Potomac Electric Power Company

Comprehensive Reliability Plan

For

District of Columbia

Including

Distribution System Overview, Reliability Initiatives and Response to Public Service Commission of the District of Columbia Order No. 15568

September 2010

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1. EXECUTIVE SUMMARY

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. 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" infrastructure with adequate systems and practices in place to assure continued reliable performance for operating conditions within the design parameter of the system as well as the ability to respond to events that exceed 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. In addition, Pepco utilizes workforces from other PHI operating companies to assist in large scale restorations. 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.

In addition, this report contains Pepco's continuous improvement plan. Specifically, pursuant to Order No. 15568 issued by the Public Service Commission of the District of Columbia, Pepco is directed to "submit a continuous improvement plan, including resourcing, specific performance targets and milestone dates to achieve the reliability and outage restoration performance of the best (quartile) performing (comparably) utilities in the Benchmarking Studies."[1] This report will address the Commission's directive. This plan details a six point strategy comprised of the following reliability initiatives:

- Enhanced Vegetation Management
- Priority Feeders
- Load Growth
- Distribution Automation
- Feeder Improvement
- Selective Undergrounding

[1] Formal Case No. 766, In the Matter of the Public Service Commission's Fuel Adjustment Clause Audit and Review Program and Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring in or Around the Underground Distribution Systems of the Potomac Electric Power Company, Order No. 15568 issued October 7, 2009, at paragraph 57.

Overhead and Underground Network Configuration

A review of Pepco's overhead and underground infrastructure shows that a significant portion of customers within the District of Columbia (District) are currently served by underground circuits. Within the District, there are 784 distribution circuits of which 573 are totally underground construction, 65 have greater than 90% overhead construction and 96 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, including Shaw Consultant International's report focused on the District of Columbia[2], 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 number of customers exposed to outage events during routine storms and outages on the system, provide for more automatic restoration after and outage and thereby improve reliability. In addition, Pepco is currently in the early stages of building 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 Public Service Commission of the District of Columbia. Further, automation enhancements are in the planning stage and will start deployment

[2] Shaw Consultant International, Inc. "Final Report - Study of the Feasibility of Undergrounding Power Lines in the District of Columbia in Formal Case No. 1026," dated July 1, 2010.

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 correct them by 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. Data from the future AMI system will further enhance the modeling capabilities and provide for more targeted upgrades to prevent overloads.

2. INTRODUCTION

Pepco delivers electricity to more than 781,000 customers in the District of Columbia and in major portions of Prince George's and Montgomery counties in suburban Maryland. This includes 253,000 in the District of Columbia. 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.

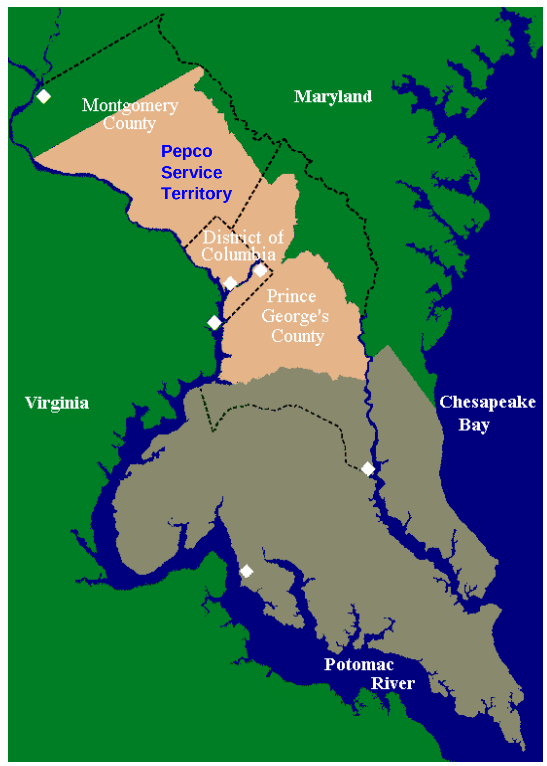


Figure 1 - Pepco Service Territory

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 the District of Columbia (Plan) has therefore been developed to focus on six attributes of Pepco's system.

System Overview

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

3. NETWORK CONFIGURATION AND 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.

- **System Design** – the balance of overhead to underground facilities is appropriate in light of existing customer density, environmental factors and applicable legal requirements such as the requirement to place facilities underground in certain parts of a utility's service area;
- **Transformation Management** – power transformers are actively managed and maintained in order to assure that they are not in danger of becoming overloaded and AMI will enhance the management of distribution transformers;
- **Connectivity/Circuitry –** switches, fusing and fault-sensing devices are properly employed to limit outages and ensure public safety;
- **Substations & Feeders –** stations and feeders are installed and configured to serve the various density and number of customers;
- **System Monitoring –** consistent, automated monitoring technologies will identify potential issues and allow for a utility to respond quickly to mitigate an outage;
- **Load Management & Customer Density –** the proper number/type of customers are served on all areas of the distribution system, and customer growth is anticipated, modeled and planned with regard to system modifications to ensure continued capacity.

3.1 System Design – Overhead vs. Underground

There are solid arguments for both underground and overhead electric distribution systems. In general, overhead systems are less costly to install, are longer-lasting, and easier to maintain, since problems are easily located and repaired. Underground systems, while more costly to install and maintain, are also less susceptible to environmental damage from storms, vegetation and other environmental disturbances. Making the proper choices between overhead and underground facilities requires balancing cost against the amount of potential for environmental impacts on reliability. Within the District, all new facilities installed, where there are no existing overhead facilities, have been required to be underground construction since the early 1970's.

Figure 2 shows the geographical distribution of customers supplied from the overhead and underground system. As this figure depicts, areas external to the Central Business District, are primarily supplied from the overhead system whereas areas within the Central Business District are completely underground. All utilities in the Central Business District of the city have been installed underground for over a hundred years in conformance with a statute passed before the turn of the 20th century intended to limit exposure of utility infrastructure to potential damage in an area called the fire zone.

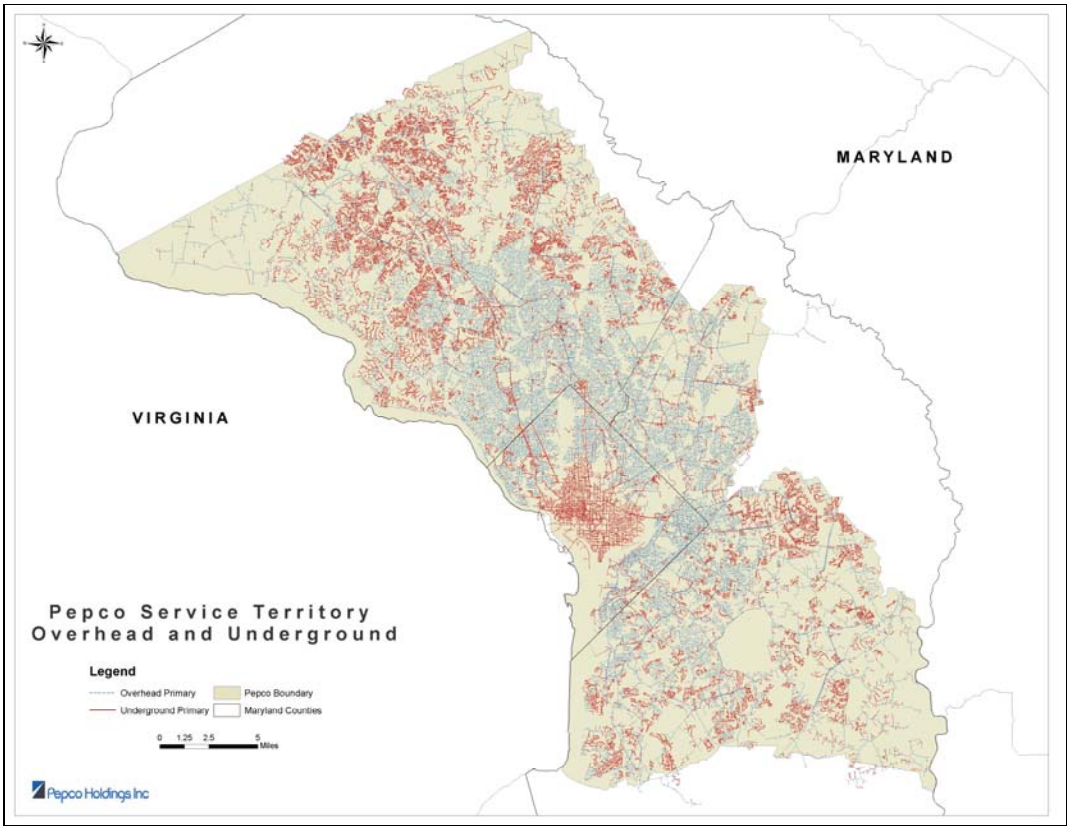


Figure 2 – Pepco Service Territory Overhead and Underground

The following table shows the District's primary distribution system by construction type as compared to the rest of the Pepco system. This chart does not include the lower voltage secondary cables or the high voltage substation supplies. It is intended to demonstrate the number of miles of distribution lines that are running along or under the streets of District of Columbia.

