

**PPL Electric Utilities Corporation**

**Annual Asset Optimization Plan**

**March 2016**

# 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 (“LTIIP”) 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 LTIIP 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 LTIIP 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 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 LTIIIP 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 LTIIIP, including information on modification of a utility's LTIIIP, 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 LTIIIP must contain and outlines the procedure and process for filing and review of LTIIIPs 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. See, 52 Pa. Code Section 121.1, et seq.

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 the Commission's various 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 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.

PPL Electric filed an LTIIIP on September 18, 2012 at Docket No. P-2012-2325034. In preparing its LTIIIP, PPL Electric followed the guidelines established in the Commission's August 2, 2012 Final Implementation Order. The Company's LTIIIP was approved as filed on January 10, 2013. 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.

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Within the LTIIP, 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 LTIIP. The AAOP provides original projections (LTIIP), revised projections (2015 AAOP) and actual replacement numbers for 2015, and original and revised projections for 2016. PPL Electric maintained the project description provided in the LTIIP, 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 on page 8 shows, in 2015 PPL Electric slightly exceeded the original amount it projected to spend on DSIC eligible projects. The Company anticipates that it will be slightly under the original LTIIP projections in 2016.

The Distribution Asset Planning process employed by PPL Electric has been focused on maintaining reliability at or above 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 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.

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	2011	2012	2013	2014	2015
<b>SAIFI (Benchmark = 0.98; rolling 12-month Std. = 1.18)</b>	1.071	1.076	0.082	0.92	0.72
<b>CAIDI (Benchmark = 145; Rolling 12-month Std. = 174)</b>	151	152	108	180	118
<b>SAIDI (Benchmark = 142; Rolling 12-month Std. = 205)</b>	162	164	89	165	84
<b>MAIFI</b>	5.033	4.11	3.54	3.26	4.2
<b>Average Number of Customers Served</b>	1,389,884	1,392,408	1,395,325	1,399,535	1,405,701
<b>Number of Sustained Customer Interruptions (Trouble Cases)</b>	18,403	16,384	14,400	17,388	14,973
<b>Number of Customers Affected</b>	1,489,203	1,497,660	1,140,583	1,284,603	1,007,983
<b>Customer Minutes of Interruptions</b>	225,087,897	228,143,195	123,601,330	230,750,454	118,547,919
<b>Number of Customer Momentary Interruptions</b>	6,994,790	5,716,569	4,936,544	4,559,353	5,886,251

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.

YEAR	PPL	COC	Total
2015	284	105	389
2016	287	107	394

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Infrastructure Initiative	2015 LTIP	2015 Actual	2016 LTIP	2016 Forecast
12 kV Underground Getaway Cables	\$5.80	\$3.94	\$6.13	\$5.64
Capacitors	\$0.28	\$0.03	\$0.36	\$0.60
Circuit SAIDI Improvement	\$8.76	\$2.34	\$11.21	\$0.53
Copper Weld Copper	\$5.92	\$2.78	\$6.11	\$0.54
Cross-Yard 12 kV Underground Tie	\$1.09	\$1.35	\$1.11	\$0.92
C-Truss Distribution Poles	\$1.57	\$1.90	\$1.60	\$2.39
Customers Experiencing Multiple Interruptions	\$2.44	\$1.59	\$3.42	\$2.97
Distribution Animal Guarding	\$1.52	\$0.64	\$0.84	\$0.76
Distribution Automation Development	\$21.29	\$26.51	\$22.74	\$24.87
Distribution Failed Equipment	\$13.88	\$15.00	\$14.01	\$14.69
Distribution Pole Replacements	\$4.40	\$7.02	\$4.43	\$11.21
Distribution Reliability Preservation	\$7.27	\$8.97	\$9.62	\$6.03
Distribution Substation Circuit Breakers	\$4.30	\$6.69	\$4.27	\$14.39
Distribution Substation DC Equipment	\$0.39	\$0.24	\$0.39	\$0.30
Fiber Wrap Distribution Poles	\$1.57	\$1.72	\$1.62	\$3.06
Improve System Reliability Projects	\$15.31	\$13.28	\$15.95	\$6.22
Low Tension Network Primary Cable, Equipment and Structures	\$4.61	\$8.53	\$4.64	\$3.91
Miscellaneous Substation Equipment	\$1.67	\$1.07	\$0.99	\$0.47
New Hydraulic Reclosers	\$0.62	\$0.40	\$0.50	\$0.29
Protection and Control	\$1.00	\$0.54	\$1.00	\$0.00
Recloser Replacements	\$5.76	\$5.22	\$4.77	\$4.38
Reliability Preservation Emergent	\$1.55	\$1.97	\$1.59	\$2.04
Repair Failed 138/69 12 kV Transformers	\$1.14	\$0.00	\$0.01	\$0.05
Replace Deteriorated/Failed Low-Tension Network Equipment and Structures	\$1.34	\$1.44	\$1.37	\$0.94
Replace Deteriorated/Failed Area Supply Substation Equipment	\$1.12	\$2.15	\$1.15	\$2.15
Replace Failed 12kV Underground Getaway Cable	\$0.48	\$1.69	\$0.49	\$1.02
Replace Failed Underground Primary Cable	\$3.50	\$5.44	\$3.62	\$4.45
Replace Failed Underground Secondary Cable	\$1.95	\$6.34	\$1.96	\$5.18
Substation 69/12 kV Transformer Replacement	\$3.40	\$1.52	\$5.27	\$5.35
Substation Animal Guarding	\$2.55	\$2.04	\$2.57	\$2.68
Underground Residential Development Cable Replacement and Life Extension	\$9.97	\$7.33	\$10.16	\$10.21
Unreimbursed Highway Relocations	\$3.05	\$2.78	\$3.14	\$3.76
<b>Grand Total</b>	<b>\$139.50</b>	<b>\$142.44</b>	<b>\$147.04</b>	<b>\$141.99</b>
<i>*Dollars in Millions</i>				

