

# **PPL Electric Utilities Corporation**

## **Long-Term Infrastructure Improvement Plan**

# PPL Electric Utilities Corporation

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## **Introduction**

This document is being submitted pursuant to the requirements of Subchapter B, Distribution Systems, of the Public Utility Code, 66 Pa.C.S. §§ 1350-1360, and the Public Utility Commission's ("PUC") Implementation Order for Establishment of a Distribution System Improvement Charge, entered on August 2, 2012 at Docket No. M-2012-2293611. It addresses a broad spectrum of Distribution Asset Management initiatives which comprise PPL Electric Utilities Corporation's ("PPL Electric") Long-Term Infrastructure Improvement Plan.

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

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

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

## **Reliability Experience**

The Distribution Asset Planning process employed by PPL Electric has been focused on maintaining reliability at the level that existed prior to passage of the Electricity Generation Customer Choice and Competition Act ("Customer Choice Act"). Since the 1994-1998 benchmark period, which defines PPL Electric's reliability performance targets, PPL Electric's service reliability has experienced annual swings, positive and negative, resulting largely from varying weather conditions. Increased and accelerated levels of funding for distribution reliability programs will help to ensure more consistent performance below the PUC benchmark. Historical benchmark performance is illustrated in Figures 1 and 2.

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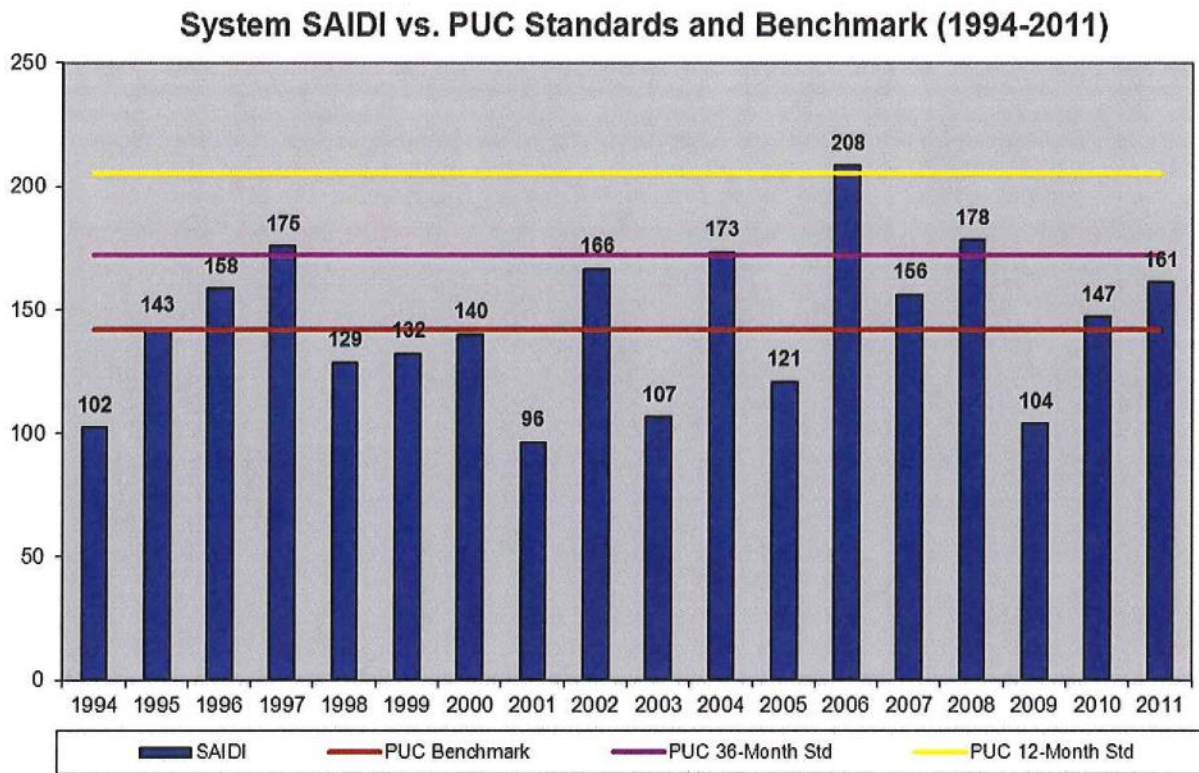