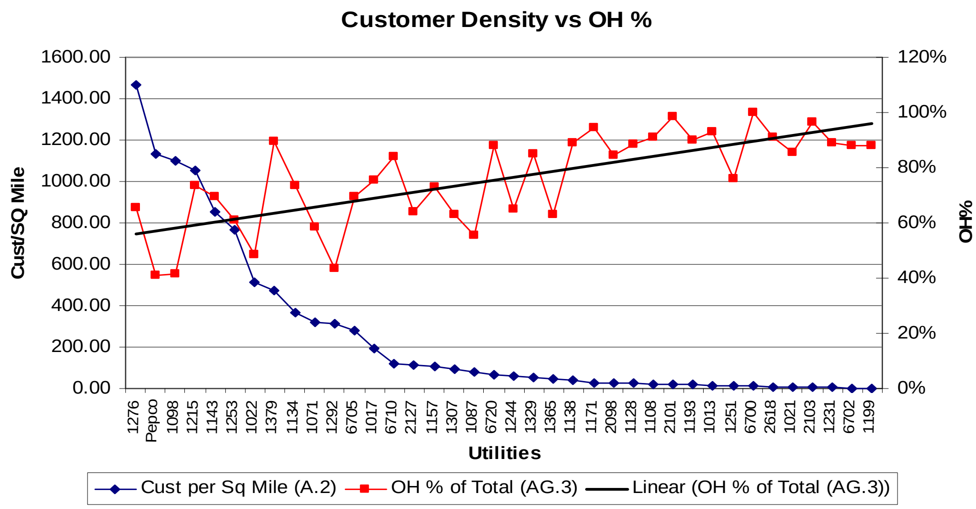
Jurisdiction	Type			Total Feeder Mileage				System Miles
	Number of OH Feeders	Number of UG Feeders	Total Feeders	OH (Miles)		UG (Miles)		
				Length	%	Length	%	
DC – 4 KV	85	48	133	204.87	58%	150.22	42%	355.09
MC - 4 KV	1	0	1	2.77	60%	1.87	40%	4.64
PG – 4 KV	7	0	7	17.41	96%	0.71	4%	18.12
DC – 13 KV	70	552	622	417.02	22%	1,462.63	78%	1,879.65
MC - 13kV	127	278	405	1,915.88	39%	3,057.78	61%	4,973.66
PG - 13kV	152	138	290	1,693.43	49%	1,751.10	51%	3,444.53
System	**442**	**1,016**	**1,458**	**4,251.38**	**40%**	**6,424.31**	**60%**	**10,675.69**

Table 1 – Pepco Distribution System by Construction Type

pepco
A PHI Company

3.1.1 Evaluation of Pepco's Use of Overhead vs. Underground Facilities

The figure below shows the trends in overhead percentage compared to total system of several utilities plotted against density. This data shows that Pepco has one of the highest customer densities per square mile while at the same time having one of the lowest percentages of overhead construction as compared

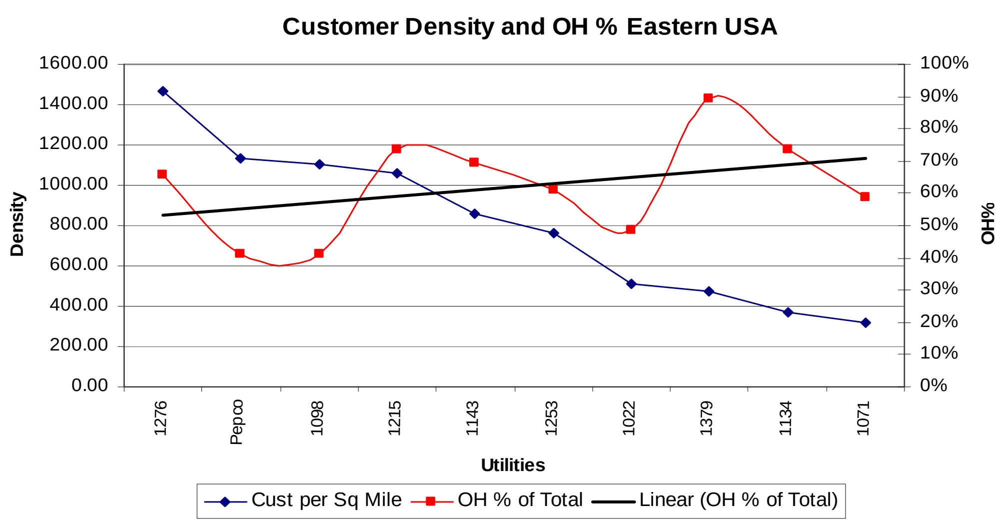


Source: PA Benchmarking ™

to the total miles of distribution plant.

Chart 1 – Customer Density versus Overhead Percentage

The same results are obtained if you compare Pepco to just eastern utilities; Pepco has high customer density and low percentage of overhead construction.



Source: PA Benchmarking ™

Chart 2 – Customer Density versus Overhead Percentage of Eastern USA

It has been shown that overhead facilities are more susceptible to weather events than underground facilities. In the comparison provided in the figure above, Pepco is shown to have the second highest customer density per square mile and the lowest percentage of overhead facilities as compared with other utilities. The significance of this analysis is that when a storm hits the Pepco system large numbers of customers can be impacted even when the storm only hits a small geographic area.

Pepco is well aware of both the positive and negative characteristics of overhead systems and monitors the performance of its systems closely. It also 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.[3] 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. These reports concluded that undergrounding the existing overhead electrical distribution system is cost prohibitive.

Understanding however that the destructiveness of recent storms would have had less impact upon service reliability if the system had been totally underground, Pepco is taking steps to strengthen the ability of its overhead system to resist environmental hazards, including: redesign of facilities to reduce impact from trees, installation of distribution automation and increased use of fusing and isolation devices.

3.1.2 Vegetation Management

For overhead systems, vegetation management (tree trimming) is Pepco's largest single preventive maintenance program. Pepco has had a routine cyclical program of tree trimming in place for many years. This program is designed to maintain minimum clearances between vegetation and overhead facilities. Efficient implementation of this program throughout the electric distribution industry has proven to minimize incidental contact between vegetation and overhead distribution circuits and thus improve the System Average Interruption Frequency Index (SAIFI). During 2010 Pepco plans to spend over $1.4 million for vegetation management within the District.

Pepco also has an enhanced tree-trimming program in limited areas, and is carefully monitoring both its cost effectiveness and consumer acceptance. This enhanced trimming includes elimination of overhanging limbs, removal of leaning/hazard trees, and removal of dead trees, at an initial cost of between $3,000 and $5,000 per mile greater than routine trimming. After the initial enhanced clearance

[3] Potomac Electric Power Company – Report on the Feasibility of Removing Pre-Existing Above ground 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, September 30, 2004 and In Response to District of Columbia Public Service Commission Order No. 13830 in Formal Case No. 1026, 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.

is obtained, the cost of routine maintenance will result in an annual increase in the cost of the routine cyclical program in order to maintain the additional clearance. Lessening of vegetation-caused outages is a key driver of Pepco's system reliability improvement efforts. Therefore, Pepco is constantly seeking opportunities to enhance tree-trimming management to improve reliability. The application of herbicides, ground-to-sky trimming, public and private partnerships and the Pepco education campaign are all initiatives that need to be actively pursued by Pepco to improve the program further. The success of this initiative is dependent on coordination with and the support of local governments.