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 2015 and revised projections for calendar year 2016. 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.

<b>Replacements in Units</b>	<b>2015</b>	<b>2016</b>
Original LTIP	600-800	600-800
<b>Future YR Adjusted / Current YR Actual</b>	<b>1200-1400/ 1,169</b>	<b>1640- 1815</b>

### 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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$4.40M	\$4.43M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$7.18M/ \$7.02M</b>	<b>\$11.21M</b>

### Comments:

In 2015, the overall inspection failure rate remained steady at 8.2%. 79.1% of all failures were able to be successfully reinforced, including 18.4% 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 (2018).

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In 2015, PPL Electric increased the volume of pole inspections by 17%, or an additional 15,270 poles. In 2016, the Company is planning to inspect 68,000 poles using a full excavation and treatment regimen.

In 2016, PPL Electric is planning to increase the rigor of the pole inspection program and move to a full excavation and treatment program instead of the part partial excavation and treatment program. As a consequence, the Company expects to identify more pole failures that would have otherwise gone unmitigated. Consequently, the percentage of c-tag, c-truss and fiber wrapped poles will increase in 2016 and 2017.

PPL Electric has changed its 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 priority requirement dates, and accelerate the replacement schedule, mitigating the risk of equipment failure.

Last year the Company moved approximately 300 poles from being replaced in 2015 to 2016 – which will directly increase the poles replaced in 2016 by those 300. Along with the poles originally identified in 2015 as 2016 work, and the poles we expect to c-tag with required by dates in 2016, the Company is expecting to replace 1729 poles in 2016.

## 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

<b>Reinforcements in Units</b>	<b>2015</b>	<b>2016</b>
Original LTIP	2800-3200	2800-3200
<b>Future YR Adjusted / Current YR Actual</b>	<b>5400-5900/5,254</b>	<b>3380-3735</b>

### Locations

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

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### Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$1.57M	\$1.60M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$3.07M/ \$1.90M</b>	<b>\$2.39M</b>

### Comments:

In 2015, PPL Electric increased the volume of pole inspections by 17% over the scheduled 90,000, or an additional 15,270 poles, to a total of 105,270 poles. In 2016, the Company is planning to inspect 68,000 poles using a full excavation and treatment regimen.

In 2016, PPL Electric is planning to increase the rigor of the pole inspection program and move to a full excavation and treatment program instead of the part partial excavation and treatment program. Every pole inspected in 2016 will be fully dug out to a depth of 18" and treated with preservative unless marked as a reject. The partial excavation process was to excavate to the depth of one foot on two sides of a pole, without preservative treatment on every pole.