Figure 1: PPL Electric's SAIDI Performance

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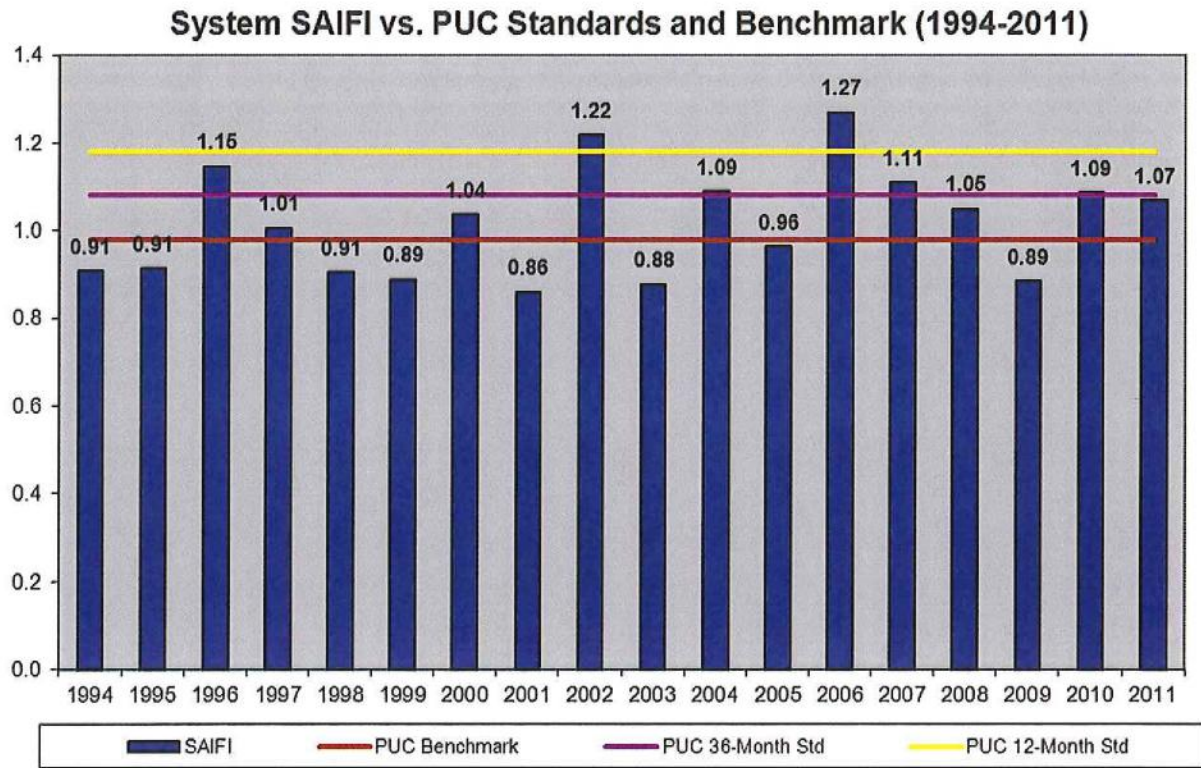
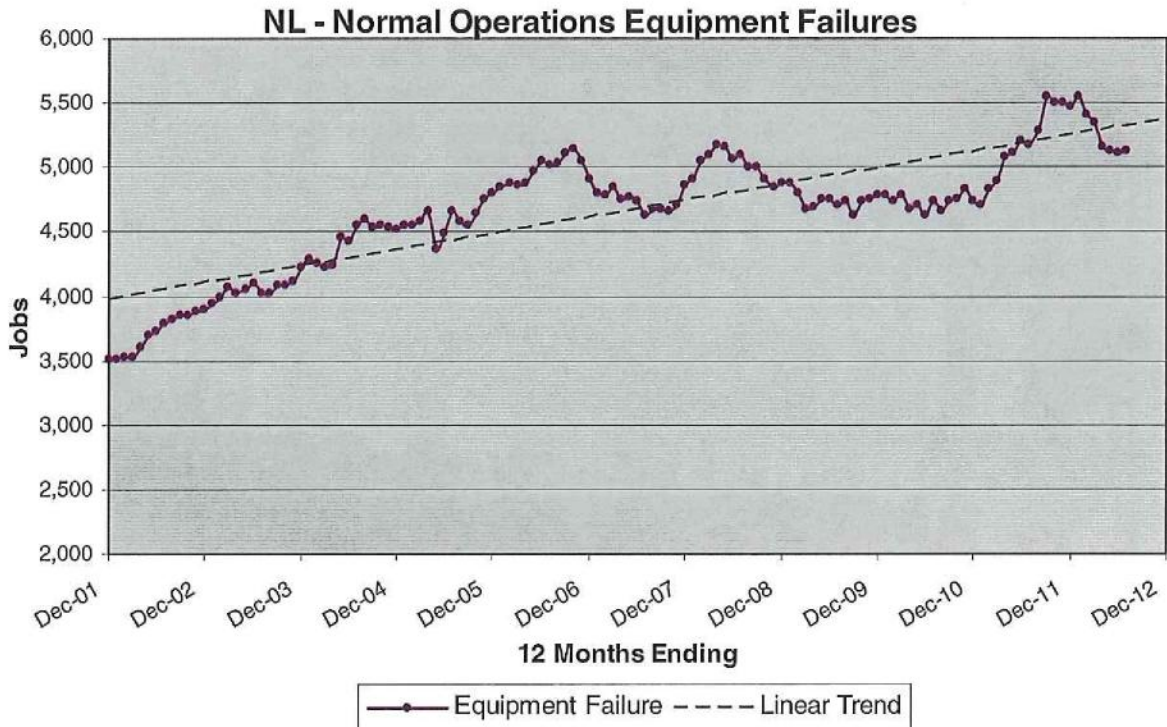


Figure 2: PPL Electric's SAIFI Performance

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



**Figure 3: Equipment Failure Service Interruption Cases**

The annual number of no-light cases due to equipment failures rose through 2006, stabilized for a time, and then resumed its upward trend in 2010. This trend clearly indicates the need to address the increasing rate of equipment failures. Components contributing the most significantly to distribution equipment failures include poles/arms/attachments, overhead conductors, and substation equipment. See Appendix B for further details on asset contribution to reliability metrics.

### **Response to Increasing Equipment Failure Rate**

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

- Analyze the historical trends of causes of service outages and other power service problems.
- Identify the drivers of those trends.
- Forecast future reliability metrics (SAIDI, SAIFI, and CAIDI) given existing mitigation programs' effect on the identified drivers.

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- Identify new programs, policies, and activities to enhance or accelerate existing mitigation programs to avoid forecasted gaps between future reliability and benchmark targets.
- Identify, evaluate, and implement new technologies that enhance the Company's condition monitoring strategy.
- Evaluate and adjust existing programs, policies, and activities to produce the desired future results.
- Incorporate the resulting portfolio of existing and new programs, policies, and activities in PPL Electric's five-year business plan.

