber Wrapping. As PPL Electric cycles through the inspection process, the pole plant population continues to age; as a consequence, the rejection rate is expected to increase slightly every year until a steady-state is achieved after completion of the full inspection cycle (2020).

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In 2016, PPL Electric inspected 68,000 poles using a full excavation and treatment regimen. In 2017, the Company is going to continue with the full excavation and treatment program on a scope of 60,000 poles.

In 2016, PPL Electric increased the rigor of the pole inspection program and moved to a full excavation and treatment program instead of the past partial excavation and treatment program. As a consequence more pole failures were corrected that would have otherwise gone unmitigated. Consequently, the percentage of c-tag, c-truss and fiber wrapped poles increased in 2016, and is forecast to stay at approximately that level in 2017.

PPL Electric has changed the prioritization of work specified in the Pole Inspection and Treatment and Pole Replacement programs', moving from end of current year and end of next year required dates to six months from inspection and one year from inspection. The change will standardize out priority requirement dates, and accelerate our replacement schedule, mitigating the risk of equipment failure.

Last year the Company moved ~370 poles from being replaced in 2016 to 2017 – which will directly increase the poles replaced in 2017 by those 370. Along with the poles originally identified in 2016 as 2017 work, and the poles expected to be replaced with required by dates in 2017, the Company is expecting to replace 1800 poles in 2017.

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 5% rejection rate from the population of yearly inspections, of which historically 70% are candidates for steel reinforcement. When applicable, this method achieves a significant savings over pole replacement.

Scope

Reinforcements in Units	2016	2017
Original LTIP	2800-3200	2800-3200
Future YR Adjusted / Current YR Actual	3380-3735/4,943	3933-4347

Locations

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

Planned Expenditures	2016	2017
Original LTIP	\$1.60M	\$2.00M
Future YR Adjusted / Current YR Actual	\$2.39M / \$3.63M	\$3.28M

Comments:

In 2016, PPL Electric inspected 68,000 poles using a full excavation and treatment regimen. In 2017, PPL Electric is planning on inspecting 60,000 poles using the same regimen.

In 2016, PPL Electric increased the rigor of the pole inspection program and moved to a full excavation and treatment program instead of the past partial excavation and treatment program. Every pole inspected in 2016 was fully dug out to a depth of 18" and treated with preservative unless marked as a reject. This full excavation process will continue in 2017.

As a result, the Company identified more pole failures that would have otherwise gone unmitigated. Consequently, the percentage of c-tag, C-Truss and fiber wrapped poles increased in 2016, and the increase will continue in 2017.

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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 non-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 expects to reduce the number of pole replacements from 30% of rejected poles to 15%. Shifting capital from replacement to fiber wrap allows capital to be invested in more effective areas.

Scope

Fiber Wrap in Units	2016	2017
Original LTIP	700-900	700-900
Future YR Adjusted / Current YR Actual	1025-1130/ 1,247	1197- 1323

Locations

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

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$1.62M	\$1.50M
Future YR Adjusted / Current YR Actual	\$3.06M /\$4.77M	\$4.65M

Comments:

In 2016, PPL Electric inspected 68,000 poles using a full excavation and treatment regimen. In 2017, PPL Electric is planning on inspecting 60,000 poles using the same regimen.

In 2016, PPL Electric increased the rigor of the pole inspection program and moved to a full excavation and treatment program instead of the past partial excavation and treatment program. Every pole inspected in PPL Electric Utilities Corp.

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2016 was fully dug out to a depth of 18” and treated with preservative unless marked as a reject. This full excavation process will continue in 2017.

As a result, the Company identified more pole failures that would have otherwise gone unmitigated. Consequently, the percentage of c-tag, C-Truss and fiber wrapped poles increased in 2016, and the increase will continue in 2017.

Recloser Replacements

Program Description and Purpose

Proactive refurbishment and replacement of oil-circuit reclosers (“OCRs”) to improve reliable service by reducing equipment failures. OCRs are used on main 12 kV lines and on three-phase and single-phase taps to minimize the number of customers affected by a sustained outage. Devices are replaced through specific maintenance and required refurbishment/replacement schedules in an effort to reduce OCR failures.