As a consequence, PPL Electric expects to identify more pole failures that would have otherwise gone unmitigated. Consequently, the percentage of c-tag, C-Truss and fiber wrapped poles will increase in 2016. However, since the Company is inspecting 35% fewer poles, the absolute quantity of C-Trussed poles should decrease.

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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

<b>Fiber Wrap in Units</b>	<b>2015</b>	<b>2016</b>
Original LTIP	700-900	700-900
<b>Future YR Adjusted / Current YR Actual</b>	<b>1250-1450/ 1,253</b>	<b>1025-1130</b>

### Locations

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

### Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$1.57M	\$1.62M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$3.32M/\$1.72M</b>	<b>\$3.06M</b>

### Comments:

In 2015, PPL Electric increased the volume of pole inspections by 17% over the scheduled 90,000, or an additional 15,270 poles, to a total of 105,270 poles. In 2016, we are going to inspect 68,000 poles using a full excavation and treatment regimen.

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In 2016, PPL Electric is planning to increase the rigor of the pole inspection program and move to a full excavation and treatment program instead of the part partial excavation and treatment program. Every pole inspected in 2016 will be fully dug out to a depth of 18” and treated with preservative unless marked as a reject. The partial excavation process was to excavate to the depth of one foot on two sides of a pole, without preservative treatment on every pole.

As a consequence, the Company expects to identify more pole failures that would have otherwise gone unmitigated. Consequently, the percentage of c-tag, C-Truss and fiber wrapped poles will increase in 2016. However, since PPL Electric is inspecting 35% fewer poles, the absolute quantity of Fiber Wrap poles should decrease.

## 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	2015	2016
Original LTIIP	700-1000	600-900
<b>Future YR Adjusted / Current YR Actual</b>	<b>100-125/ 110</b>	<b>90-110</b>

### Locations

Region	2015 Actual
Lehigh	7
Northeast	11
Central	26
Susquehanna	17
Harrisburg	26
Lancaster	23

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## Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$5.76M	\$4.77M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$4.44M/ \$5.22M</b>	<b>\$4.38M</b>

## 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 2016, the projected scope and budget are in line with the Company's original LTIP filing.

## 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

<b>Installations in Units</b>	<b>2015</b>	<b>2016</b>
Original LTIP	17-23	17-23
<b>Future YR Adjusted / Current YR Actual</b>	<b>17-23/ 0</b>	<b>60-100</b>

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## Locations

Region	2015 Actual
Lehigh	0
Northeast	0
Central	0
Susquehanna	0
Harrisburg	0
Lancaster	0

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$.28M	\$.36M
Future YR Adjusted / Current YR Actual	\$0/ \$.02	\$0.60M

## 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. 2016 forecasted spend has been modified from the original LTIP filing to support these changes.

## *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.

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## Scope

<b>Installations in Units</b>	<b>2015</b>	<b>2016</b>
Original LTIP	15-20	10-15
<b>Future YR Adjusted / Current YR Actual</b>	<b>35-40/ 28</b>	<b>20-30</b>

## Locations

<b>Region</b>	<b>2015 Actual</b>
Lehigh	2
Northeast	3
Central	11
Susquehanna	7
Harrisburg	5
Lancaster	0

## Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$.62M	\$.50M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$.73M/ \$.40M</b>	<b>\$.29M</b>

## Comments:

In 2015, fewer single-phase hydraulic reclosers were installed in favor of installing intelligent vacuum circuit reclosers with remote capability as part of the Smart Grid initiative. Due to the change of the recloser refurbishments program scope focusing only on three-phase reclosers, this budget will include the new installation of single phase hydraulic reclosers and installation of larger single-phase hydraulic reclosers to replace single phase reclosers that potentially could be overloaded.

## **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.

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## Scope

Areas To Address	2015	2016
Original LTIP	40-60	20-40
<b>Future YR Adjusted / Current YR Actual</b>	<b>125-175/ 229</b>	500-700

## Locations

Region	2015 Actual
Lehigh	50
Northeast	12
Central	71
Susquehanna	72
Harrisburg	15
Lancaster	9

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$1.52M	\$.84M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$1.27M/ \$.64M</b>	<b>\$.76M</b>

## 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.

## **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

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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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$13.88M	\$14.01M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$12.10M /\$15.0M</b>	<b>\$14.69M</b>

### Comments:

The program cost increased in 2015 based on an increase in the cost of recloser replacements which are now being using a more expensive smart grid recloser.