In June 2011, PPL Electric's Reliability Principles and Practices ("P&P") were revised to help reduce the overall impact to our customers from outages due to various causes, including but not limited to, equipment failures. The P&P sets forth a set of Principles that PPL Electric follows to plan, protect and operate the Electrical Distribution System ("EDS"). These Principles are implemented through a set of standard Practices that are used as guidelines in designing the EDS. These Practices are reasonable, acceptable and are in accordance with leading utility practices. More specifically, to reduce the number of customers experiencing permanent outages and outage duration over the long term, the following circuit design guidelines are used wherever practical, starting with those identified as Worst Performing Circuits ("WPCs"):

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

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

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

- **Enhanced Pole Inspection/Treatment Program:** Beginning in 2010, the Company's wood pole maintenance program was enhanced from an inspection-only process to an inspection and treatment program, whereby all poles passing inspection are chemically treated to arrest decay and extend useful life at the same visit. The preservative treatment permits the next inspection to be at a uniform ten-year cycle. As an integral part of the ten-year pole inspection process, the inspector observes, notes, and reports at-risk conditions of all pole attachments, specifically crossarms, braces, conductors, transformers, fuse cutouts, lightning arresters, reclosers, regulators, capacitors, switches, wildlife protection, vegetation encroachment, guys, anchors, ground wires, and ground rods.
- **Increased Utilization of Infrared Inspections:** PPL Electric conducted a trial of infrared inspections of multi-phase lines in 2006. The trial inspections cost \$122,500 and identified repairs costing \$100,000, saving an estimated 1,460,000-2,600,000 Customer Minutes Interrupted ("CMI"). Funding of infrared

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inspections and repairs was increased significantly during 2010 and has remained at a higher funding level. Infrared inspections occur on all 3-phase and 2-phase overhead lines adjacent to roadways every two years.

- **Expanded Operational Reviews (“EOR”):** EORs are performed on each feeder on a four-year cycle. The engineering review addresses both operational and reliability characteristics of each circuit. Voltage support, phase balancing, power factor maintenance and loading issues are addressed from an operational perspective. Service reliability analysis, exposure analysis, and field checks address reliability.
- **Distribution Automation Strategy:** In 2010, PPL Electric launched a “smart grid” pilot project that enables the Company to move power more efficiently, react instantaneously to changes on the delivery system, and automatically re-route power around problems that occur. The project focused mainly on the Harrisburg, Pa. area, although all customers will benefit from the introduction of a new centralized distribution management system. Future plans include the installation of hundreds of automated electrical devices through 2018. PPL Electric will upgrade approximately 146 substations and 543 circuits, and will create a secure communications framework to operate devices remotely. The end-result will be a delivery system that operates more efficiently, recognizes problems immediately, and responds in seconds to restore the service for many customers who otherwise need to wait minutes or hours.

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

### Asset Optimization Strategy

The purpose of the AOS study was to develop a strategy for accelerated capital replacement improvements that would combat the anticipated effects of aging infrastructure and bolster PPL Electric’s ability to effectively maintain reliable electric service. A plan was developed to address the predicted wave of equipment failures that would result due to the age distribution of the asset base. The plan includes replacements in kind, as well as upgrades to current standards.

For the distribution system, 17 asset classes were studied consisting of roughly 30 million units of equipment. PPL Electric defined an asset class as a collection of distribution assets grouped by their functional system purpose, such as sectionalizing devices, transformers, conductors, and cables. The distribution system assessment encompassed all distribution lines and associated equipment, equipment within area supply substations, and high voltage switching devices.

PPL Electric used data such as vendor support, availability of replacement parts, vintage performance, field experience, maintenance results, and equipment age, to derive the final health assessment of each asset. The assessment categorized the 17 asset classes into five states of health: ‘poor,’ ‘marginal,’ ‘good,’ ‘very good,’ and ‘excellent.’ For each asset class, individual assets were assigned to one of the five health categories.

The development team recommended a capital plan divided into two distinct replacement strategies. In some cases, such as with distribution substation components, it is more economical to replace on an individual component basis.

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In other cases, such as aging distribution lines, it is more economical and more effective to replace all equipment components on a line section or complete line basis.

### Accelerated Investment

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

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

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

**Figure 4: Original 2008-2012 Capital Investment Plan**

Having concluded the AOS study, PPL Electric began engineering and making large material purchases for the identified proactive and accelerated replacements during 2009, followed by a ramp up period during 2010 and full implementation of the strategy in 2011. PPL Electric has refined processes and work planning efforts in support of the sustained investment levels. Acceleration of capital investment into the distribution infrastructure is illustrated in Figure 5 below. PPL Electric has approximately doubled its investment in DSIC-eligible property since 2009, as a result of the AOS study. The 2013-2017 business plan includes projections for expenditures on DISC-eligible reinvestment that approximates the 2010 through 2012 levels.

	2008	2009	2010	2011	2012*
Asset Optimization Strategy	\$ 115,046	\$ 5,115,041	\$ 19,661,586	\$ 32,667,111	\$ 20,438,113
Improve System Reliability	\$ 7,177,339	\$ 12,470,418	\$ 33,186,012	\$ 39,598,466	\$ 26,672,610
Smart Grid Investment		\$ 100,193	\$ 9,299,164	\$ 7,320,142	\$ 5,458,371
Maintain System Reliability	\$ 33,648,603	\$ 34,407,064	\$ 46,388,673	\$ 47,206,474	\$ 51,980,585
Unreimbursed Highway Relocations	\$ 3,082,209	\$ 3,265,414	\$ 2,521,236	\$ 4,858,351	\$ 2,254,769
<b>Total</b>	<b>\$ 44,023,197</b>	<b>\$ 55,358,131</b>	<b>\$ 111,056,672</b>	<b>\$ 131,650,544</b>	<b>\$ 106,804,448</b>

\*2012 is the forecasted capital spend.

**Figure 5: Accelerated Capital Investment**

The timely recovery of the costs associated with such a large capital appetite is key to ensuring access to the capital markets for financing. Prior to the enactment of Act 11, PPL Electric faced the possibility of requiring more frequent rate cases, perhaps as often as annual filings. The availability of the DSIC mechanism ensures the timely cost recovery of investments in DSIC-eligible property which could result in less frequent and smaller rate increase requests in the future.