Identification/Justification Process

Candidates are identified based on an adherence to an eight-year cycle, not the age of the device. An eight-year cycle ensures compliance with the PUC’s Inspection & Maintenance Standards.

Scope

Replacements in Units	2016	2017
Original LTIP	600-900	600-900
Future YR Adjusted / Current YR Actual	90-110/93	70-85

Locations

Region	2016 Actual
Lehigh	15
Northeast	5
Central	14
Susquehanna	5
Harrisburg	38
Lancaster	16

Planned Expenditures

Planned Expenditures	2016	2017
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Original LTIP	\$4.77M	\$4.92M
Future YR Adjusted / Current YR Actual	\$4.38M / \$4.89M	\$2.35M

Comments:

The recloser replacement program changed significantly in 2015 to replace all existing three-phase reclosers with intelligent vacuum circuit reclosers with remote capability on a ten year cycle in order to move to condition based maintenance and improve reliability. In 2014, refurbishment of the single phase recloser was stopped and this was the last year existing hydraulic three-phase reclosers were refurbished. This change was reviewed and approved with the PUC staff in January 2014. In 2017, our projected scope and budget are in line with the updated replacement methodology.

Capacitors

Program Description and Purpose

Installation of capacitors on the 12 kV system to achieve a 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 MVAR requirements to support any system shortages. Regional splits are analyzed annually based on need.

Scope

Installations in Units	2016	2017
Original LTIP	17-23	17-23
Future YR Adjusted / Current YR Actual	60- 100/507	400- 500

Locations

Region	2016 Actual
Lehigh	103
Northeast	89
Central	50
Susquehanna	42
Harrisburg	144
Lancaster	79

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Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$.36M	\$.26M
Future YR Adjusted / Current YR Actual	\$0.60M/ \$3.43M	\$3.07M

Comments:

Program scope has been modified to include replacing fixed capacitors with switched capacitors and adding voltage regulators where needed in an effort to improve substation bus voltage. 2017 forecasted spend has been modified from the original LTIP filing to support these changes.

As part of this program, the Company completed various types of work including but not limited to (new capacitor controller installations, new switched capacitors, converting fixed capacitors to switched, minor capacitor repairs, new voltage regulators, phase balancing, and substation transformer tap changes). The program is scheduled to continue through 2017.

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

Installations in Units	2016	2017
Original LTIP	15-20	15-20
Future YR Adjusted / Current YR Actual	20-30/ 11	3-6

Locations

Region	2016 Actual
Lehigh	1
Northeast	2

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Central	2
Susquehanna	2
Harrisburg	2
Lancaster	2

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$.50M	\$.40M
Future YR Adjusted / Current YR Actual	\$.29M / \$.18M	\$.08M

Comments:

This budget includes the new installation of single phase hydraulic reclosers and installation of larger single-phase hydraulic reclosers to replace single phase reclosers that are at a potential to be overloaded. The budget is based on the identification of viable candidate locations. Due in part to recent aggressive deployment of single phase fusing, the number of viable candidate locations is observed to be diminishing.

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

Densities of transformers and air breaks are grouped together in a location. Locations are determined by a vectoring approach which identifies the most cost-effective locations, focusing on high-density outage areas susceptible to animal contacts.

Scope

Areas To Address	2016	2017
Original LTIP	20-40	15-35
Future YR Adjusted / Current YR Actual	500-700/ 694	700-900

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Locations

Region	2016 Actual
Lehigh	111
Northeast	143
Central	142
Susquehanna	63
Harrisburg	108
Lancaster	127

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$.84M	\$.86M
Future YR Adjusted / Current YR Actual	\$.76M / \$.42M	\$.67M

Comments:

The methodology for how work is tracked was changed late in 2015, which allows for better visibility of assets. Rather than bundling multiple animal guarding locations per job, each job now represents one animal guarding location which allows for better asset tracking and more efficient work completion. In 2016, some work efficiency gains were realized through bundling work and use of second shift crews, as the actual spend was lower than forecasted.