System reliability performance will improve and is being monitored; statistics resulting from the vegetation management program are not yet available. However, reliability will be positively impacted and if vegetation related faults are reduced reliability could be significantly improved.

3.2 Overall Assessment Of Pepco's Overhead & Underground System Design

Recent storms have prompted Pepco to review its overhead to underground facilities ratio, even though its policy is consistent with other utilities sharing similar urban and customer characteristics. A thorough investigation of adopting a strategy to underground its entire overhead system, however, revealed that the cost would not justify the return in reliability. The Company has, instead, undertaken a process that will evaluate the long-term benefits of a targeted Primary Feeder undergrounding strategy, when the required reliability cannot be obtained using more traditional methods of enhanced reliability measures. This represents a common sense approach that is in line with industry best practice.

3.3 Transformation Management

The nature of the electrical feeder/circuit design includes transformers that severe secondary lines and cables and individual transformers that feed individual customers. The management of all transformers in the system impacts reliability and management of transformer loading at the distribution substation level is correlative to high performing (reliability) utilities.

3.3.1 Pepco Use of Transformers

Pepco's system design guidelines allow for the design of the primary and secondary systems so that transformers operate within their design parameters and that sufficient contingency capacity exists to load transformers above their design parameters for limited periods when other transformers in the system fail or become de-energized due to faults.

Best practices for design considerations for a robust system include the use and loading on all components, with a critical element being the transformers. Power transformers (in substations) and distribution transformers (converting primary voltages to service voltage at or near the customer service location) are designed to operate continuously for many years. The concept of transformer "management" takes into consideration economic and emergency loading conditions in excess of their design, versus additional maintenance, monitoring, and ultimate replacement cost: an evaluation of the total life cost for the asset.

Once the system is in place, the operation and maintenance of the system is critical to providing reliable service to customers. The condition of all equipment in the system impacts reliability performance directly. Transformers, being the most costly individual items of equipment, deserve special attention when it comes to maintenance. The conditions of major transformers are monitored using various methods that measure the performance of the equipment as well as the actual condition under which the equipment is operating. This information helps Pepco design the best maintenance program for each individual unit. Pepco manages its transformers closely. Transformers are costly to install and replace and, therefore, prolonging transformer service life is vital to the integrity and reliability of the electric system.

3.4 Connectivity/Circuitry

System connectivity typically consists of medium to high voltage circuits having closed interconnections with other circuits through the use of switches and reclosers, which can be remotely controlled. This helps assure that fewer customers on the system will experience a service interruption in the case of an outage or other problem on the system, thereby increasing overall system reliability.

There are three types of distribution system electrical connectivity – radial, radial loop, and network design – relevant to an assessment of Pepco's distribution system. Radial design typically consists of circuits having no interconnections with other circuits. Overhead laterals are typically constructed in this manner. A fault anywhere on the lateral interrupts power to customers beyond the protective device or fuse. Service cannot be restored until the cause of the outage is located and repaired. With overhead damage visible and easily repaired relative to underground, service interruptions are usually limited in duration.

Radial Loop connectivity typically consists of circuits with an interconnection to other circuits as shown in the below figure for a 13 kV underground residential circuit. The feeder from the substation may be either overhead or underground and this schematic displays the capabilities of the distribution system to be able to transfer customers between feeders and restore customers during storms even when the main feeder may be out of service. This typical arrangement can apply to a feeder that is overhead, underground or a combination of both.

CABLE SCHEMATIC - TYPICAL 13,000 VOLT RADIAL LOOP SYSTEM

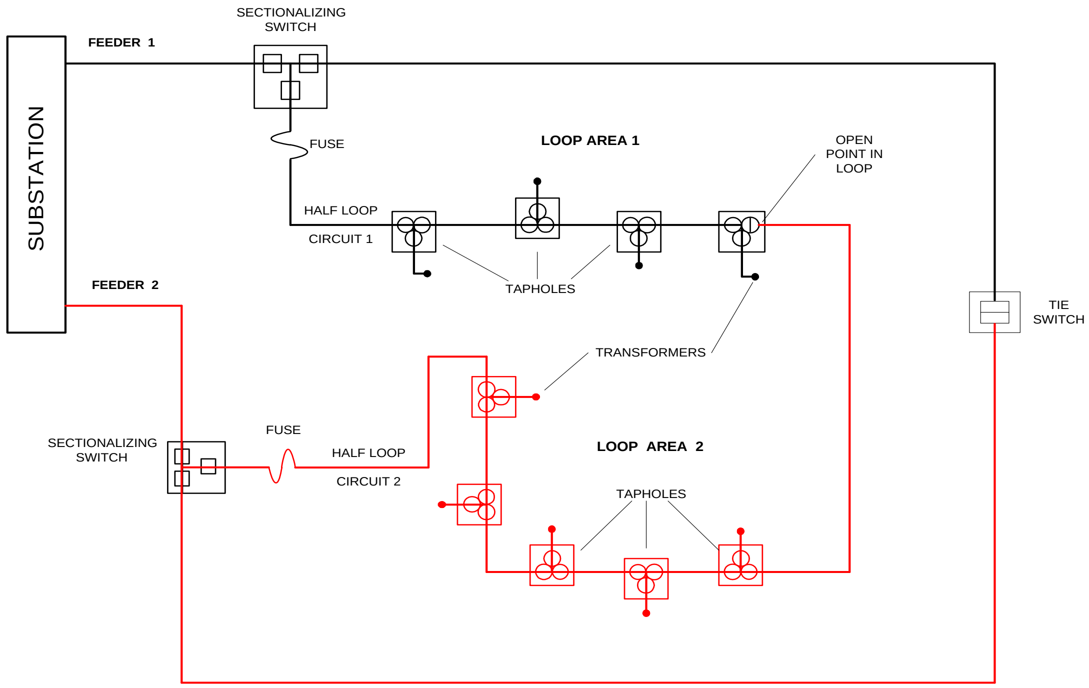


Figure 3 – Radial Loop System

An open point divides the loop into two radial supplies under normal operating conditions. A fault interrupts power to all customers beyond the protective device, as in a radial overhead lateral. However, sectionalizing devices or switches enable the isolation of failed components, and the open interconnection devices enables the resumption of supply to consumers not directly involved in a component failure. Underground laterals are usually constructed in this manner since the outage cause is difficult to locate and time consuming to repair relative to overhead

Network connectivity, in the following illustration, typically consists of low voltage circuits having closed interconnections with other circuits so that customers will normally not experience a service interruption. Electrical protection and power flow control is difficult and expensive relative to radial or radial looped. More sophisticated equipment is required, resulting in additional initial cost and increased maintenance.

LOW VOLTAGE SECONDARY NETWORK DESIGN

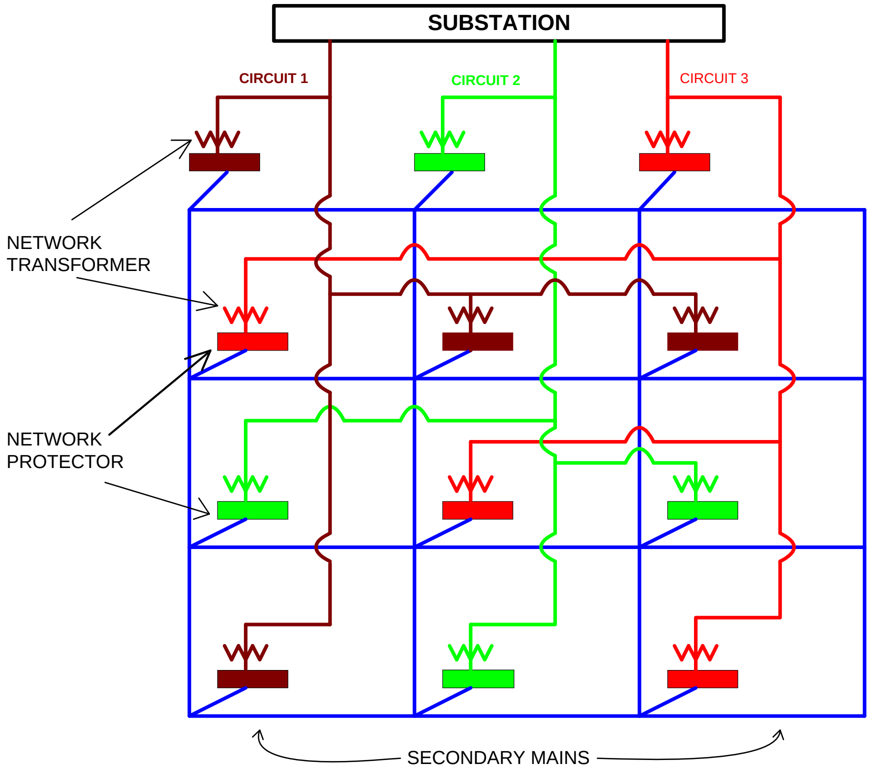


Figure 4 – Network Design

Because of the cost and complexity of the network type design connectivity, widespread use has generally been limited to downtown urban centers such as Washington, DC. On a very small scale, network connectivity has been used in dense central business districts of suburban areas and in areas where specific consumers paid the additional incremental costs.