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## **Implementation of Long-Term Infrastructure Improvement Plan**

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

PPL Electric routinely reviews the effectiveness of programs to ensure cost-effective investment. Program/project impact on SAIDI and SAIFI, in addition to potential reductions in outage response costs, are compared to the overall program/project costs. PPL Electric utilizes a project prioritization process that defines the cost-effectiveness of programs/projects to ensure effective optimization of reliability investments. PPL Electric currently is exploring the use of ongoing asset health indices to further refine asset replacement criteria.

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

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

## **Utilization of a Qualified Work Force**

### **PPL Electric Workforce**

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

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

PPL's formal training programs are administered by the Technical Development & Improvement ("TD&I") group. The training section of the TD&I group is comprised of approximately 35 full time employees, both training

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professionals and craft employees. Experienced training professionals lead the design and development of the training programs with input from subject matter expertise provided by craft employees from the field. Training program (curriculum) content is approved by a curriculum committee which is comprised of business line managers. The basic job requirement for an instructor includes 5-years of experience performing the work and attainment of Journeyman level (or equivalent) qualifications. Craft instructors are then trained and mentored. Training delivery is governed by PPL Electric policies and procedures to ensure quality and consistency.

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

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

In preparation for turnover associated with an aging workforce, PPL Electric is engaged in multiple initiatives to ensure a sustainable, knowledgeable, well-trained workforce. In 2009, PPL Electric began preparation of a long range Strategic Workforce Plan ("SWP"). The SWP provides a 15+ year analysis of the projected employee turnover by job category and year, projections on worker availability (resource pool), and strategies (both sourcing and recruiting) to ensure the long-term ability to attract, hire, develop, and retain qualified workers.

### Contractor Workforce

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

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

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

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

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

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

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

### **Summary**

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

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

To achieve these results, PPL Electric anticipates the need for the following total capital expenditures over the 2013-2017 period. Note that planned expenditures for certain initiatives can fluctuate yearly due to the various factors identified previously.

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Infrastructure Initiative	Planned Asset Repair/Upgrade/Replacement Expenditures					5 Year Total
	2013	2014	2015	2016	2017	
Distribution Pole Replacements	\$6.61M	\$4.0M	\$4.4M	\$4.43M	\$4.64M	\$24.08M
C-Truss Distribution Poles	\$1.45M	\$1.54M	\$1.57M	\$1.6M	\$2.0M	\$8.16M
Fiber Wrap Distribution Poles	\$3.36M	\$1.58M	\$1.57M	\$1.62M	\$1.5M	\$9.63M
Recloser Replacements	\$6.38M	\$5.72M	\$5.76M	\$4.77M	\$4.92M	\$27.55M
Capacitors	\$0.24M	\$0.23M	\$0.28M	\$0.36M	\$0.26M	\$1.38M
New Hydraulic Reclosers	\$0.81M	\$0.7M	\$0.62M	\$0.5M	\$0.4M	\$3.03M
Distribution Animal Guarding	\$1.06M	\$1.5M	\$1.52M	\$0.84M	\$0.86M	\$5.77M
Distribution Failed Equipment	\$13.35M	\$13.17M	\$13.88M	\$14.01M	\$14.57M	\$68.98M
Replace Failed Underground Primary Cable	\$3.6M	\$3.48M	\$3.5M	\$3.62M	\$3.68M	\$17.88M
Replace Failed Underground Secondary Cable	\$1.83M	\$1.9M	\$1.95M	\$1.96M	\$2.03M	\$9.68M
Replace Failed 12kV Underground Getaway Cable	\$0.46M	\$0.47M	\$0.48M	\$0.49M	\$0.51M	\$2.43M
Replace Deteriorated/Failed Low-Tension Network Equipment and Structures	\$1.46M	\$1.52M	\$1.34M	\$1.37M	\$1.39M	\$7.07M
Underground Residential Development Cable Replacement and Life Extension	\$11.54M	\$9.66M	\$9.97M	\$10.16M	\$10.4M	\$51.73M
Low Tension Network Primary Cable, Equipment and Structures	\$4.41M	\$8.56M	\$4.61M	\$4.64M	\$5.61M	\$27.83M
12 kV Underground Getaway Cables	\$2.72M	\$5.02M	\$5.8M	\$6.13M	\$6.21M	\$25.88M
Copper Weld Copper	\$4.97M	\$6.56M	\$5.92M	\$6.11M	\$6.32M	\$29.88M
Customers Experiencing Multiple Interruptions	\$4.41M	\$2.37M	\$2.44M	\$3.42M	\$2.86M	\$15.5M
Distribution Reliability Preservation	\$10.81M	\$7.39M	\$7.27M	\$9.62M	\$9.81M	\$44.91M
Reliability Preservation Emergent	\$1.01M	\$1.13M	\$1.55M	\$1.59M	\$1.7M	\$6.98M
Circuit SAIDI Improvement	\$6.54M	\$8.44M	\$8.76M	\$11.21M	\$9.23M	\$44.17M
Distribution Automation Development	\$9.99M	\$14.73M	\$21.29M	\$22.74M	\$24.43M	\$93.17M
Improve System Reliability Projects	\$13.58M	\$15.07M	\$15.31M	\$15.95M	\$16.3M	\$76.21M
Unreimbursed Highway Relocations	\$2.83M	\$2.96M	\$3.05M	\$3.14M	\$3.33M	\$15.31M
Distribution Substation Circuit Breakers	\$5.74M	\$3.24M	\$4.3M	\$4.27M	\$3.64M	\$21.2M
Substation 69/12 kV Transformer Replacement	\$3.42M	\$7.76M	\$3.4M	\$5.27M	\$4.5M	\$24.35M
Protection and Control	\$1.41M	\$0.88M	\$1.0M	\$1.0M	\$1.0M	\$5.3M
Cross-Yard 12 kV Underground Tie	\$1.03M	\$1.06M	\$1.09M	\$1.11M	\$1.13M	\$5.41M
Replace Deteriorated/Failed Area Supply Substation Equipment	\$1.05M	\$1.09M	\$1.12M	\$1.15M	\$1.19M	\$5.59M
Repair Failed 138/69 12 kV Transformers	\$1.07M	\$1.1M	\$1.14M	\$0.01M	\$0.01M	\$3.33M
Distribution Substation DC Equipment	\$0.35M	\$0.37M	\$0.39M	\$0.39M	\$0.39M	\$1.89M
Miscellaneous Substation Equipment	\$1.93M	\$1.06M	\$1.67M	\$0.99M	\$1.73M	\$7.38M
Substation Animal Guarding	\$3.25M	\$2.46M	\$2.55M	\$2.57M	\$2.68M	\$13.51M
<b>Grand Total</b>	<b>\$132.68M</b>	<b>\$136.73M</b>	<b>\$139.51M</b>	<b>\$147.02M</b>	<b>\$149.23M</b>	<b>\$705.17M</b>

