



A PHI Company

Pepco  
Reliability Enhancement Plan  
For  
Montgomery County, Maryland  
Including  
Distribution System Overview and Reliability Initiatives

**August 2010**

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## 1. EXECUTIVE SUMMARY

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Pepco is committed to providing safe and reliable service at a reasonable cost. This requires the Company and utility regulators to balance the cost of various system designs and equipment replacement strategies with the increased reliability that these designs will provide so as to demonstrate reasonableness. It also requires balancing the effectiveness of these investments relative to the additional cost to our customers. In support of this business objective, Pepco's goal is to have a "robust" system with adequate systems and practices in place to assure continued reliable performance for a median range of operating conditions and the ability to respond to events that are in excess of the design of the system. For daily operations, Pepco maintains sufficient staffing of utility employees and contractor resources to address routine maintenance and construction activities, and most storm events, on our distribution system. In the event of significant outages, resource requirements may exceed normal staffing levels. For such events, Pepco follows accepted business practices and participates in several state, regional and national mutual assistance groups that pool resources during significant outage events and allocates them, by mutual agreement, for the most effective deployment. Periodically, member utilities meet to review restoration procedures, mutual assistance and operating best practices. This report provides an overview of Pepco's distribution system and the efforts under way or planned to increase reliability of the distribution system, all of which support Pepco's goal to provide safe and reliable service to its customers.

### **Overhead and Underground Network Configuration**

A review of Pepco's overhead and underground infrastructure shows that a significant portion of customers within Montgomery County (County) are currently served by underground circuits. Within the County, there are 398 distribution circuits of which 84 are totally underground construction, 193 have greater than 90% overhead construction and 77 circuits have greater than 25% underground construction. Therefore, many customers supplied from an underground circuit may also have a limited exposure to the overhead system due to circuits containing both overhead and underground facilities. Many studies have been performed to evaluate the potential to underground overhead facilities to improve reliability during storms. However, the cost of undergrounding large portions of the overhead system would place Pepco outside of industry norms from a cost standpoint and would not meet the test of reasonableness to impose additional costs on customers for the return in increased reliability. Instead, Pepco has undertaken a process that will provide the long-term benefits of a targeted Primary Feeder undergrounding strategy, paired with a plan to reduce the vulnerability of its overhead system to environmental hazards. This represents a reasonable approach that is in line with industry best practice as well as regulatory standards, and is directly aligned with improving outages most commonly caused by storm conditions.

## **System Design**

Pepco's practices surrounding placement and maintenance of system design components such as substations, transformers and feeders are well within industry practices; there are, however, some areas of opportunity. Pepco is also taking advantage of current technologies that will support increases in reliability. For instance, Pepco is increasing the number of automatic reclosers on its system and replacing mechanical switching devices with more sophisticated electronic devices. This increase in system flexibility and fault isolation capability will reduce the impact of routine storms on the system and thereby improve reliability. In addition, Pepco is currently in the early stages of building out a new wireless network that will enable the retrieval of network outage information down to the customer meter to significantly improve customer restoration times. This is the rollout of our Advance Metering Infrastructure (AMI) system that was recently approved by the Maryland Public Service Commission. Further, automation enhancements are in the planning/engineering stage and will be tested in the field this year. Pepco anticipates that it will take approximately four years to fully implement the AMI and distribution automation systems.

## **Load Modeling**

Pepco uses the industry best practices of load modeling and forward load forecasting in order to identify loads which are at, or near, limits, and corrects them by the adding or up-rating feeders where required. Pepco's state-of-the-art, software-based process allows the company to model system loading to ensure that the system is not unduly overloaded and that the provision of contingency also does not overload the system.

## 2. INTRODUCTION

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Pepco delivers electricity to more than 781,000 customers in major portions of Montgomery and Prince George's counties in suburban Maryland and in the District of Columbia. This includes 305,000 customers in Montgomery and 222,000 customers in Prince George's counties in Maryland. Pepco's customer base is comprised of approximately 90% Residential and the remaining 10% is Commercial, Government and other services.