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.

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Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$14.01M	\$14.57M
Future YR Adjusted / Current YR Actual	\$14.69M /\$13.74M	\$15.72M

Comments:

The 2017 budget is an approximately 15% increase over the 2016 budget and is based upon trend projections from the past three years.

Replace Failed Underground Primary 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. Cables which have failed for the second time in a calendar year, or for the third time in their lifetime are replaced instead of repaired. Cables which fail only once are typically repaired on-site. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures. PPL Electric has initiated a program to cable cure failed cables to extend the cable lifetime at a lower cost than replacement. This may cause a reduction in this budget over time because fewer failed cables will be replaced.

Scope & Locations

Scope and locations are determined as cable fails.

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$3.62M	\$3.68M

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Future YR Adjusted / Current YR Actual	\$4.45M / \$6.67M	\$5.13M
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Comments:

In 2016, PPL Electric has seen a higher amount of failures than normal due to aging assets. The 2016 actuals were also higher due to the unpredictable cost of boring new cable. The nature of this work is heavily dependent on the area and ground conditions. As a result, PPL Electric is increasing its original 2017 forecast based on the 2016 actuals.

Replace Failed Underground Secondary Cable

Program Description and Purpose

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

Identification/Justification Process

Candidates are identified via actual failures, customer complaints and poor neutral test 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.

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$1.96M	\$2.03M
Future YR Adjusted / Current YR Actual	\$5.18M /\$5.59M	\$5.46M

Comments:

The spending on failed secondary replacements was higher than projected in 2016 due to an increased number of replacements as many are reaching the end of their expected life. A decision was made to replace all failed secondary cables in order to reduce the number of customers affected. The Company has increased the original 2017 forecast based on the actuals from 2016 and the elimination of the repair program.

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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. 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

Planned Expenditures	2016	2017
Original LTIP	\$.49M	\$.51M
Future YR Adjusted / Current YR Actual	\$1.02M / \$1.43M	\$1.56M

Comments:

This program was initially developed to replace underground getaway cables that have catastrophically failed in the field. In addition, this program will also fund the replacement of getaways with poor testing results to avoid catastrophic failures and customer interruptions. The projected spend for 2017 has been increased from our original LTIP filing to be consistent with our actual program spend in 2016.

Replace Deteriorated/Failed Low Tension Network (LTN) 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

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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 and vault equipment fails.

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$1.37M	\$1.39M
Future YR Adjusted / Current YR Actual	\$\$.94M / \$.99M	\$1.23M

Comments:

The 2016 actuals were very similar to 2015 and thus the Company will maintain the approximate original budget level for 2017.

Underground Residential Development Cable Replacement and Life Extension

Program Description and Purpose

Programmatic replacement and treatment of deteriorated underground residential development ("URD") cable to maintain reliable electric service in residential developments. PPL Electric's course of action is to treat entire developments where possible.

Identification/Justification Process

Candidate developments are selected based on history of cable failures. Once the initial failure is treated, remaining cable sections in that development 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

Scope In Cable	Treatment	2016	2017
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Sections			
Original LTIP	Replacement After Test	400-450	400-450
Future YR Adjusted / Current YR Actual	Replacement After Test	150-225/106	55-65
Original LTIP	Cure	750-800	750-800
Future YR Adjusted / Current YR Actual	Cure	725-775/900	800-1000
Original LTIP	Proactive Replacement	150-200	150-200
Future YR Adjusted / Current YR Actual	Proactive Replacement	110-250/90	55-65

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$10.16M	\$10.40M
Future YR Adjusted / Current YR Actual	\$10.21M / \$6.58M	\$6.35M

Comments:

In 2016, due to reprioritization of our replacement strategy to focus on the emergent outage issues, PPL Electric was unable to meet the planned numbers for proactive replacements and replacements after test. Due to an increase in efficiency in our cable curing program, the Company was able to exceed the number of segments cured significantly without additional cost. The Company plans to carry forward with the increased efficiency and cure the same number of segments in 2017.