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

Some of the initiatives, such as animal guarding, clearly have implied end-points, where no further opportunities for improvement remain. Others, such as 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 detail 5-years projections for Long-Term Infrastructure Improvements initiatives that apply to distribution line assets. These assets include, but are not limited to, the following:

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

# PPL Electric Utilities Corporation

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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.

Planned Replacements in Units					
2013	2014	2015	2016	2017	Total Scope
900-1200	600-800	600-800	600-800	600-800	3300-4400

### 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					
2013	2014	2015	2016	2017	Total
\$6.61M	\$4.00M	\$4.40M	\$4.43M	\$4.64M	\$24.08M

# PPL Electric Utilities Corporation

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## C-Truss Distribution Poles

### Program Description and Purpose

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

### Identification/Justification Process

PPL Electric inspects approximately 90,000 poles per year. Historical data suggests an approximate 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

Planned Reinforcements in Units					
2013	2014	2015	2016	2017	Total Scope
2800-3200	2800-3200	2800-3200	2800-3200	2800-3200	14000-16000

### Locations

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

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$1.45M	\$1.54M	\$1.57M	\$1.60M	\$2.00M	<b>\$8.16M</b>

# PPL Electric Utilities Corporation

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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

Planned Reinforcements in Units					
2013	2014	2015	2016	2017	Total Scope
1600-1900	700-900	700-900	700-900	700-900	4400-5500

### Locations

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

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$3.36M	\$1.58M	\$1.57M	\$1.62M	\$1.50M	\$9.63M

# PPL Electric Utilities Corporation

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## 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

Planned Replacements in Units					
2013	2014	2015	2016	2017	Total Scope
800-1100	700-1000	700-1000	600-900	600-900	3400-4900

### Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	540 - 780
Northeast	610 - 880
Central	540 - 780
Susquehanna	650 - 930
Harrisburg	510 - 740
Lancaster	540 - 780

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$6.38M	\$5.72M	\$5.76M	\$4.77M	\$4.92M	\$27.55M

# PPL Electric Utilities Corporation

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## 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

Planned Installations in Units					
2013	2014	2015	2016	2017	Total Scope
17-23	17-23	17-23	17-23	17-23	85-115

### Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	27 - 36
Northeast	9 - 12
Central	9 - 12
Susquehanna	9 - 12
Harrisburg	18 - 24
Lancaster	13 - 18

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$.24M	\$.23M	\$.28M	\$.36M	\$.26M	<b>\$1.38M</b>

# PPL Electric Utilities Corporation

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## New Hydraulic Reclosers

### Program Description and Purpose

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

### Identification/Justification Process

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

### Scope

Planned Installations in Units					
2013	2014	2015	2016	2017	Total Scope
23-27	20-25	15-20	10-15	10-15	115-135

### Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	22 - 26
Northeast	22 - 26
Central	22 - 26
Susquehanna	22 - 26
Harrisburg	18 - 21
Lancaster	9 - 10

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$.81M	\$.70M	\$.62M	\$.50M	\$.40M	<b>\$3.03M</b>

# PPL Electric Utilities Corporation

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## 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

Planned Areas To Address					
2013	2014	2015	2016	2017	Total Scope
30-50	40-60	40-60	20-40	15-35	145-245

### Locations (Approximate total over 5 year plan)

Region	Areas
Lehigh	30 - 50
Northeast	15 - 25
Central	26 - 44
Susquehanna	19 - 31
Harrisburg	26 - 44
Lancaster	30 - 50

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$1.06M	\$1.50M	\$1.52M	\$.84M	\$.86M	\$5.77M

# PPL Electric Utilities Corporation

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## Distribution Failed Equipment

### Program Description and Purpose

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

### Identification/Justification Process

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

### Scope & Locations

Scope and locations are determined as equipment fails.

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$13.35M	\$13.17M	\$13.88M	\$14.01M	\$14.57M	\$68.98M

# PPL Electric Utilities Corporation

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## 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.

### Scope & Locations

Scope and locations are determined as cable fails.

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$3.60M	\$3.48M	\$3.50M	\$3.62M	\$3.68M	\$17.88M

# PPL Electric Utilities Corporation

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## 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					
2013	2014	2015	2016	2017	Total
\$1.83M	\$1.90M	\$1.95M	\$1.96M	\$2.03M	\$9.68M

# PPL Electric Utilities Corporation

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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					
2013	2014	2015	2016	2017	Total
\$ .46M	\$ .47M	\$ .48M	\$ .49M	\$ .51M	\$2.43M

# PPL Electric Utilities Corporation

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## Replace Deteriorated/Failed Low Tension Network Equipment and Structures

### Program Description and Purpose

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

### Identification/Justification Process

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

### Scope & Locations

Scope and locations are determined as cable fails.