3.5 System Wide Outage Detection and Automation Project

Pepco is currently in the early stages of installing improvements to its electric system which should yield significant improvements in customer reliability and satisfaction. These improvements include the build-out of a new wireless network that will enable the retrieval of network outage information down to a distribution transformer level. Additionally, this same wireless network will be used to automatically control field installed disconnects and sectionalizers with the hope of significantly improving customer restoration times. This project should also improve the overall efficiency of Pepco's field crews through the intelligent dispatch of crews to areas where repairs are needed most.

Pepco maintains a balanced approach in these undertakings, channeling expenditures in a way that leverages best equipment and reliability benefits. In other words, the addition of equipment intended to improve reliability will be employed where the company has determined that it is prudent and will render significant operational benefits.

The reliability of a distribution system is determined by the size and condition of the substations and protection equipment installed and by their ability to detect faults. To be most effective, the flexibility of switching equipment and the configuration of the system should work to minimize, in a cost effective manner, the impact of a fault to the fewest number of customers for the shortest reasonable duration.

Overall, Pepco's distribution and subtransmission systems are designed to operate at all design load levels without interruption to load for any single contingency. This includes any substation supply circuit, transformer, breaker or bus section.

3.6 Load Management & Customer Density

Providing reliable electric service to customers requires well-designed systems using high quality equipment installed in accordance with best industry practices and maintained in good condition.

The design of reliable electric systems requires a thorough understanding of load growth trends. Whenever new loads are added or systems are reconfigured to incorporate new services, it is good design and planning practice to model the addition of new load to determine its impact on the system.

Pepco uses various software systems to model system loading and ensure that the system is not unduly overloaded and that the provision of contingency also does not overload the system while at the same time reliability is maintained with minimum interruption to customer supply. A comprehensive process exists for the gathering of data, inputting to the model and correcting the resulting list of load violations generated. This process also ensures that new loads and system modifications are also updated in the model ensuring the latest system configuration is reflected.

Customer density is a term referring to the number of customers per feeder. In the case of Pepco, density is high relative to its peers and the engineers need to take this density into account when designing the system.

Understanding trends in customer load growth is important when designing systems and load flow modeling software provides a convenient method of planning the design of systems to provide for growth in already densely supplied areas.

4. RELIABILITY INITIATIVES

This section contains reliability-related initiatives which include the Company's Integrated Vegetation Management and Priority Feeder programs, load growth, selective undergrounding, and Distribution Automation (DA).

4.1 Enhanced Integrated Vegetation Management Program

Pepco's Enhanced Integrated Vegetation Management (EIVM) Program aims to provide safe and reliable electric service to its customers while maintaining the aesthetics of the environment. EIVM, while challenging, is essential to meeting the Company's commitment to maintaining electric reliability and is a key priority for the company. Pepco places an equal amount of importance on the beauty and the environmental health of the area vegetation in its EIVM program execution. The Company's licensed and professional foresters and contract tree pruning experts perform their functions for public safety and the safety and health of the trees and in accordance with state and national standards. Tree pruning for all PHI operating companies is performed following the standards and practices as outlined in the *American National Standards Institute (ANSI) publication A300 (Part 1) – 2001: Tree, Shrub and Other Woody Plant Maintenance* and its companion best management practices publication, *Utility Pruning of Trees*. Additionally, Pepco must comply with all state and local laws and regulations regarding vegetation management practices.

Pepco conducts tree and vegetation maintenance, 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. Pepco has a 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 imminent vegetation problems as necessary on all overhead feeder sections at least once every two years.

- Pepco’s preventive maintenance program includes proactive circuit trimming, herbicide control of tree growth, and hazard tree removal
- Pepco’s reactive maintenance involves all unplanned and emergency vegetation management activities including work initiated by customer inquiries and weather related events

Vegetation management in new construction involves removal of vegetation and establishment of line clearance corridors for new line construction and infrastructure replacement to improve feeder reliability performance

History

Historically, Pepco has endeavored to achieve its reliability targets through disciplined application of programs designed to improve individual and overall feeder performance. Further, Pepco has worked to meet all regulatory requirements associated with reliability of service and set an aggressive target of achieving first quartile performance among its peers. Despite consistent funding in its vegetation management program, customer interruptions associated with vegetation remain generally flat and are increasing in some areas. The Company has studied this phenomenon and attributes these results to several factors:

1. The Pepco service territory includes the fourth (4th) most dense urban tree canopy in America.

Research as of 8 Aug 2010 (Latest study was Charlotte, NC - April 2010)		
City	**Tree Cover**	**Population**
Charlotte	46.00%	709,441
Portland	42.00%	550,396
Atlanta	32.90%	519,145
Washington	**31.10%**	**588,292**
Houston	28.40%	2,208,180
Dallas	28.00%	1,240,499
Minneapolis	26.40%	377,392
Denver	26.00%	588,349
Seattle	22.90%	563,374
Baltimore	21.50%	637,455
Boston	21.20%	599,351
Oakland	21.00%	401,489
Milwaukee	19.10%	602,191
New York	16.60%	8,274,527
Philadelphia	15.70%	1,449,634
Tucson	13.70%	525,529
San Francisco	11.90%	764,976
Chicago	11.00%	2,836,658
Tampa	9.60%	336,823
San Diego	8.60%	1,266,731

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Nowak, David J.; Crane, Daniel E.; Stevens, Jack C. 2006. Air pollution removal by urban trees and shrubs in the United States. Urban Forestry and Urban Greening 4:115-123

Nowak, David J.; Hoehn, Robert E., III; Crane, Daniel E.; Stevens, Jack C.; Walton, Jeffrey T. 2007. Assessing urban forest effects and values, New York City's urban forest

Nowak, David J.; Hoehn, Robert E., III; Crane, Daniel E.; Stevens, Jack C.; Walton, Jeffrey T. 2007. Assessing urban forest effects and values, Philadelphia's urban forest

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American Forest, April 2010, Urban Ecosystem Analysis: Mecklenburg County and the City of Charlotte, North Carolina; American Forests (http://media.charlotteobserver.com/images/pdf/CharMecktreestudy2010.pdf)

Michaela Parlin, May 7, 2009, Seattle, Washington Urban Tree Canopy Analysis Project Report: Looking Back and Moving Forward, (http://www.seattle.gov/trees/docs/NCDC_Final_Project_Report.pdf)

2. Many of the legacy trees in Pepco, both public space and customer owned, are mature and overhanging the utility zone of clearance. These mature trees are also beginning to fail more frequently, causing significant damage to utility facilities.

3. Pepco rights-of-way over public space are very narrow and clearance obtained must be limited to no more than 2 years of growth between the utility's distribution lines and privately owned trees. Many individual customers are reluctant to permit Pepco to trim their privately owned trees in favor of maintaining green space, canopy, and privacy.

4. Pepco's current annual selection process to select the locations to trim utilizes an evaluation period of prior year's performance in its reliability assessment. The feeders with the highest number of outages related to trees will be selected for trimming within the current year.

5. Customers are also reluctant to allow Pepco to remove danger trees from private property outside of the utility right-of-way.

6. Pepco's current vegetation management practices focus primarily on electrical clearance from the distribution lines as well as dead or dying branches above the lines. About half of all vegetation related outages are caused by trees and branches falling from outside of the utility's clearance and removal zone.

Selection Criteria

In the District, a total of 10 feeders have been added to the 2010 plan as a result of re-evaluation of circuit based performance year to date. A similar re-evaluation of performance of both long-term and emergent trends will be performed at the end of 2010 and be utilized to prepare the pruning schedule for the first half of 2011.