## *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.

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## Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIIP	\$3.50M	\$3.62M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$3.29M/ \$5.44M</b>	<b>\$4.45M</b>

## Comments:

In 2015, PPL Electric saw a higher amount of failures than normal, due to aging assets which is why the actuals are more than forecasted. The 2015 actuals were also higher due to the unpredictable cost of boring new cable. This is the nature of this type of work and it heavily depends on the area and ground conditions. Due to this pattern, the Company is increasing its original 2016 forecast based on the 2015 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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIIP	\$1.95M	\$1.96M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$4.33M/\$6.34M</b>	<b>\$5.18M</b>

## Comments:

The spending on failed secondary replacements was higher than projected in 2015 due to an increased number of replacements. Because many underground secondary cables are reaching the end of their

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expected life, a decision was made to eliminate the budget for the repair of failed secondary cables and replace all failed secondary cables in order to reduce the number of customers affected by failed secondary cables in the future. The Company has increased its original 2016 forecast based on the actuals from 2015 and the elimination of the repair program.

### **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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIIP	\$ .48M	\$ .49M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$.94M/ \$1.69M</b>	<b>\$1.02M</b>

#### Comments:

Historically, this program replaces any failed cables. In addition, program scope has been modified to replace any cables that have failed a diagnostic test due to the high probability of future outages to customers. There was an increase in the spending for cable failures in 2015 because the cost for replacements was higher than projected as well as new specifications mandating the use of copper conductor. As a result, the budget has been increased in 2016 to address this projected unit cost increase.

### **Replace Deteriorated/Failed Low Tension Network (LTN) Equipment and Structures**

#### Program Description and Purpose

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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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$1.34M	\$1.37M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$1.18M/ \$1.44M</b>	<b>\$.94M</b>

### Comments:

The 2015 budget overrun was mainly driven by two work orders which were a result of deteriorated sections of cables that caused multiple trips on PPL Electric's system. The replacement of these sections has alleviated the weakness in the LTN system. These replacements along with other proactive measures have allowed the Company to lower its 2016 forecast for failed/deteriorated equipment.

### ***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

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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 Sections	Treatment	2015	2016
Original LTIP	<b>Replacement After Test</b>	350-400	400-450
<b>Future YR Adjusted / Current YR Actual</b>	<b>Replacement After Test</b>	<b>175-250/ 200-250</b>	<b>150-225</b>
Original LTIP	<b>Cure</b>	750-800	750-800
<b>Future YR Adjusted / Current YR Actual</b>	<b>Cure</b>	<b>700-750/ 623</b>	<b>725-775</b>
Original LTIP	<b>Proactive Replacement</b>	150-200	150-200
<b>Future YR Adjusted / Current YR Actual</b>	<b>Proactive Replacement</b>	<b>105-125/ 105-125</b>	<b>110-250</b>

### Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$9.97M	\$10.16M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$10.12M/ \$7.33M</b>	<b>\$10.21M</b>

### Comments:

In 2015, PPL Electric was forecasting a larger number of cable segments to be cured. The Company was on target to meet its curing goal, as well as proactive replacement for 2015, but due to reprioritizing its investment strategy, the Company stopped the program earlier than originally planned causing the costs to come in lower than forecasted. The Company is planning to meet its goal for 2016.

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## 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

Replacements in Units		2015	2016
Original LTIP	<b>Lead Cable (miles)</b>	0	0
<b>Future YR Adjusted / Current YR Actual</b>	<b>Lead Cable (miles)</b>	.5/ .4	0
Original LTIP	<b>LTN Equipment</b>	50-70	50-70
<b>Future YR Adjusted / Current YR Actual</b>	<b>LTN Equipment</b>	30-40/ 28	15-25

### Locations

Region	2015 Actual
Lehigh	9
Northeast	8
Central	2
Susquehanna	1
Harrisburg	5
Lancaster	3

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## Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$4.61M	\$4.64M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$6.75M/ \$8.53M</b>	<b>\$3.91M</b>

## Comments:

In 2015, PPL Electric replaced less equipment than originally forecasted due to other LTN work that took priority. This was mostly the result of LTN Secondary cable replacement being done under the LTN equipment budget. Since this work had a high dollar value, costs came in higher than forecasted in 2015. Since then, a LTN Secondary Cable replacement program was started but was put on hold due to reprioritizing the Company's investment strategy. The 2016 forecast was decreased due to multiple factors. These factors included budget priorities in future years, consulting recommendations, and benchmarking results.