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$1.46M	\$1.52M	\$1.34M	\$1.37M	\$1.39M	\$7.07M

# PPL Electric Utilities Corporation

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## 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

Treatment	Planned Scope In Cable Sections					Total Scope
	2013	2014	2015	2016	2017	
<b>Replacement After Test</b>	550-600	350-400	350-400	400-450	400-450	2050-2300
<b>Cure</b>	750-800	750-800	750-800	750-800	750-800	3750-4000
<b>Proactive Replacement</b>	250-300	150-200	150-200	150-200	150-200	850-1100

### Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	1600 - 1800
Northeast	700 - 800
Central	500 - 500
Susquehanna	400 - 500
Harrisburg	2100 - 2300
Lancaster	1300 - 1500

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### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$11.54M	\$9.66M	\$9.97M	\$10.16M	\$10.40M	\$51.73M

# PPL Electric Utilities Corporation

## Low Tension Network Primary Cable, Equipment and Structures

### Program Description and Purpose

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

### Identification/Justification Process

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

### Scope

	Planned Replacements in Units					Total Scope
	2013	2014	2015	2016	2017	
<b>Lead Cable (miles)</b>	0	4.75	0	0	0	4.75
<b>LTN Equipment</b>	50-70	70-90	50-70	50-70	50-70	270-370

### Locations (Approximate total over 5 year plan)

Region	LTN Equipment	Cable
Lehigh	64 - 88	3 mi
Northeast	48 - 65	0
Central	29 - 39	0
Susquehanna	12 - 17	1.75 mi
Harrisburg	99 - 135	0
Lancaster	18 - 25	0

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$4.41M	\$8.56M	\$4.61M	\$4.64M	\$5.61M	<b>\$27.83M</b>

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## 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

Planned Replacements in Units					
2013	2014	2015	2016	2017	Total Scope
25-30	50-55	60-65	60-65	60-65	255-280

### Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	52 - 57
Northeast	52 - 57
Central	28 - 31
Susquehanna	38 - 41
Harrisburg	38 - 41
Lancaster	47 - 52

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$2.72M	\$5.02M	\$5.80M	\$6.13M	\$6.21M	<b>\$25.88M</b>

# PPL Electric Utilities Corporation

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## Copper Weld Copper Replacement

### Program Description and Purpose

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

### Identification/Justification Process

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

### Scope

Planned Replacements in Miles					
2013	2014	2015	2016	2017	Total Scope
24-26	31-34	29-31	30-32	31-34	265-290

### Locations (Approximate total over 5 year plan)

Region	Miles
Lehigh	57 - 62
Northeast	47 - 52
Central	38 - 41
Susquehanna	38 - 41
Harrisburg	33 - 36
Lancaster	52 - 57

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$4.97M	\$6.56M	\$5.92M	\$6.11M	\$6.32M	\$29.88M

# PPL Electric Utilities Corporation

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## 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

Planned Projects					
2013	2014	2015	2016	2017	Total Scope
10-20	15-35	15-35	15-35	15-35	70-160

### Locations

Locations are identified based upon emergent reliability needs.

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$4.41M	\$2.37M	\$2.44M	\$3.42M	\$2.86M	\$15.5M

# PPL Electric Utilities Corporation

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## Distribution Reliability Preservation

### Program Description and Purpose

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

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

### Identification/Justification Process

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

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

### Scope

Planned Projects					
2013	2014	2015	2016	2017	Total Scope
150-300	150-300	150-300	150-300	150-300	750-1500

### Locations

Locations are identified based upon emergent reliability needs.

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$10.81M	\$7.39M	\$7.27M	\$9.62M	\$9.81M	\$44.91M

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## 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					
2013	2014	2015	2016	2017	Total
\$1.01M	\$1.13M	\$1.55M	\$1.59M	\$1.70M	<b>\$6.98M</b>

# PPL Electric Utilities Corporation

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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

Planned Installations in Units					
2013	2014	2015	2016	2017	Total Scope
150-300	150-300	150-300	150-300	150-300	750-1500

### Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	125 - 250
Northeast	125 - 250
Central	125 - 250
Susquehanna	125 - 250
Harrisburg	125 - 250
Lancaster	125 - 250

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$6.54M	\$8.44M	\$8.76M	\$11.21M	\$9.23M	\$44.17M

# PPL Electric Utilities Corporation

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## 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.

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## Scope

Planned Substation Upgrades						
Voltage	2013	2014	2015	2016	2017	Total Scope
138/69-12 kV	16	17	24	25	28	110

Planned Distribution Device Upgrades						
Voltage	2013	2014	2015	2016	2017	Total Scope
12 kV	215-230	275-295	350-375	505-530	525-550	1870-1980

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

## Locations (Approximate total over 5 year plan)

Region	Distribution Substations
Lehigh	35
Northeast	25
Central	12
Susquehanna	15
Harrisburg	11
Lancaster	12

Region	Distribution Devices
Lehigh	633 - 670
Northeast	341 - 361
Central	219 - 232
Susquehanna	253 - 268
Harrisburg	248 - 263
Lancaster	175 - 186

## Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$9.99M	\$14.73M	\$21.29M	\$22.74M	\$24.43M	\$93.17M

# PPL Electric Utilities Corporation

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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

Planned Projects					
2013	2014	2015	2016	2017	Total Scope
10-16	10-20	10-25	10-25	10-25	52-111

### Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	9 - 19
Northeast	9 - 19
Central	9 - 19
Susquehanna	9 - 19
Harrisburg	9 - 19
Lancaster	9 - 19

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## Planned Expenditures

<b>Planned Expenditures</b>					
<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>Total</b>
\$13.58M	\$15.07M	\$15.31M	\$15.95M	\$16.30M	<b>\$76.21M</b>

# PPL Electric Utilities Corporation

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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. Historically, reimbursement for distribution projects is approximately 35%.

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

### Scope & Locations

Scope and locations are determined as requests are received.