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

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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

Replacements in Units		2016	2017
Original LTIP	Lead Cable (miles)	0	0
Future YR Adjusted / Current YR Actual	Lead Cable (miles)	0/0	0
Original LTIP	LTN Equipment	50-70	50-70
Future YR Adjusted / Current YR Actual	LTN Equipment	15-25/ 10	5-10

Locations

Region	2016Actual
Lehigh	1
Northeast	4
Central	4
Susquehanna	0
Harrisburg	0
Lancaster	1

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$4.64M	\$5.61M
Future YR Adjusted / Current YR Actual	\$3.91M / \$2.03M	\$1.45M

Comments:

The 2016 actual spend and 2017 forecast are lower than our original LTIP filing due to reprioritizing the investment strategy.

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This program was tracked by number of projects (or Work Orders) as it was concluded the original measurement in the LTIP was not able to be tracked in our asset management tool. The dollars were not impacted in how this program is now being measured.

12 kV Underground Getaway Cables

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.

Scope

Replacements in Units	2016	2017
Original LTIP	60-65	60-65
Future YR Adjusted / Current YR Actual	30-40/ 26	10-14

Locations

Region	2016 Actual
Lehigh	4
Northeast	0
Central	8
Susquehanna	5
Harrisburg	4
Lancaster	5

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$6.13M	\$6.21M
Future YR Adjusted / Current YR Actual	\$5.64M / \$3.66M	\$2.4M

Comments:

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In 2016, the number of units replaced was less than forecasted due to increased cost in material and boring. The number of getaways to be replaced in 2017 is lower than our original LTIP filing based on the reprioritization of our investment strategy.

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

Projects	2016	2017
Original LTIP	30-32	31-34
Future YR Adjusted / Current YR Actual	1-5/ 1	0

Locations

Region	2016Actual
Lehigh	0
Northeast	0
Central	1
Susquehanna	0
Harrisburg	0
Lancaster	0

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$6.11M	\$6.32M
Future YR Adjusted / Current YR Actual	\$.53M/ \$1.06M	0

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Comment:

This program was tracked by number of projects (or Work Orders) as it was concluded the original measurement in the LTIP was not able to be tracked in the Company's asset management tool. The dollars were not impacted in how this program is now being measured.

Due to a reprioritization of our investment strategy to continue to drive reliability improvements, funding for this program was moved to other LTIP projects with a higher reliability benefit, resulting in no projections for 2017.

Customers Experiencing Multiple Interruptions

Program Description and Purpose

Improve reliability for customers experiencing multiple interruptions ("CEMI") 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.

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. Projects are vetted at a cross-functional task force meeting for approval and ranked systematically based on historical CEMI performance, year-to-date CEMI performance, cost per customer benefit, and expected reliability improvements. 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

Projects	2016	2017
Original LTIP	15-35	15-35
Future YR Adjusted / Current YR Actual	15-30/ 55	30-60

Locations

Locations are identified based upon emergent reliability needs.

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$3.42M	\$2.86M
Future YR Adjusted / Current YR Actual	\$2.97M / \$1.12M	\$2.15M

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Comments:

Because the nature of the projects that have been identified to improve the reliability of customers experiencing multiple interruptions is varied, the cost of the projects will also vary significantly. The 2017 budget represents a significant increase to the 2016 actual, which is commensurate with a renewed focus on aggressively remediating CEMI customers.

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

Projects	2016	2017
Original LTIP	150-300	150-300
Future YR Adjusted / Current YR Actual	150-250/ 513	300-400

Locations

Locations are identified based upon emergent reliability needs.

Planned Expenditures

Planned Expenditures	2016	2017
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Original LTIP	\$9.62M	\$9.81M
Future YR Adjusted / Current YR Actual	\$6.03M / \$5.88M	\$5.33M

Comments:

For 2016, volume was high due to SAIFI funding added into this category. The addition of a second shift allowed a high volume of low cost work to be performed when crews were not responding to outages. Cost for 2016 remained within projections and are expected to remain consistent for 2017.