Reflective of its commitment to continuous improvement, Pepco has been proactive in commissioning various studies internally and from independent external sources to assess its system performance and response to outages.

Combined, the system design and performance review capabilities constitute a model for evaluating Pepco's distribution system robustness with the purpose of understanding its impact on the Company's ability to provide safe and reliable service. In particular, the Company is evaluating those aspects and characteristics of the distribution system design which have a direct impact upon an electric distribution system's reliability. This Reliability Enhancement Plan for Montgomery County (Plan) has therefore been developed to focus on six attributes of Pepco's system.

### System Overview

Pepco's service territory includes 566 square miles in parts of Montgomery and Prince George's Counties in Maryland and 70 square miles in the District of Columbia.

Within this service territory, there are:

- 22 transmission substations
- 39 sub-transmission substations
- 116 distribution substations
- 14,266 miles of overhead lines
- 10,718 miles of underground cable
- 2,945 miles of underground conduit

Figure 1 - Pepco Service Territory



### 3. NETWORK DESIGN

The reliability of an electrical system is directly related to implementing the appropriate design principles and construction practices, along with the proper deployment of distribution assets and equipment comparable to the demands placed upon the system by its users.

#### 3.1 System Design – Overhead vs. Underground

Figure 2 shows the geographical distribution of customers supplied from the overhead and underground system. As this figure depicts, the more established areas of Montgomery County are primarily supplied from the overhead system. As growth expanded across the County, construction became more underground, as required by the State of Maryland.