### Planned Expenditures

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

Planned Expenditures "Net Spend"					
2013	2014	2015	2016	2017	Total
\$2.83M	\$2.96M	\$3.05M	\$3.14M	\$3.33M	\$15.31M

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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 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

Voltage	Planned Projects					Total Scope
	2013	2014	2015	2016	2017	
12 kV	60-65	30-35	32-37	31-37	32-37	185-211
69 kV	0-3	0-4	1-5	1-5	0-3	2-20

### Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	28 - 35
Northeast	28 - 35
Central	28 - 35
Susquehanna	37 - 46
Harrisburg	37 - 46
Lancaster	28 - 35

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Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$5.74M	\$3.24M	\$4.30M	\$4.27M	\$3.64M	\$21.2M

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## 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

Planned Projects					
2013	2014	2015	2016	2017	Total Scope
13-17	3-7	13-17	3-7	13-17	45-65

### Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	7 - 9
Northeast	8 - 12
Central	7 - 11
Susquehanna	8 - 12
Harrisburg	10 - 14
Lancaster	5 - 7

### Planned Expenditures

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

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$3.42M	\$7.76M	\$3.40M	\$5.27M	\$4.50M	\$24.35M

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## 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 assets at the same substation within the five-year planning window. The specific type of relays that have been targeted for early replacement in this program are the Agastat 2400 Series, Westinghouse COI, General Electric IAC, General Electric CFF, General Electric NLR, ABB DPU 245/445, and Westinghouse COM.

### Scope

Planned Projects					
2013	2014	2015	2016	2017	Total Scope
5-8	5-8	5-8	5-8	5-8	25-40

### Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	5 - 8
Northeast	2
Central	5 - 8
Susquehanna	3 - 5
Harrisburg	3 - 5
Lancaster	7 - 11

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$1.41M	\$.88M	\$1.00M	\$1.00M	\$1.00M	\$5.3M

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## Cross-Yard 12 kV Underground Ties

### Program Description and Purpose

Programmatic replacement of underground substation cables to maintain reliable service.

### Identification/Justification Process

Candidates for replacement are identified based on age and/or maintenance condition, both indicators of potential failure. Assets with an age significantly greater than 29 years are deemed good candidates for replacements. In addition, assets with unfavorable test results, which indicate the likelihood of failure, are prioritized for replacement. Currently, there is an average of 23 replaced per year over a five-year period. The average age of assets identified for replacement is 40 years. These assets were installed between 1960 and 1989; 85 of these assets are over 40 years old.

### Scope

Planned Projects					
2013	2014	2015	2016	2017	Total Scope
15-25	15-25	15-25	15-25	15-25	75-125

### Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	14 - 23
Northeast	11 - 18
Central	10 - 17
Susquehanna	12 - 20
Harrisburg	13 - 22
Lancaster	15 - 25

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$1.03M	\$1.06M	\$1.09M	\$1.11M	\$1.13M	\$5.41M

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## Replace Deteriorated/Failed Area Supply Substation Equipment

### Program Description and Purpose

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

### Identification/Justification Process

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

### Scope & Locations

Scope and locations are determined as equipment fails.

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$1.05M	\$1.09M	\$1.12M	\$1.15M	\$1.19M	\$5.59M

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## Repair Failed 138/69/12 kV Transformers

### Program Description and Purpose

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

### Identification/Justification Process

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

### Scope & Locations

Scope and locations are determined as equipment fails.

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$1.07M	\$1.10M	\$1.14M	\$.01M	\$.01M	\$3.33M

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## 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

Planned Projects					
2013	2014	2015	2016	2017	Total Scope
22-28	22-28	22-28	22-28	22-28	110-140

### Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	21 - 27
Northeast	15 - 19
Central	24 - 30
Susquehanna	17 - 21
Harrisburg	16 - 20
Lancaster	18 - 22

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$.35M	\$.37M	\$.39M	\$.39M	\$.39M	\$1.89M

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## Miscellaneous Substation Equipment

### Program Description and Purpose

Programmatic replacement of older substation equipment, including air breaks, potential transformers (“PTs”), capacitance-coupled voltage transformers (“CCVTs”), circuit switchers, 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

Planned Projects					
2013	2014	2015	2016	2017	Total Scope
30-35	15-20	20-25	20-25	22-27	107-132

### Locations (Approximate total over 5 year plan)

Region	Projects
Lehigh	17 - 21
Northeast	9 - 11
Central	33 - 41
Susquehanna	24 - 30
Harrisburg	14 - 18
Lancaster	10 - 12

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$1.93M	\$1.06M	\$1.67M	\$ .99M	\$1.73M	\$7.38M

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## Substation Animal Guarding

### Program Description and Purpose

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

### Identification/Justification Process

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

### Scope

Planned Installations in Units					
2013	2014	2015	2016	2017	Total Scope
50-60	45-55	45-55	45-55	35-45	220-270

### Locations (Approximate total over 5 year plan)

Region	Units
Lehigh	40 - 50
Northeast	45 - 55
Central	40 - 50
Susquehanna	18 - 22
Harrisburg	36 - 44
Lancaster	40 - 50

### Planned Expenditures

Planned Expenditures					
2013	2014	2015	2016	2017	Total
\$3.25M	\$2.46M	\$2.55M	\$2.57M	\$2.68M	\$13.51M

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## Appendix A : Average Age of Major Units of Property

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

<b>Average Age of Major Units of PPL Electric's Distribution Property</b>		
<b>Utility Account</b>	<b>Description</b>	<b>Avg Asset Age*</b>
362.0 - Station Equipment	DC System Equipment	20
362.0 - Station Equipment	Substation Animal Guards	4
362.0 - Station Equipment	Power Circuit Breakers	32
362.0 - Station Equipment	Power Transformers	36
362.0 - Station Equipment	Protection and Control Equipment	43
364.4 - Poles and Fixtures	Distribution Wood Poles	37
365.0 - Overhead Conductors, Device	Distribution Animal Guards	1
365.0 - Overhead Conductors, Device	OH Primary Conductor	42
365.0 - Overhead Conductors, Device	Air Break Switches	11
365.0 - Overhead Conductors, Device	Automatic Switches (Primarily OCRs/VCRs)	5
365.0 - Overhead Conductors, Device	Disconnect Switches	46
366.0 - Underground Conduit	UG Primary Conductor (includes Getaways and Cross Yard Ties)	30
366.0 - Underground Conduit	Equipment Foundation, Man Holes, Transformer Vaults	21
368.4 - Submersible or Padmt Type	UG Transformers (includes LTN Transformers & Network Protectors)	20

\* Note that the average age of several classifications is skewed by recent increased installations. For example, automatic switches and animal guards.