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

Planned Expenditures	2016	2017
Original LTIP	\$1.59M	\$1.70M
Future YR Adjusted / Current YR Actual	\$2.04M / \$1.54M	\$1.97M

Comments:

This is an emergent program. The small under-run in 2016 does not result in any revision to the 2017 budget.

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Circuit SAIDI Improvement

Program Description and Purpose

Proactive installation of reclosers and air breaks with communications capabilities or the upgrade of existing reclosers and air breaks to include communication capability. Such installations allow for remote operation and monitoring of circuit sectionalizing equipment. This program also includes installation of manual switches to address emergent reliability issues. The results of these improvements are threefold:

- Reduce the number of upstream customers affected by a service outage.
- Reduce the time necessary to restore customers by transferring circuit sections to alternate sources and limiting long-duration service outages to smaller circuit sections involving fewer customers.
- Facilitate fault location and reduce the time necessary for repair and restoration.

Identification/Justification Process

Candidate locations are those that have experienced substandard reliability, as determined by system SAIDI contribution, and could benefit from improved sectionalizing capability.

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

Scope

Installations in Units	2016	2017
Original LTIP	150-300	150-300
Future YR Adjusted / Current YR Actual	5-10/ 9	0

Locations

Region	2016 Actual
Lehigh	2
Northeast	0
Central	1
Susquehanna	2
Harrisburg	2
Lancaster	2

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$11.21M	\$9.23M

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Future YR Adjusted / Current YR Actual	\$.53M / \$.50M	0
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Comments:

In 2015 and 2016, instead of a mix of devices, the entirety of this Circuit SAIDI budget consists only of intelligent vacuum circuit reclosers with remote capability. 2016 is projected be the last year of this program as it has been incorporated into the Distribution Automation Deployment program.

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.

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.

Scope

Substation Upgrades	Voltage	2016	2017
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Original LTIP	138/69-12 kV	25	28
Future YR Adjusted / Current YR Actual	138/69-12 kV	0	0

Device Upgrades	Voltage	2016	2017
Original LTIP	12 kV	505-530	525-550
Future YR Adjusted / Current YR Actual	12 kV	550-600/587	350-400

Distribution devices include air break switch upgrades, VCR upgrades/installations, and (in 2013) communication infrastructure.

Locations

Region	2016 Actual - Substation
Lehigh	0
Northeast	0
Central	0
Susquehanna	0
Harrisburg	0
Lancaster	0

Region	2016 Actual - Device
Lehigh	101
Northeast	60
Central	93
Susquehanna	77
Harrisburg	80
Lancaster	176

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$22.74M	\$24.43M
Future YR Adjusted / Current YR Actual	\$24.87M / \$30.69M	\$18.43M

Comments:

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The increase in cost of the devices drove the budget up for this program. Work to install these devices may also include the upgrade of the pole on which the device is being installed in order to accommodate the device.

Substation upgrades were originally anticipated in order to accommodate the device communications. Substation upgrades are still done on an as-needed basis, but distribution automation is no longer a driver due to changes in communication technologies. The original budget for the substation upgrades has been rolled into the device installation budget to allow for significantly more device installations each year than previously projected.

Originally, areas selected for deployment were chosen partly on geographic proximity starting specifically in the Northeast and Lehigh regions (due to the range and type of communications infrastructure), and having distribution feeders that were identified as Worst Performing Circuits. Since the Company has changed the communications strategy, it is able to target specific feeders based on reliability history. Over the course of this project, PPL Electric intends to address nearly all of our feeders. The Company intends to make circuit upgrades as necessary to improve the operational flexibility to allow transfers and restoration of customers when service outages occur.

Our planned installation scope for 2017 is lower than originally planned due to reprioritization of the investment plan and inclusion of work planned for 2017 completed in 2016.

System Reliability Improvement 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

Projects	2016	2017
Original LTIP	10-25	10-25

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Future YR Adjusted / Current YR Actual	5-15/ 9	5-15
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Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$15.95M	\$16.30M
Future YR Adjusted / Current YR Actual	\$6.22M / \$9.2M	\$13.01M

Comments:

The program was modified to reprioritize the composition of projects which had a direct impact on the actual and budgeted dollars.