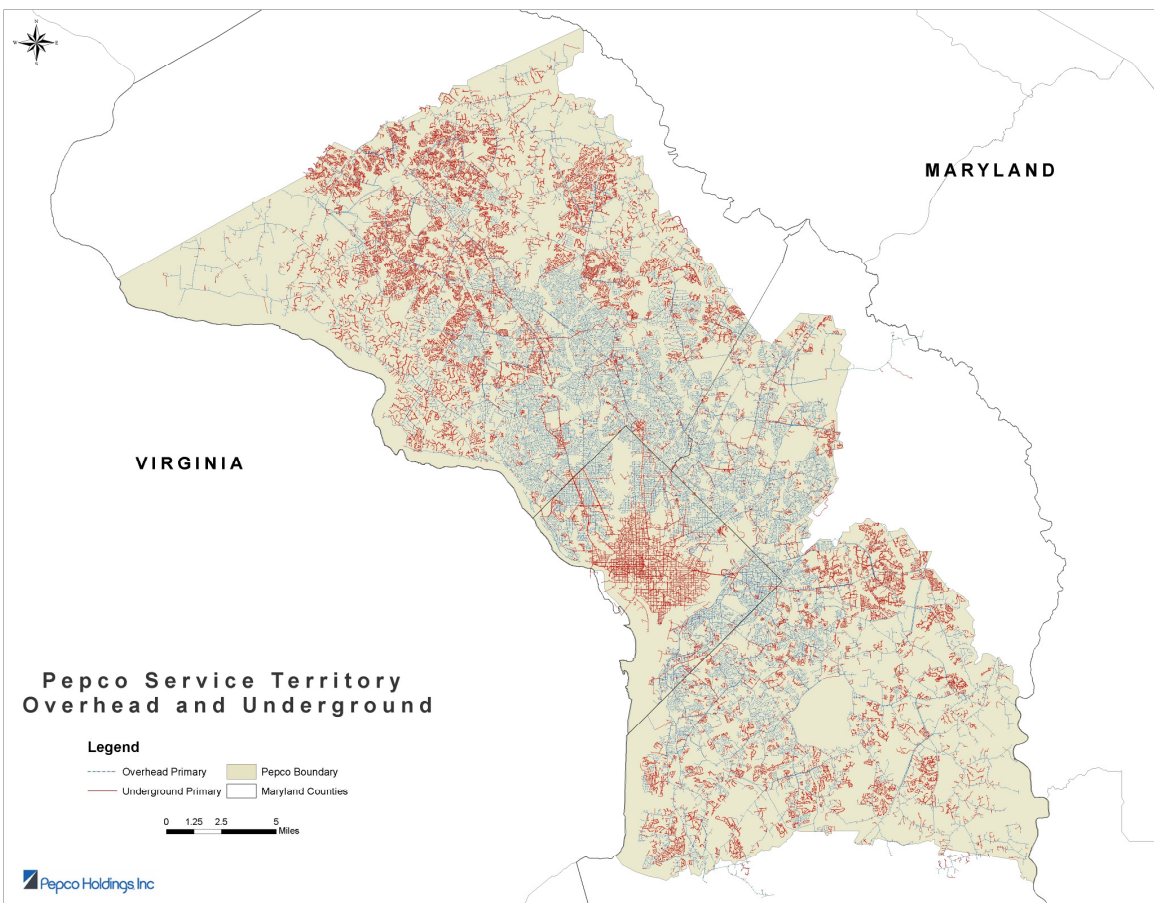


Figure 2 – Pepco Service Territory Overhead and Underground

Pepco is well aware of both the positive and negative characteristics of overhead systems and monitors the performance of its systems closely. The Company is sensitive to trends in the industry and actively participates in several benchmarking studies to provide performance comparisons and best practices insights for consideration in all aspects of planning, design and operation of the system. Pepco has completed an assessment of the cost and reliability benefits of undergrounding a portion of its current

overhead system.<sup>1</sup> In addition, the District of Columbia Public Service Commission in July 2010 issued a report that evaluated the benefits of undergrounding the existing overhead system. Both reports conclude that undergrounding the existing overhead electrical distribution system is cost prohibitive.

#### **4. RELIABILITY INITIATIVES**

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This section contains reliability-related initiatives which includes the Company's Vegetation Management and Priority Feeder programs, load growth, selective undergrounding and substation supply hardening, Distribution Automation (DA) and the Underground Residential Distribution Cable Replacement Program.

##### **4.1 Enhanced Vegetation Management Program (Tree Trimming)**

Pepco conducts tree and vegetation maintenance, which includes trimming and/or removing branches that overhang power lines, and removing dead and diseased trees that are too close to the lines. Trees located along the overhead lines are trimmed as appropriate for the specific locality and in accordance with state and local regulations. In addition, the Company has an enhanced vegetation management plan that is designed to:

- Maintain a high degree of reliability across the entire electric system;
- Target areas of the electric system found to be most susceptible to damage from trees during storms;
- Assist in the removal of trees in close proximity to Pepco's electric lines;
- Perform emergency tree and limb removal from electric lines; and
- Provide support for local jurisdictions that require assistance to remove trees that are in close proximity to the electric facilities.

The circuits are selected for inspection and trimming according to a pre-scheduled plan, created on the basis of a prioritization process that takes into account the number of outages and reliability statistics of the circuit. At a minimum, Pepco inspects and mitigates eminent vegetation problems as necessary on all overhead feeder sections at least once every four years.

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<sup>1</sup>"Report on the Feasibility of Removing Pre-Existing Aboveground Utility Lines and Cables, and Relocating them Underground, In Response to District of Columbia Public Service Commission Order No. 13209 in Formal Case No. 1026," filed September 30, 2004; and " Report on the Feasibility of Undergrounding Pre-Existing Aboveground Utility Lines and Cables in Selected Areas in the District of Columbia and Relocating Them Underground, In Response to District of Columbia Public Service Commission Order No. 13830 in Formal Case No. 1026 and Order No. 13877 in Formal Case No. 766," filed June 5, 2006.