This program was tracked by number of projects (or Work Orders) because the original measurement in the LTIP could not be tracked in the Company's asset management tool. The expenditures were not impacted by 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

<b>Replacements in Units</b>	<b>2015</b>	<b>2016</b>
Original LTIP	60-65	60-65
<b>Future YR Adjusted / Current YR Actual</b>	<b>30-40/ 27</b>	<b>30-40</b>

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## Locations

Region	2015 Actual
Lehigh	6
Northeast	5
Central	5
Susquehanna	4
Harrisburg	1
Lancaster	6

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$5.80M	\$6.13M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$5.48M/ \$3.94M</b>	<b>\$5.64M</b>

## Comments:

In 2015, PPL Electric replaced fewer cables than forecasted due to a reprioritization of the Company's investment strategy to continue to drive reliability improvements and funding being moved to other LTIP projects with a higher reliability benefit. In 2016, the forecast for the number of unit replacements has decreased by almost half due to the adjusted unit rate for getaway replacement. This unit rate has increased due to the increased cost in material and the high cost of boring. The budget has also slightly decreased for 2016 due to reprioritizing the investment strategy. The Company is still on track to replace the number of forecasted units in 2016.

## **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.

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## Scope

<b>Projects</b>	<b>2015</b>	<b>2016</b>
Original LTIIIP	29-31	30-32
<b>Future YR Adjusted / Current YR Actual</b>	<b>18-22/ 25</b>	<b>1-5</b>

## Locations

<b>Region</b>	<b>2015 Actual</b>
Lehigh	8
Northeast	2
Central	5
Susquehanna	5
Harrisburg	2
Lancaster	3

## Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIIIP	\$5.92M	\$6.11M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$4.48M/ \$2.78M</b>	<b>\$0.53M</b>

## Comment:

This program was tracked by number of projects (or Work Orders) because the original measurement in the LTIIIP could not be tracked in the Company's asset management tool. The expenditures were not impacted in how this program is now being measured.

The program was modified to break existing work into smaller projects, which impacted the composite of work (scope and dollars) in each year.

## *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.

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## 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	2015	2016
Original LTIP	15-35	15-35
<b>Future YR Adjusted / Current YR Actual</b>	<b>15-30/ 12</b>	<b>15-30</b>

## Locations

Locations are identified based upon emergent reliability needs.

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$2.44M	\$3.42M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$2.21M/ \$1.59M</b>	<b>\$2.97M</b>

## 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. In order to support other capital improvements in 2015, lower priority work was moved to later years, resulting in a lower than anticipated spend in 2015.

## **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.

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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

<b>Projects</b>	<b>2015</b>	<b>2016</b>
Original LTIP	150-300	150-300
<b>Future YR Adjusted / Current YR Actual</b>	<b>250-350/ 291</b>	<b>150-250</b>

### Locations

Locations are identified based upon emergent reliability needs.

### Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$7.27M	\$9.62M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$8.79M/ \$8.97M</b>	<b>\$6.03M</b>

### Comments:

For 2016, the Company's investment strategy was reprioritized to continue to drive reliability improvements which align with the original LTIP.

### **Reliability Preservation Emergent**

### Program Description and Purpose

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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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$1.55M	\$1.59M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$1.81M/ \$1.97M</b>	<b>2.04M</b>

## Comments:

The overrun in 2015 was in line with historical trend of actual spend, which resulted in adjusting the budget for 2016 to support this trend.

## **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.

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

### Scope

<b>Installations in Units</b>	<b>2015</b>	<b>2016</b>
Original LTIP	150-300	150-300
<b>Future YR Adjusted / Current YR Actual</b>	<b>50-60/ 64</b>	<b>5-10</b>

### Locations

<b>Region</b>	<b>2015 Actual</b>
Lehigh	15
Northeast	2
Central	16
Susquehanna	13
Harrisburg	13
Lancaster	5

### Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$8.76M	\$11.21M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$1.97M/ \$2.34M</b>	<b>\$.53M</b>

### Comments:

In 2014, the last of the motorized switches were installed or retrofitted which resulted in less spend than anticipated. 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

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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