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, although other cost share determinations are used when PPL Electric and PennDOT agree it is more appropriate. 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 and construction dates routinely shift as PennDOT's construction schedules move.

Scope & Locations

Scope and locations are determined as requests are received.

Planned Expenditures

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

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Planned Expenditures	2016	2017
Original LTIP	\$3.14M	\$3.33M
Future YR Adjusted / Current YR Actual	\$3.76M / \$2.66M	\$4.39M

Comments:

Changing PennDOT construction schedules and uncertainties due to incomplete highway construction designs complicates forecasting more than six months into the future. PennDOT's tendency to schedule work two and three years in advance leads to initial estimates preceding PPL Electric issuing engineering design. Frequent receipt of incomplete highway designs from PennDot and their contractors during PPL's preliminary engineering leads to engineering changes during the project, further complicating forecasting and increasing inaccuracies.

In 2015 PennDOT initiated a state wide "Rapid Bridge Replacement". Between 2015 and 2017 this program added 85 projects across the PPL Electric service territory. Timeline from initiation to construction is compressed less than one year for each project. Through 2016 PPL completed 40 relocations for this program specifically. Remaining projects for 2017 are 45 above the typical 70 to 120 relocation projects per year. Coupled with PennDOT's regularly scheduled road work PPL expects increased highway relocation costs in 2017 and beyond.

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Substation Assets

The following pages detail 5-year projections for Long-Term Infrastructure Improvements initiatives that apply to distribution substation assets. These assets include, 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

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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

Projects	Voltage	2016	2017
Original LTIP	12 kV	31-37	32-37
Future YR Adjusted / Current YR Actual		65-70/ 67	15-20
Original LTIP	69 kV	1-5	0-3
Future YR Adjusted / Current YR Actual		0-4/2	0-2

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Locations

Region	2016 Actuals
Lehigh	14
Northeast	5
Central	12
Susquehanna	10
Harrisburg	18
Lancaster	10

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$4.27M	\$3.64M
Future YR Adjusted / Current YR Actual	\$14.39M / \$10.15M	\$3.36M

Comments:

In 2016, program costs came in as expected based on forecasted spend. The number of circuit breaker replacements in 2017 is lower than the original LTIP filing due to the reprioritization of PPL Electric's investment strategy.

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 12 per year, averaged over a five-year period.

The average age of assets identified for replacement is 52 years; 14 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

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Projects	2016	2017
Original LTIP	3-7	13-17
Future YR Adjusted / Current YR Actual	5-7/ 6	0-2

Locations

Region	2016 Actual
Lehigh	1
Northeast	3
Central	0
Susquehanna	1
Harrisburg	1
Lancaster	0

Planned Expenditures

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

Planned Expenditures	2016	2017
Original LTIP	\$5.27M	\$4.50M
Future YR Adjusted / Current YR Actual	\$5.35M /\$.89M	\$.11M

Comments:

PPL Electric has adopted a system wide design standard for new substations. As transformers are evaluated for replacement, PPL Electric will determine if the substation should be upgraded to this design standard. This design standard provides increased reliability for customers. In 2016, program costs came in as expected based on our forecasted spend, with some carry over costs into 2017. There is currently no 2017 program scope for the replacement program due to the reprioritization of our investment strategy.

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.

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

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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.

Projects	2016	2017
Original LTIP	5-8	5-8
Future YR Adjusted / Current YR Actual	3-7/0	40-50

Locations

Region	2016 Actual
Lehigh	0
Northeast	0
Central	0
Susquehanna	0
Harrisburg	0
Lancaster	0

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$1.00M	\$1.00M
Future YR Adjusted / Current YR Actual	\$0M / \$.2M	\$1.22M

Comments:

There were no jobs that went into service as a part of this program in 2016, due to the reprioritization of our investment strategy. In 2016, the Protection and Control work was bundled with the circuit breaker replacement work. Actual spend in 2016 represents carry over costs from 2015. For 2017, a new design standard for all feeder relays was developed by Distribution Protection and Distribution Substation Design Engineering; this is to provide a more cost-effective protection and control scheme at all of our substations. 2017 and 2018 will act as pilot years in order to increase efficiency with engineering and implementing this new design standard.