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## Appendix B : Asset Contribution To Reliability Metrics

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

### *Outage Contribution By Component - Equipment Failure Cause - Non Major Events*

Component Asset Type	Component	2007		2008		2009		2010		2011		
		# Customers (Permanent)	CMI (Permanent)	# Customers (Permanent)	CMI (Permanent)	# Customers (Permanent)	CMI (Permanent)	# Customers (Permanent)	CMI (Permanent)	# Customers (Permanent)	CMI (Permanent)	
Distribution	OH-Pole/Arms Attachments	55,503	7,852,001	62,387	7,602,197	63,361	5,474,070	74,472	10,359,827	51,446	5,362,487	
	OH-PRI Splices and Connectors	16,455	1,100,345	10,111	1,479,278	11,129	1,391,998	12,755	1,862,049	9,010	1,167,864	
	OH-Lightning Arrester	12,765	1,798,144	13,262	1,268,391	4,294	539,817	7,389	715,809	12,148	1,139,743	
	OH-Primary/Neutral	129,128	20,118,051	141,349	17,175,386	127,138	15,486,250	128,121	15,506,499	151,487	22,716,345	
	OH-Capacitor Bank			174	4,875	895	34,229	12	2,640	4,784	164,255	
	OH-Switch/Manual/AB/Disc/OS/LBD	3,834	504,632	13,624	1,293,100	16,546	1,869,534	13,771	1,227,946	11,011	1,064,042	
	OH-Switch/Automatic	23,887	3,009,382	15,151	1,624,440	18,295	1,835,918	23,737	3,197,397	33,196	3,786,423	
	OH-Tap Fuse/Cutout	11,731	1,871,420	15,851	2,043,692	13,878	1,334,946	11,531	1,543,587	11,233	1,202,273	
	OH-Transformer Fuse	7,277	742,464	14,704	1,855,432	20,707	1,862,240	18,663	2,223,796	27,056	3,134,127	
	OH-Transformer	8,360	1,851,653	6,804	1,490,960	5,093	1,073,496	9,934	1,690,496	11,736	2,190,276	
	OH-Secondaries/Services	4,391	549,428	3,533	436,100	2,178	214,687	3,007	368,046	3,008	325,284	
	OH-SEC Splices and Connectors	592	45,795	644	69,898	680	57,569	1,571	92,096	1,207	64,664	
	OH-Other Equipment	20,570	2,092,055	6,760	767,981	8,284	1,184,186	5,351	485,684	10,262	1,134,482	
	UG-Riser Pole Equip & Devices	978	164,425	1,409	388,797	1,727	188,417	4,116	475,306	3,267	288,688	
	UG-PRI Splices and Connectors	94	48,882	163	68,418	469	80,365	1,421	201,718	2,378	187,036	
	UG-Lightning Arrester	137	26,949	74	6,233	61	5,534	118	21,917	82	31,981	
	UG-Primary Cable/Neutral	23,971	4,905,521	28,766	5,136,677	22,123	3,647,145	17,479	4,019,207	19,307	3,622,397	
	UG-Switchgear	1,902	193,604	3,931	730,722	4,496	371,080	4,528	457,390	8,727	1,097,034	
	UG-Elbows	380	91,099	538	212,537	497	81,404	962	107,841	323	111,037	
	UG-Load Break Junctions	381	73,101	224	56,555	59	12,271	172	34,465	271	60,109	
	UG-Transformer/Transformer Fuse	2,339	362,348	1,893	607,611	1,774	500,589	2,027	762,926	2,086	589,224	
	UG-Secondaries/Services	1,463	173,294	659	169,617	433	94,313	339	65,014	542	87,134	
	UG-Pads/Vaults/MHs & Splice Boxes	1,892	199,265	1,443	39,773	74	15,687	1,459	369,020	1,923	238,393	
	UG-SEC Splices and Connectors	8	1,291	1	135	3	251	41	2,940	47	12,564	
	UG-Other Equipment	447	21,667	6	2,475	548	103,221	28	1,062	1,858	93,891	
	Substation	SUB-Power Fuse	14,724	1,508,663	2,216	305,320	6	942	4,430	239,587	1,752	90,890
		SUB-Structure					319	28,012				
SUB-Power Wiring				1,507	162,756	4,923	339,812	1,635	109,027			
SUB-Insulator		8,218	690,903	162	34,509	3,278	91,028	49	33,491	700	52,497	
SUB-Switch/Manual/AB/Disc/LBD		1	146	11,508	1,321,850	7,808	596,138	2,513	163,375	11,160	953,097	
SUB-Switch/Automatic		7,420	561,695	14,133	1,090,727	4,724	268,957	16,764	1,627,045	11,353	753,270	
SUB-Transformer		15,481	1,364,112	3,340	381,755	1,723	94,024	6,489	347,568	22,204	2,598,591	
SUB-Lightning Arrester		12,275	1,094,382	2,282	91,971	2,015	59,255			21	2,046	
SUB-Control/Relay		3,498	174,900	168	26,890	7,901	577,276	15,565	454,630			
SUB-Circuit Breaker		53,235	4,749,599	31,569	2,696,735	27,635	1,457,567	45,215	3,488,333	32,681	3,505,632	
<b>Total</b>			<b>466,204</b>	<b>61,428,204</b>	<b>410,346</b>	<b>50,643,796</b>	<b>385,074</b>	<b>40,972,226</b>	<b>435,664</b>	<b>52,257,735</b>	<b>458,266</b>	<b>57,827,777</b>