<b>Substation Upgrades</b>	<b>Voltage</b>	<b>2015</b>	<b>2016</b>
Original LTIIP	138/69-12 kV	24	25
<b>Future YR Adjusted / Current YR Actual</b>	<b>138/69-12 kV</b>	<b>0</b>	<b>0</b>

<b>Device Upgrades</b>	<b>Voltage</b>	<b>2015</b>	<b>2016</b>
Original LTIIP	12 kV	350-375	505-530
<b>Future YR Adjusted / Current YR Actual</b>	<b>12 kV</b>	<b>550-600/619</b>	<b>550-600</b>

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

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## Locations

Region	2015 Actual
Lehigh	0
Northeast	0
Central	0
Susquehanna	0
Harrisburg	0
Lancaster	0

Region	2015 Actual
Lehigh	153
Northeast	77
Central	93
Susquehanna	79
Harrisburg	77
Lancaster	140

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$21.29M	\$22.74M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$23.40M/ \$26.5M</b>	<b>\$24.87M</b>

## Comments:

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 WPCs. 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 its 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.

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## 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

<b>Projects</b>	<b>2015</b>	<b>2016</b>
Original LTIP	10-25	10-25
<b>Future YR Adjusted / Current YR Actual</b>	<b>10-15/ 10</b>	<b>5-15</b>

### Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$15.31M	\$15.95M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$9.51M/ \$13.28M</b>	<b>\$6.22M</b>

### Comments:

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

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## 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.

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$3.05M	\$3.14M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$4.67M/ \$2.78M</b>	<b>\$3.76M</b>

### Comments:

Changing PennDOT construction schedules and uncertainties from incomplete highway construction designs continue to complicate forecasting more than six months into the future. PennDOT's tendency to schedule work two and three years in advance leads to initial estimates normally preceding PPL Electric issuance of engineering design. Frequently receiving incomplete designs from PennDOT and/or its contractors during preliminary engineering tends towards engineering changes during the project, further complicating forecasting and increasing inaccuracies.

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PennDOT initiated a state wide “Rapid Bridge Replacement” program starting in 2015. Between 2015 and 2017 this program adds 96 projects across the PPL Electric service territory. In 2015 22 projects were completed. Remaining projects are 36 for 2016 and 38 for 2017 in addition to the typical 70 to 120 relocation projects per year. Projects within this program occur on compressed timelines with incomplete plans from PennDOT’s contractor. Coupled with PennDOT’s regularly scheduled road work PPL Electric expects to increase its relocation costs in 2016 and beyond.

### **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

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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

<b>Projects</b>	<b>Voltage</b>	<b>2015</b>	<b>2016</b>
Original LTIP	12 kV	32-37	31-37
<b>Future YR Adjusted / Current YR Actual</b>		<b>30-35/ 31</b>	<b>65-70</b>
Original LTIP	69 kV	1-5	1-5
<b>Future YR Adjusted / Current YR Actual</b>		<b>0-4/2</b>	<b>0-4</b>

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## Locations

Region	2015 Actuals
Lehigh	8
Northeast	0
Central	3
Susquehanna	1
Harrisburg	14
Lancaster	7

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$4.30M	\$4.27M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$6.79M/ \$6.69M</b>	<b>\$14.39M</b>

## Comments:

In 2015, program costs came in as expected based on the Company's forecasted spend. The 2016 program scope is forecasted higher than the original LTIP filing due to an increased unit rate which was a result of a new standard of breaker and additional scope being identified for replacement in an effort to address more aging assets.

## **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.

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## Scope

<b>Projects</b>	<b>2015</b>	<b>2016</b>
Original LTIP	13-17	3-7
<b>Future YR Adjusted / Current YR Actual</b>	<b>2-3/ 5</b>	<b>5-7</b>

## Locations

<b>Region</b>	<b>2015 Actual</b>
Lehigh	2
Northeast	2
Central	0
Susquehanna	0
Harrisburg	1
Lancaster	0

## Planned Expenditures

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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$3.40M	\$5.27M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$4.13M/\$1.52M</b>	<b>\$5.35M</b>

## 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 2015, program spend was more in line with the original LTIP filing. 2016 scope and spend is consistent with this trend.

## **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.

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## 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.