Short –Term Actions

Pepco has examined vegetation related feeder performance year to date to adjust the 2010 pruning schedules in order to address emergent vegetation issues using a planned approach in lieu of addressing these issues under the Company's reactive maintenance strategy.

The 2010 VM budget has been increased in Pepco to add additional feeders to the 2010 trimming schedule, thus addressing the emergent vegetation related reliability issues identified as a result of the reassessment and reprioritization. Execution of the revised trimming schedule has commenced with additional tree crews being added to the Pepco system and will be completed by the end of 2010. This action will focus not only the additional crews but also the existing crews on the areas experiencing tree related reliability problems and the areas most impacted by the storms. The expectation is that this redirected focus will reduce the number of tree related outages in these areas.

Long –Term Actions

Traditionally, utilities have administered their vegetation management on a pre-specified trimming cycle (for example, four years). In order to get the most effective use of funding in terms of reliability performance, At a minimum, Pepco inspects and mitigates vegetation problems as necessary on all overhead feeder sections within the District of Columbia at least once every two years. Pepco has determined that some circuits may need to be pruned more often than others during the two-year cycle program. For example, rural circuits with lower tree density can be inspected and pruned in the normal cycle while, some circuits in urban areas with high tree density may have to be pruned more frequently. Pepco will analyze system performance impacts due to vegetation mid-year and revise pruning schedules accordingly to address emergent reliability issues. Additionally, Pepco will work with private property owners to remove more danger trees and overhangs prone to cause significant system damage.

Budget

The yearly budget for Pepco's vegetation management program within the District of Columbia is being increased from approx $1.0 million to $1.5 million.

Conclusion

Through reprioritization and expansion of the pruning schedule for the remainder of 2010, performance improvement of feeders due to vegetation related causes is expected to improve. Pepco will continue to work with customers, regulators, and state / local jurisdictions to enact and execute recognized best practices in vegetation management. Customer support for increased tree trimming is a vital component of the program to ensure our success. Therefore, this effort must be a joint effort between the Community, District of Columbia, Company and the Commission.

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.

History

The priority feeder program was initiated in 2001. Sixteen (16) feeders were selected in 2010 for improvements in performance within the District of Columbia. The number of feeders selected annually represents 2% of all of the feeders that serve the District of Columbia service territory. Composite Performance Index (CPI) is used to rank distribution feeders which ensure that the least performing feeders are selected for investigation and corrective action. CPI is composed of four measurements of each feeder: Number of Interruptions (NI), Number of Customer Hours of Interruption (CHI), System Average Frequency Index (SAIFI), and System Average Interruption Duration Index (SAIDI). Feeders are selected using outage data for a 12-month period from October 1 of the previous year through September 30 of the current year.

Reliability performance for feeders selected for the 2% Priority Feeder initiative are compared to the performance of the same feeder in previous years using SAIDI, SAIFI, and CAIDI. These indices are components of CPI but are better utilized when comparing feeder performance that spans several years. Feeder performance that does not improve ranks the priority feeder as a repeat feeder. Repeat feeders are investigated for reliability improvement in addition to the 2% Priority Feeder Program.

Short –Term Actions

Pepco will continue to execute the Priority Feeder program as agreed upon with its regulators. Reliability Engineering assigns the selected Priority Feeders to engineers for analysis and evaluation in order to identify and design circuit reliability improvement actions. The assignees will gather and review system performance data on their assigned feeders, check for potential overloads and imbalances, and submit feeder maps and Field Inspection Request Forms to the designated field inspection crew.

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 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 of new lateral tap fuses
- Installing sectionalizing devices
- Tree trimming
- Replace missing or damaged grounds and guys
- Check for appropriate fuse installation and resizing of fuses for fuse co-ordination with respect to inspection results

Long –Term Actions

Pepco follows a process that uses the routine corrective actions that history has shown usually provide significant reliability improvements. In those cases that significant reliability improvement has not been obtained and a feeder is repeated on the priority feeder listing, within a five year period Pepco will examine more extensive options for addressing performance. Overhead work that is “out of the box” and beyond normal reliability improvement work might include:

- Installation of tree wire in close configuration construction to replace bare wire through heavily treed areas where tree trimming and standard cross-arm construction would have limited success or is restricted by ordinance or property owners

- Installation of preassembled aerial cable for use as the main trunk of the feeder with the existing mainline truck reconfigured as fused laterals

- Installation of a guy wire above open wire construction to provide a shield for tree limbs / branches that overhang the feeder

- Installation of double cross arms and longer poles for increased overhead construction strength in heavy treed areas
- Installation of laminated poles for free standing (no guy) installations

Selection Criteria

A composite performance index (CPI) methodology is used to evaluate and rank feeder performance. CPI is a weighted calculation measuring historic performance data using the following basic and averaged, or combined, variables:

- Number of Interruptions (NI)
- Number of Customer Hours of Interruption (CHI)
- System Average Interruption Frequency Index (SAIFI)
- System Average Interruption Duration Index (SAIDI)

A CPI value is calculated for each feeder and the top 2% of ranked feeders in each jurisdiction will be identified for the Priority Feeder Program.

All Priority Feeders requiring vegetation work are inspected for tree problems and pruned accordingly by Vegetation Management. Upon completion of the analysis of each selected feeder, Work Requests and drawings are prepared for issuance to construction. Reliability Engineering tracks the status of all Priority Feeder projects and ensures that the Work Request is completed in a timely manner. Following remediation, the performance of Priority Feeders is tracked on a monthly basis by the System Performance and Analysis group and provided to Reliability Engineering for effectiveness of the remediation efforts.

In some cases, despite Pepco's efforts to efficiently improve a particular feeder's performance via the methodology outlined in the Priority Feeder Program, a feeder may repeat on the Priority Feeder program within a short time after initial remediation has occurred. In cases where a declared Priority Feeder repeats two or more times on the priority feeder list in the District of Columbia, Pepco will seek to improve the feeder's performance utilizing higher cost alternatives, including selective undergrounding or wholesale rebuilds / conversions of feeders. In addition, the Company will identify, prepare and file with the District of Columbia Public Service Commission detailed analyses of 4kV and 13kV feeders that have repeated on the Priority Feeder listings three and four times respectively.[4]

Budget

The 2010 budget for projects identified under Pepco's Priority Feeder Program in the District of Columbia is $1.6 million. The proposed budget for the next five years is being more than doubled to a yearly total of $3.6 million.

[4] Formal Case No. 766, In the Matter of the Commission's Fuel Adjustment Clause Audit and Review Program and Formal Case No. 991, In The Matter of the Investigation into Explosions Occurring in or Around the Underground Distribution Systems of the Potomac Electric Power Company, Order No. 15941, issued August 18, 2010.

4.3 Load Growth

This section outlines the short and long range construction programs developed by Pepco to meet continued load growth and maintain system reliability within Pepco's District of Columbia distribution service area.

History

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.

Planning for future load growth starts with the development of load growth projections. Short-term, summer-peak forecasts are developed for three years to allow adequate time to complete routine 4 kV and 13 kV construction work. Long range forecasting is used to develop advance plans for large 4 kV and 13 kV construction projects that require more than two to three years to complete, to develop routine and advance plans for 34.5 kV to 230 kV construction work, and to identify future capital projects. Planning for upgrades to the transmission system are completed in conjunction with PJM

To provide for rational and orderly changes to the electric system, Pepco has developed engineering and operating criteria which it applies to the design of new and modified systems. The three major components of system planning criteria are:

1) Voltage and reactive support – The data that are reviewed and tracked for "Voltage and Reactive Support" include feeder and substation voltage drop data and capacitor data (i.e., KVAR value and capacitor bank status). This information is kept for the historical and planned configurations, and is reviewed to determine the adequacy of individual feeder and substation voltage and reactive support. The System Planning Criteria stipulates that voltage will be considered adequate when the voltage at the utility's service terminals as installed for each customer, on a 120 volt nominal system, can be maintained after regulation, between 126 and 114 volts under normal conditions and between 126 and 105 volts under contingency conditions. In order to maintain the prescribed voltage regulation on the distribution system, the subtransmission system, substation supply lines, will have automatic controls capable of maintaining voltages at levels which will not exceed the limits of the connected equipment during both normal and contingency conditions. Generally, the voltages on the subtransmission system shall be maintained at or slightly above nominal voltage under normal conditions, and within ±5% of nominal voltage under contingency conditions. Supply to Primary Service Customers served from the subtransmission system shall be planned to meet voltage limits established by the local jurisdictions. Generally, these limits carry a ±10% variation from nominal voltage in the District of Columbia.