## **Enhanced Integrated Vegetation Management (EIVM) Program**

Pepco has examined vegetation-related feeder performance year to date to adjust the 2010 pruning schedules in order to address emergent vegetation issues in the areas that have been most impacted by outages caused by trees.

Pepco will fund and add elements of its proposed EIVM Program to the vegetation management practices utilized by the Company, removing more overhangs and off right-of-way danger trees and increasing zones of electrical clearance where possible. Since much of this program is dependent on increased customer approvals and continued cooperative efforts with state and local jurisdictions, Pepco is optimistic the EIVM program will be supported by regulators, legislators and community stakeholders.

### **4.2 Priority Feeder Program**

The objective of the Priority Feeder Program is to identify the least reliable distribution feeders, select, analyze and prioritize those feeders and initiate corrective actions to improve individual and overall distribution feeder reliability.

Based on the field inspection results, the information is reviewed, evaluated and analyzed in order to recommend appropriate corrective actions. Proposed corrective actions may include but are not limited to the following activities:

- Installing animal guards
- Replacing blown lightning arrestors
- Replacing deteriorated poles/cross arms
- Re-tensioning slack spans and installing spacers
- Replacing deteriorated insulators
- Inspecting and/or replacing transformers and other distribution equipment based on observed condition
- Installing new lateral tap fuses
- Installing sectionalizing devices
- Trimming trees
- Replacing missing or damaged grounds and guys
- Checking for appropriate fuse installation and resizing of fuses for fuse co-ordination with respect to inspection results
- Installing Automatic Circuit Reclosers (ACRs) and load break switches in loop scheme configuration to provide automotive sectionalizing and restoration
- Installing taller poles to put the overhead wires above the tree canopy

- Installing larger class poles for strength with double arms, double dead ends and larger and stronger tree wire to support tree limbs
- Installing a large grounded shield conductor above the open wire to support tree limbs and protect the open wire feeder
- Installing preassembled aerial cable (PAC) for the feeder main trunk with the existing feeder trunk into fused laterals
- Rerouting the overhead portion of the feeder to avoid trees
- Selecting undergrounding of limited sections of the feeder

Pepco conducts annual system performance reviews of approximately 2,200 distribution feeders and ranks these feeders from the most reliable to the least reliable, based on high frequency and extended duration outages, using data from a rolling 12-month period from October 1 to September 30.

### 4.3 Load Growth

Pepco continuously analyzes the adequacy of its electric system to ensure that the demand for energy on its system is met and that plans to meet future growth are in place. The Company maintains engineering and operating criteria to be used in the design of new and modified portions of the system as follows:

- Voltage and reactive support,
- Ratings of facilities and
- Reliability

Pepco completes short-term planning studies for every area in the Pepco distribution system on a bi-annual basis. When forecasting Pepco's feeder and substation loads, System Planning begins with a close examination of the summer historical load. Engineering staff compare the peak meter readings on the summer peak day for each feeder and substation with the previous historical loads and the previously predicted load, while considering the effects of predicted new customer load, actual new customer load, planned changes in feeder configuration and emergency transfers.

Solutions to relieve equipment capacity overloads and voltage deficiencies at the feeder or substation level are developed, usually with alternatives. The alternatives are evaluated on an economic and effectiveness basis with the most effective/least cost solution being proposed into a Construction Recommendation.

Following the review of components of the existing electrical system and the requirements for new service hook-ups, system planners develop the costs and schedule for the changes to the electric system which will be taken forward as candidates for inclusion in the construction budget process.

#### 4.4 Selective Undergrounding / Substation Supply Hardening

When a feeder continues to appear on the least performing feeder list even after it has been through the Priority Feeder Program and Load Growth Analysis, the feeder will be evaluated for undergrounding criteria. Feeder(s) that are identified to selectively underground portions of the overhead system must contain portions of the feeder with known tree-related outages on the main trunk of the feeder. By undergrounding a portion of the feeder, the expectation would be that the number of feeder lockouts or times that the entire feeder is out of service due to tree contact, would be reduced. The process of targeted or selective undergrounding will be used as a last resort effort. In addition, the process of selective undergrounding will be for reliability improvement purposes only and not for aesthetic reasons.