<b>Projects</b>	<b>2015</b>	<b>2016</b>
Original LTIP	5-8	5-8
<b>Future YR Adjusted / Current YR Actual</b>	<b>3-6/2</b>	<b>3-7</b>

## Locations

<b>Region</b>	<b>2015 Actual</b>
Lehigh	1
Northeast	1
Central	0
Susquehanna	0
Harrisburg	0
Lancaster	0

## Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$1.00M	\$1.00M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$1.17M/ \$.54M</b>	<b>\$0M</b>

## Comments:

In this program, work can vary in size and scale. In 2015, three projects were deferred to better align relay upgrades with the planned circuit breaker replacement schedule. For 2016, the Relay and Protection work is bundled with the circuit breaker replacement work.

## **Cross-Yard 12 kV Underground Ties**

### Program Description and Purpose

Programmatic replacement of underground substation cables to maintain reliable service.

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## 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; 85 of these assets are over 40 years old.

## Scope

<b>Projects</b>	<b>2015</b>	<b>2016</b>
Original LTIP	15-25	15-25
<b>Future YR Adjusted / Current YR Actual</b>	<b>20-30/ 18</b>	<b>12-18</b>

## Locations

<b>Region</b>	<b>2015Actual</b>
Lehigh	5
Northeast	0
Central	2
Susquehanna	4
Harrisburg	3
Lancaster	4

## Planned Expenditures

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$1.09M	\$1.11M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$1.47M/ \$1.35M</b>	<b>\$.92M</b>

## Comments:

As a consequence of reprioritizing the investment strategy in 2015, some work was deferred resulting in a lower than planned replacement schedule. In 2016, the planned scope is in line with the Company's original plan.

## **Replace Deteriorated/Failed Area Supply Substation Equipment**

### Program Description and Purpose

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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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$1.12M	\$1.15M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$2.10M/ \$2.15M</b>	<b>\$2.15M</b>

## Comments:

PPL Electric has experienced increased failure rates of miscellaneous substation equipment in 2015, attributed primarily to aging components. This trend is likely to continue in 2016. However, in response, PPL Electric began an extensive, top-to-bottom substation condition review program to proactively identify ailing equipment and replace it prior to failure.

## **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

<b>Planned Expenditures</b>	<b>2015</b>	<b>2016</b>
Original LTIP	\$1.14M	\$.01M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$.33M/ \$0</b>	<b>\$0</b>

## Comments:

PPL Electric experienced one transformer failure in 2015, however the Company decided not to repair it due to the extent of condition. The 2016 budget was determined based on historical failure trends.

## **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

<b>Projects</b>	<b>2015</b>	<b>2016</b>
Original LTIP	22-28	22-28
<b>Future YR Adjusted / Current YR Actual</b>	<b>22-28/ 28</b>	<b>25-25-31</b>

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## Locations

Region	2015 Actual
Lehigh	9
Northeast	6
Central	4
Susquehanna	4
Harrisburg	1
Lancaster	4

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIIP	\$ .39M	\$ .39M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$ .34M/ \$ .24M</b>	<b>\$ .30M</b>

## Comments:

This program was on track based on projections. Projections for 2016 are consistent with original estimates.

## *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	2015	2016
Original LTIIP	20-25	20-25
<b>Future YR Adjusted / Current YR Actual</b>	<b>20-25/ 16</b>	<b>12-15</b>

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## Locations

Region	2015 Actual
Lehigh	0
Northeast	0
Central	10
Susquehanna	3
Harrisburg	1
Lancaster	2

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$1.67M	\$.99M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$1.49M/ \$1.07M</b>	<b>\$.47M</b>

## Comments:

This program was on track based on projections. Projections for 2016 are lower than originally estimated due to reprioritization of the Company's investment strategy to continue to drive reliability improvements.

## *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	2015	2016
Original LTIP	45-55	45-55
<b>Future YR Adjusted / Current YR Actual</b>	<b>50-60/ 38</b>	<b>30-40</b>

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## Locations

Region	2015 Actual
Lehigh	9
Northeast	6
Central	7
Susquehanna	3
Harrisburg	6
Lancaster	7

## Planned Expenditures

Planned Expenditures	2015	2016
Original LTIP	\$2.55M	\$2.57M
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$2.55M/ \$2.04M</b>	<b>\$2.68M</b>

## Comments:

In 2015, some work was deferred in order to better coordinate with the planned outage schedule. Of the remaining substations left to animal guard under PPL Electric's new standards, a smaller percentage of substations is planned for 2016 due to a reprioritization of the Company's investment strategy to continue to drive reliability improvements.