2) Ratings of facilities – The data that are reviewed and tracked for "Ratings of Facilities" include Normal, 24 Emergency, and Short-term Emergency (applicable to some transmission facilities) ratings of all electrical facilities including feeders, power transformers, circuit breakers, busses, etc., for both summer and winter periods. These ratings are incorporated into databases that are used internally within the company and transmitted to PJM for their use. These ratings are also incorporated into the Energy Management System (EMS) at Pepco's Control Center to monitor the real time feeder and substation loadings. Loadings in excess of the applicable ratings are reported to the System Operators via an alarm function on the EMS. All ratings are based on PJM rating methods and are provided by either Transmission Engineering and Design or Distribution and Transmission Engineering; however, System Planning coordinates these ratings and issues the official feeder and substation ratings. In accordance with the System Planning Criteria, the Transmission, Subtransmission, and Distribution System will be designed so that the applicable ratings are not exceeded. The applicable rating of a facility will be the appropriate rating, normal or emergency, of the particular facility approved for use in System Planning. The normal or emergency ratings of a facility will be calculated reflecting all components associated with the facility.

3) Reliability – Maintain n-1 reliability for all substation facilities. This means that at any Pepco substation in the District, there is enough capacity so that any one component, be it a substation transformer and/or its associated supply feeder or other device can be out of service without suffering loss of customer load or overloading any remaining equipment. In addition, Pepco plans its radial distribution system so that any feeder can be backed up through four manual switching operations or less upon loss of that feeder at the substation under peak load conditions.

Pepco completes short term planning studies for every area in the Pepco distribution system on a biennial basis. When forecasting Pepco's feeder and substation loads, System Planning begins with a close examination of the summer historical load. Department Staff compare the peak meter readings on the day of the summer peak 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. Pepco does not normalize loads at the feeder level, but bases them on the more severe weather conditions. The same process is applied to substation loading based on the substation peak hour. The subtransmission system historical load is developed from the 4kV and 13 kV substation loads diversified to the peak time of the subtransmission system.

After historical loads have been developed, the Pepco System Planning Department prepares short-term forecasts (which are used to identify detailed construction requirements) for each Construction Recommendation plan. These short-term, summer-peak forecasts are developed for three years to allow adequate time to complete routine 4 kV and 13 kV construction work. Any work in the first forecasted year of the plan would have been recommended in the previous plan, so historical feeder or feeder group loads are adjusted to reflect this previously recommended work. The loads are then increased to reflect actual service requests received on each circuit. These service requests are provided to System Planning in Prospective New Business (PNB) reports, which present information on the size, the location, and the estimated timing of the new services. The individual feeder and feeder group loads for each year are calculated and adjusted to produce the substation load predictions for each year of the plan.

Once predicted loads are established a power flow analysis is conducted on each distribution feeder in the planning area. Power flow analysis is a computational tool used to calculate power flows and voltages within a modeled electric system. The purpose of load flow analysis is to determine where there are conductor or equipment capacity overloads and whether there are any voltage deficiencies on the feeder by using a model of the primary mainline configuration of a feeder.

Solutions to relieve equipment capacity overloads and voltage deficiencies, be they 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.

Long range forecasting is used to develop advance plans for large 4 kV and 13 kV construction projects that require more than three years to complete, to develop routine and advance plans for 34.5 kV to 230 kV construction work, and to identify future capital projects forecasting process. When used in 34.5 kV to 230 kV construction recommendations, the 4 kV and 13 kV substation loads are diversified to the peak hour of the subtransmission system. To develop long term forecasts, load increases in the load forecast are divided between the District of Columbia and Maryland jurisdictions and the resultant increases are allocated to each substation in each jurisdiction based on an extrapolation of its short term forecast, while considering the expected saturation of the area load. As can be seen by the above description, planning for load growth within a distribution system requires the development of load forecasts at the feeder level, first with these feeder projections rolling up to the substation level, and then to the subtransmission and transmission systems.

Following the review of components of the existing electric system and the requirements for new service hook-ups, system planners develop the costs and schedules for the changes to the electric system which will be taken forward as candidates for inclusion in the construction budget process. The construction budget process takes place during the second half of each year and culminates with the approval of the following year's budget.

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

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.

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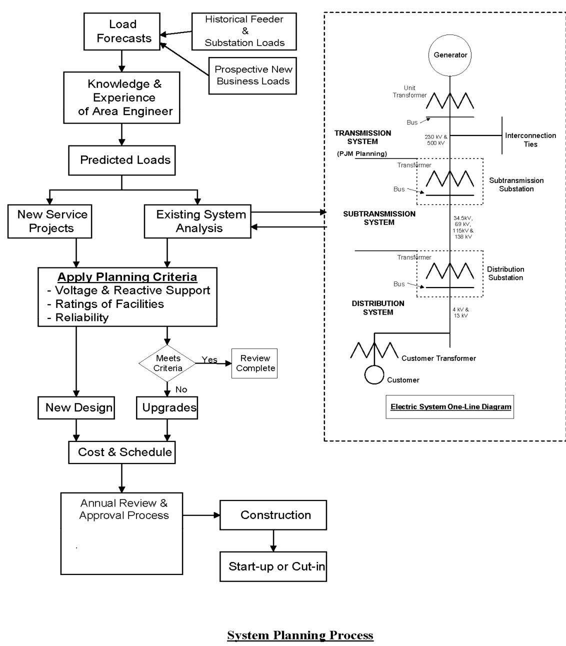


Figure 4 – System Planning Process

Short –Term Actions

For 2010, Pepco recommended for the District's distribution system: the installation of six new feeders, 55,000 feet of new overhead conductor, 8,800 feet of new overhead preassembled aerial cable, 9,900 feet of new underground conduit, 129,000 feet of new underground conductor, 14 new overhead gang operated switches, 18 new underground three-way switches, 3 new pole mounted voltage regulators, and five new pole mounted capacitor banks.

For 2011, Pepco is recommending the installation of three new distribution feeders, 400 feet of new underground conduit, 9,500 feet of new underground cable, 25,200 feet of new overhead conductor, one new overhead gang operated switch, three new pole mounted voltage regulators and three new pole mounted capacitor banks for the District's Distribution System.

Long –Term Actions

Over the next five years, Pepco has recommended to add a third 69kV transformer to an existing substation, add a fourth 69kV transformer to an existing substation, and extend 50 new distribution feeders for the District's Distribution System.

Selection Criteria

The new transformer(s) will be installed in our substation near Florida Avenue, NW and our substation near Harry Thomas Way, NE and will benefit those areas. There is assorted feeder work scattered through out the District that will benefit many neighborhoods.

Budget

The 2010 year end projection for money spent on load relief projects in the District is $2,744,000. The proposed budget for the next five years for load relief projects in the District of Columbia is currently:

(Dollars in millions)

2011	2012	2013	2014	2015
$31.0	$22.1	$25.2	$38.8	$61.7

Conclusion

Pepco's system is inherently reliable compared to other utilities because all of its substations are planned, constructed, and operated for n-1 reliability meaning that the loss of any single substation supply feeder or transformer should not result in the loss of load.

Pepco has a process in place to effectively identify and relieve equipment overloads and system voltage violations on a proactive basis through its planning process. Feeder and substation loads are monitored continuously through Pepco's SCADA system with system operators being alerted to substation operational abnormalities including feeder or transformer overloads.

Pepco has also developed Substation Load Emergency Restoration plans to provide guidance about what should be done to restore service to the load of a substation if it, or a major portion of it, is not available or has a reduced ability to adequately and reliably supply its load for a lengthy period of time. The plans call for bringing in mobile transformers and switchgear to the substation site in order to create a temporary substation from which the out of service feeders can be connected thereby restoring the customers. This gear, while mobile, will still take a number of days to move, stage, and connect. There are plans for using field switching to energize as many customers as possible and calling on customers to conserve and curtail load where possible.

4.4 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 various intelligent devices and technologies such as automatic circuit reclosers, remotely controlled switches, smart relays, switches and digital remote terminal units (DRTU), fault indicators, etc. 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.