The criteria for determining which feeders shall be used for selective undergrounding are as follows:

Priority 1 = Feeder with high number of lock outs

Priority 2 = Repeating Feeders on the Priority Feeder list (10-year list)

Priority 3 = Feeders with a high tree System Average Interruption Frequency Index (SAIFI)

Priority 4 = Outage Management System (OMS) Restoration Priority Weighting or feeders that supply critical customers

Pepco Substations are generally served from three 34,500 or 69,000 Volt supply feeders. Substations served from overhead circuits have been subjected to outages when multiple short circuits have occurred during major storms. These substations typically serve 10,000 to 12,000 customers.

By aggressively trimming the trees along the route of the substation's supply feeders, the substation outages can be significantly reduced in the short term, protecting the main power source to 10 to 12 distribution feeders that emanate from each of these substations. Longer term evaluations will be completed to determine if more aggressive measures are needed to mitigate substation supply feeder outages.

Longer term evaluations will be completed to determine if more aggressive measures are needed to mitigate substation supply line outages. Long term actions that will be considered for specific locations include: rebuilding existing supply lines, rerouting supply lines to avoid areas where the trees have formed canopies, selectively replacing overhead circuits with underground cable, installing Motorized Operated Disconnect switches remote controlled from the Control Center, replacing wood poles with steel pole construction, and use of fully insulated Pre-assembled Aerial Cable or Spacer Cable.

#### **4.5 Distribution Automation**

Distribution Automation (DA) is a major component of Pepco's electric system for improving reliability in the future. It includes sensors and controls throughout Pepco's power lines and a number of devices and technologies such as automatic sectionalizing and restoration schemes, smart relays, smart switches and a number of other intelligent devices. These sensors will help Pepco Operations to identify and resolve problems with the system more quickly. As a result, benefits such as quicker restoration, improved reliability and better overall control of the system are achieved.

One of the major components of Pepco's DA is Automatic Sectionalizing and Restoration (ASR) scheme. This consists of automated switches, controllers, smart sensors, and substation electronic relays that are connected to electric distribution system, allowing for continuous visibility and remote control of the system. These devices work together to identify faults, automatically isolate identified problem areas and reconfigure the controlled feeders. This reduces the number and length of electric system outages, and minimizes the impact to customers.

#### **4.6 Underground Residential Distribution (URD) Cable Replacement Program**

The purpose of the URD Program is to identify, analyze and initiate corrective actions for the mitigation of URD cable failures and to ensure the integrity of the URD system, in terms of reliability, safety and cost. A proactive approach has been developed to identify sections of underground cable that are approaching its end of life and to replace or refurbish that cable before unacceptability high failure rates are experienced by our customers.

Pepco uses a scoring methodology to prioritize subdivisions for cable replacement or cable refurbishment. The selection criteria include recent cable failure history, number of customers served, system design, cable design and cable vintage. Each criterion is weighted to determine the priority.

## 5. CONCLUSION

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Additional actions can and are being taken to further improve the reliability of Pepco's distribution system. These actions include the implementation of the Enhanced Vegetation Management Program, the installation of distribution automation equipment to reduce the time required to restore customers, replacement of aging infrastructure, application of an increased analysis of feeders that have proven to be below acceptable reliability performance and evaluation of selective undergrounding when other lower cost options have not produced acceptable results. Pepco is committed to providing safe and reliable electric service to all of our customers at a reasonable cost. Therefore, each initiative undertaken must consider the cost to obtain and the anticipated benefits to be realized. Working together with communities, political officials and the Commission, a robust reliability plan can be developed that balances the cost and benefits to our customers.