Cross-Yard 12 kV Underground Ties

Program Description and Purpose

Programmatic replacement of underground substation cables to maintain reliable service.

Identification/Justification Process

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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; 85 of these assets are over 40 years old.

Scope

Projects	2016	2017
Original LTIP	15-25	15-25
Future YR Adjusted / Current YR Actual	12-18/ 7	5-10

Locations

Region	2015 Actual
Lehigh	0
Northeast	0
Central	1
Susquehanna	2
Harrisburg	0
Lancaster	4

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$1.11M	\$1.13M
Future YR Adjusted / Current YR Actual	\$.92M / \$.68M	\$.56M

Comments:

In 2016, program costs came in as expected based on our forecasted spend. The work scope for 2017 is consistent with 2016 spend based on the reprioritization of our investment strategy.

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.

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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

Planned Expenditures	2016	2017
Original LTIP	\$1.15M	\$1.19M
Future YR Adjusted / Current YR Actual	\$2.15M / \$3.00M	\$2.45M

Comments:

PPL Electric has experienced increased failure rates of miscellaneous substation equipment in 2016 attributed primarily to aging components. In response, PPL Electric began an extensive, top-to-bottom substation condition review program to proactively identify ailing equipment and replace prior to failure. Deteriorated assets may also be replaced proactively based on certain test data that is collected in the field.

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.

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Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$0.01M	\$0.01M
Future YR Adjusted / Current YR Actual	\$0/ \$0	\$0

Comments:

The 2016 budget was determined based on historical failure trends. There is no budget allocated for this program in 2017 based upon these low historical failure rates.

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 six-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, 96 devices will be beyond their expected life by the time of replacement.

Scope

Projects	2016	2017
Original LTIP	22-28	22-28
Future YR Adjusted / Current YR Actual	25-25/ 23	10-15

Locations

Region	2016 Actual
Lehigh	4
Northeast	4
Central	4
Susquehanna	5
Harrisburg	1

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Lancaster	5
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Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$.39M	\$.39M
Future YR Adjusted / Current YR Actual	\$.30M / \$.19M	\$.15M

Comments:

In 2016, program costs came in as expected based on our forecast. The program work for 2017 is consistent with 2016, however, it is lower than our original LTIP filing due to the reprioritization of our investment strategy.

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, 120V batteries, lightning arresters, 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 24 pieces of equipment scheduled to be replaced per year over the next six-year period. The average age of assets identified for replacement is 47 years. These assets are of vintages between 1947 and 2000. Approximately 90 of these assets are projected to have exceeded their expected life by the time they are replaced.

Scope

Projects	2016	2017
Original LTIP	20-25	22-27
Future YR Adjusted / Current YR Actual	12-15/ 8	8-12

Locations

Region	2016 Actual
Lehigh	2
Northeast	0
Central	3

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Susquehanna	1
Harrisburg	0
Lancaster	2

Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$.99M	\$1.73M
Future YR Adjusted / Current YR Actual	\$.47M / \$.20M	\$.34M

Comments:

This program was on track based on projections. Projections for 2017 are lower than originally estimated due to the reprioritization of our investment strategy.

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

Installations in Units	2016	2017
Original LTIP	45-55	35-45
Future YR Adjusted / Current YR Actual	30-40/ 25	18-20

Locations

Region	2016 Actual
Lehigh	6
Northeast	8
Central	4
Susquehanna	0
Harrisburg	1
Lancaster	6

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Planned Expenditures

Planned Expenditures	2016	2017
Original LTIP	\$2.57M	\$2.68M
Future YR Adjusted / Current YR Actual	\$2.68M / \$1.08M	\$1.7M

Comments:

In 2016, some work was deferred in order to better coordinate with the planned outage schedule. Therefore, some of the 2017 work scope consists of remaining work from 2016. Of the remaining substations left to animal guard under PPL's new standards, a smaller percentage of substation are planned for 2017 due to a reprioritization of our investment strategy to continue to drive reliability improvements.