4.4.1 Automatic Sectionalization and Restoration

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.

Pepco DA plans, as part of its Smart Grid Investment Grant (SGIG) Award spanning over the next three years (by summer of 2013), will result in significant customer reliability benefits. Pepco projects that the Distribution Automation will incur a system wide reliability improvement as follows:

SAIDI 19 %

SAIFI 13 %

CAIDI 7 %

Below are the major components of Pepco's DA system that Pepco is either currently using, or will implement over the next three years as part of DOE's SGIG award:

Feeder-Level Devices and Technologies

- Automatic Circuit Reclosers (ACRs)
- Automatic Sectionalizing and Tie Switches
- Network Protector Monitoring & Control

Substation-Level Devices and Technologies

- Automatic Sectionalizing and Restoration (ASR) scheme
- Substation Local Area Network (SLAN)
- Microprocessor or "Smart" Relays
- DRTUs
- Smart Monitoring & Controls

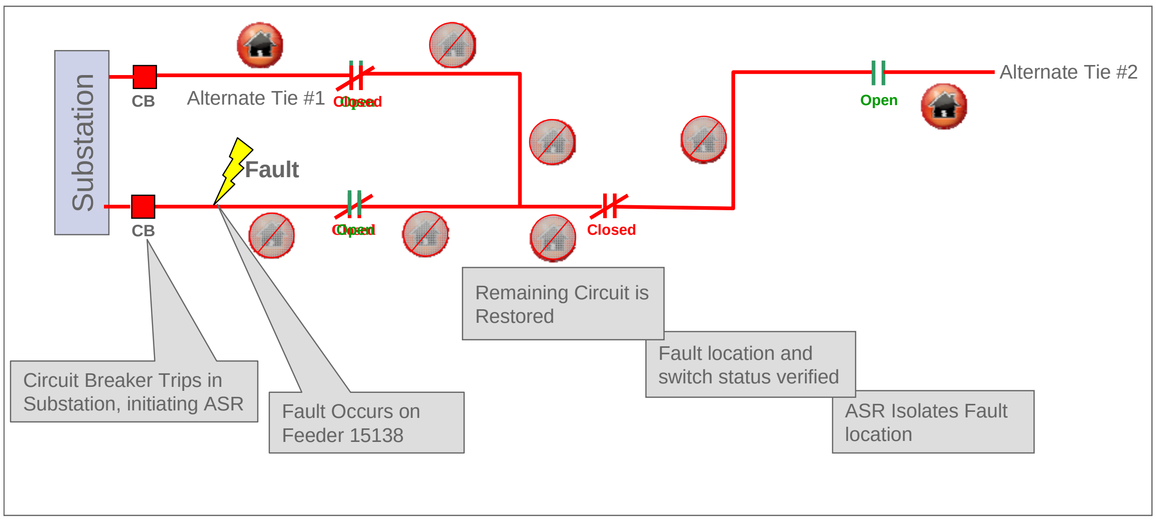
History

Pepco began selective deployment of DA components and systems, for the purposes of system protection and reliability improvement, in the late 1990s and accelerated in 2003, post-hurricane Isabel. Pepco's work in the last decade has allowed it to develop an extensive DA expansion plans over the next few years. DOE's SGIG award has allowed Pepco to accelerate its DA implementation in its Maryland and District of Columbia service territories over the next three years.

At this stage, Pepco has developed its DA vision and high level strategy implementation strategy. Pepco has already developed Project Plans for DOE approvals. Major decisions regarding technology and vendor selections are already made.

Pepco had a major ASR pilot successfully implemented in the Maryland. This ASR scheme covered Pepco's 4 substations (Crain Highway, Oak Grove, Kingswood, and Walker Mill Rd). This scheme has operated several times over the past three years, yielding significant benefits in reduction in customer outage duration. One example of this is an event that occurred on June 13, 2008.

Automatic Sectionalization and Restoration System (ASR) Sequences



With ASR…	Without ASR…
1080 total customers affected	1080 total customers affected
780 customers restored within 51 seconds	1080 customers out for 2 hours
300 remaining customers restored in less than 1 hour	

Figure 5 – ASR Sequences

In order to cover this ASR event, a sequence of events is spelled out below. This sequence largely follows a cause and effect model. The chronological order of steps is listed below:

- At 06:33 AM on June 13th 2008, Pepco's feeder breaker number 15138 locked out;
- As a result, an ASR was triggered at that time. The system forced polls of the five SF_6 switches;
- After verifying the open/closed status and fault indication status of each switch, the ASR determined (due to no switch fault indications) that the fault was located between the 15138 breaker and switch 15138I;
- A command was then transmitted to open 15138I to isolate the fault. After the successful opening of 15138I, ASR determined there were two alternate sources for the non-faulted load – the 15135 feeder or the 14163 feeder;
- The load on each feeder was checked to determine which feeder had the most reserve capacity and that the transfer would not cause an overload on the feeder;
- Feeder 15135 was selected as the preferred acceptable alternate source;
- ASR then turned Low Set Instantaneous Trip and Automatic Reclosing OFF on the 15135 feeder smart relay;

- ASR issued a close command to the feeder tie switch which successfully closed to restore service to the non-faulted sections of 15138 via the 15135 feeder;
- ASR confirmed that feeder 15135 was successfully carrying the transferred load and proceeded to return the LSI and Reclosing functions for the 15135 feeder back to their pre-incident status;
- The non-faulted load was restored approximately 51 seconds after the initial lockout.

Short –Term Actions

Pepco has completed its DA plan development and major equipment selection work as part of its DOE SGIG award work. Pepco has significant ASR work planned as part of SGIG award over the next three years in the District of Columbia. This timeline for this work along with the substations affected is:

- The ASR scheme for substation group Benning-Tuxedo is targeted for completion by August 2011.
- The ASR scheme for substation group Harrison-Van Ness-Little Falls is targeted for completion by December 2012.
- The ASR scheme for substation group 12th and Irving-Fort Slocum-Green Meadows-Takoma is targeted for completion by May 2013.
-

The neighborhoods partly or fully impacted by this work are:

Barnaby Woods	Foxhall Crescent	Michigan Park
Benning	Foxhall Terrace	Palisades
Brookland	Friendship Heights	Pinehurst Circle
Burleith	Glover Park	River Terrace
Burrville	Hampshire Knolls	Senate Heights
Canal View	Hawthorne	Shepherd Park
Chevy Chase	Hillandale	Takoma
Colonial Village	Lamond Riggs	Tenleytown
Deanwood	Lincoln Heights	Westchester
Fort Dupont	Manor Park	Woodridge
Fort Totten	McLean Gardens	

Long-Term Actions

As shown in the tabulation below, Pepco plans to install ASR schemes in about 56 of 600 applicable feeders in its Maryland and Washington, DC territories as part of the Smart Grid Investment Grant. In the summer of 2008, Pepco conducted a system analysis to develop a high level target for the number of ASR schemes required. This study included Pepco's entire electric distribution system (including the District of Columbia, Prince Georges County and Montgomery County). Pepco will continue evaluate results of the DA program and determine if and how the program should be expanded beyond 2013.

High level summary assumptions and the study results are provided as follows:

Pepco Parameter	Input
Number of DA switches per feeder	3
Percentage of feeder beyond fuses	40%
Percentage of time backup available	67%
Percentage of feeders with reclosers	10%
Total number of feeders	600
Percentage reduction due to DA	29%
Target percentage of SAIDI reduction	10%
Percentage of feeders to automate to achieve target	9.3%
Number of feeders to automate to achieve target	56

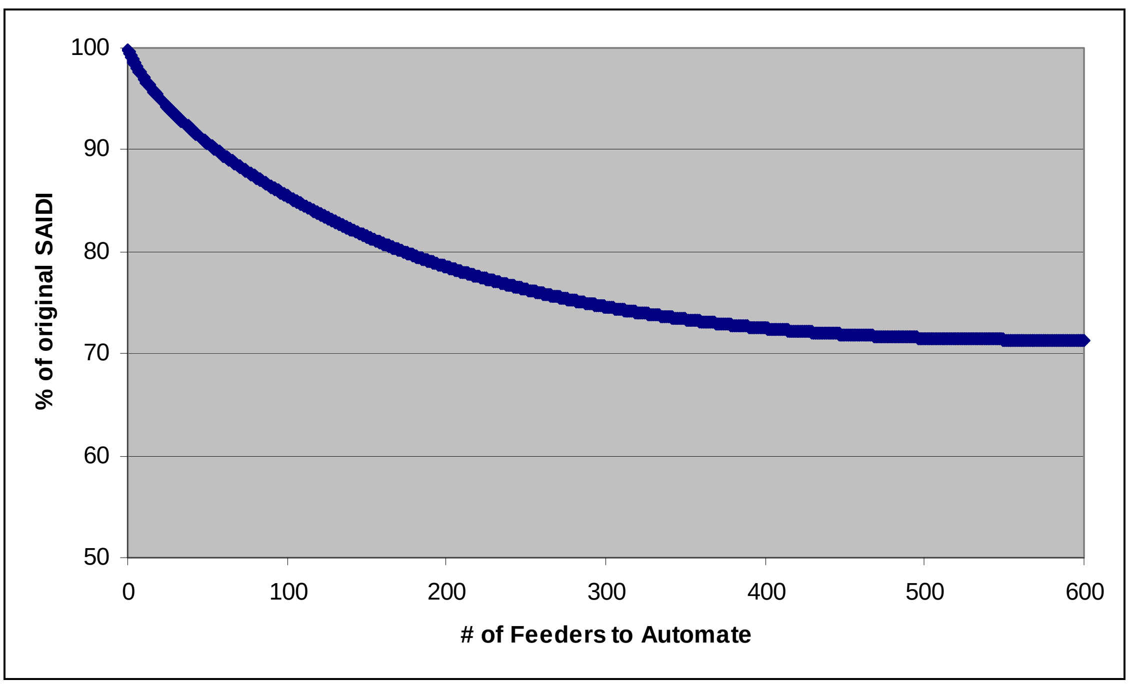


Figure 6 – ACRs Required

Selection Criteria

Selection criteria for ASR deployment includes the following critical steps: (1) rank reliability performance of distribution feeders based on the number of lockouts; (2) group feeders to substations and rank those based on number of feeder lockouts; (3) identify substation groups which are in geographic proximity and will yield the greatest performance improvement for ASR (Automatic Sectionalizing & Restoration) deployment; (4) install or upgrade Smart Relays and Remote Terminal Units (RTU)s (if not already existing or compatible with network operation) for all feeders within the substation groups; (5) install, for each identified feeder that is part of the ASR scheme approximately three to six Sectionalizing switches based upon the length of feeders, number of customers, and potential for improvement in service reliability. The timeline for this review is the performance over the last 24 months. This selection process would provide the greatest benefit to the most customers possible.

4.4.2 Additional Smart Monitoring Deployments

Network Protector Monitors

In a network secondary distribution system, service is redundantly provided through multiple transformers as opposed to radial systems where there is only one path for power to flow from the distribution substation to a particular load. The secondaries of networked transformers are connected together to provide multiple potential paths for power and thus much higher reliability than an equivalent radial feeder. To keep power from inappropriately feeding from one transformer back through another transformer (feeding a fault on the primary side, for example), devices called network protectors are used to detect such a back feed and open very quickly.

Network protectors are automatic electrically operated air circuit breakers consisting of a breaker operated mechanism, network relays and control equipment. Their purpose is to isolate a fault on a primary feeder from the low voltage network. The master relay is a very sensitive three phase reverse power relay that opens the protector when real power flow is from the network to the primary feeder. It is utilized both on LVAC secondary distributed network and spot network. It ensures that the loss of one feeder will not result in a service outage at any secondary load. The other primary feeders will carry the load until a feeder can be repaired or returned to service.

Pepco will install 37 remote network protector monitors in the Navy Yard/Southeast Federal Center area of Southeast D.C. These network protector monitors will remotely provide critical data from the network protector such as current, voltage, temperature, and switching status to the Pepco Control Center. The monitor will also allow command and control over the network protector breaker. The Network RMS program will improve reliability of the network system by alerting Pepco personnel when the network protector opens or when a measured parameter is outside defined limits. Pepco field workers would be dispatched based on this information and can possibly correct problems before they become failures or restore a faulted network transformer or protector faster.

Faulted Circuit Indicators

Pepco will install non-remote faulted circuit indicators on selected overhead portions of the distribution system in the District of Columbia in 2011. This initiative will further assist in locating faults faster,and improving restoration time. While not technically a part of Pepco's distribution automation program, the purpose of utilizing faulted circuit indicators is in line with the restoration improvement goals of the DA program. Faulted Circuit Indicators are used on transmission and distribution circuits to help repair crews to faster identify the location of faulted equipment, thereby reducing outage time, operating costs, and improving overall reliability. During typical fault conditions, a large magnitude of fault current is present on the system from the source to the point of the fault. Faulted circuit indicators installed at various points on the system, sense these high currents and signal their presence by means of a local and optionally remote indication. Dispatched crews will first look for fault indicators to assist in problem location and isolation of the fault to a specific segment of the circuit. By switching out the faulted segment, service can be restored to the balance of the circuit while the faulted segment is repaired. The deployment of faulted circuit indicators will target overhead portions of feeders with higher restoration times attributable to long feeder backbones and those along heavy traffic routes within the District of Columbia.

Short-Term Actions

Pepco will install 37 network protector remote monitors as part of the DOE Stimulus grant. These monitors are to be installed in 2011. In addition, Pepco will install between 30 and 50 overhead faulted circuit indicators with local indication on selected overhead feeders to help reduce troubleshooting time and overall outage minutes.

Budget

Pepco's DA plan budget for 2011 - 2015 for District of Columbia is $13.5 million. A portion of this investment will be recovered by the DOE Smart Grid Investment Grant.

Conclusion

Pepco has a well established Distribution Automation program. The work done by Pepco in the last decade has resulted in significant learning. This has allowed Pepco to secure funding from DOE and has allowed Pepco to accelerate its DA program in the next three years.

4.5 Feeder Improvement

Pepco’s feeder improvement strategy is focused on addressing equipment, vegetation, weather and animal related interruptions which negatively impact reliability performance. This effort concentrates on feeders not included in the Priority Feeder Program.

The primary goal of feeder improvement is to minimize conditions on the distribution system which could lead to interruptions of service. Equipment upgrades, line section rebuilds, conversion of spans to tree wire and installation of animal guards are several of the tactics employed by Pepco to eliminate potential fault causing conditions.

The secondary goal of feeder improvement is to minimize the impact of interruptions. Minimizing the impacts of faults is accomplished by adding or improving sectionalization on distribution lines. This mitigation tactic can include significant measures such as deployment of automatic reclosing equipment when applicable.

History

Pepco identifies feeders not included in the Priority Feeder Program which also exhibit poor performance based on the feeder’s individual reliability indices as well as the feeder’s contribution to overall system reliability. Those feeders that exhibit the best opportunity for improvement of the overall system reliability are targeted for improvements. Additionally, sections of feeders which exhibit multiple interruptions for ostensibly avoidable causes are addressed.

Pepco has endeavored to address problematic feeder performance at a community level as well. Should a particular feeder exhibit poor performance and that feeder supplies a community, Pepco tries to address the community-based reliability impact by looking at all of the distribution supplies into the community for improvement opportunities. Some recent examples of this are the Crestwood, Shepherd Park, and Palisades communities within the District.

Although Pepco continues to register relatively low CEMI (customers experiencing multiple interruptions) statistics in its DC service area (there were 243 customers or 0.097% of Pepco's customer base in DC, having more than 8 outages for the immediate past 12 months), Pepco continues an initiative to reduce its CEMI indices further as a driver of customer satisfaction. The initiative includes improved detection and internal reporting on the operation of protective devices experiencing repeated interruptions as well as timelier investigation and remediation of conditions contributing to repetitive outages.

Short –Term Actions

Pepco will continue to address feeders not included in the priority feeder program in an effort to improve customer satisfaction and overall system reliability.

Long –Term Actions

Pepco will increase the funding in this effort, allowing more sub-par feeders to be addressed and/or more extensive projects to improve overall reliability. Pepco is also anticipating continued reductions in CEMI as measured at the $CEMI_8$ level. In 2011, Pepco plans on focusing its efforts in reduction at the $CEMI_6$ level, customers experiencing more than six outages, toward eventually monitoring and controlling at the $CEMI_3$ level. This will be accomplished through better and timelier identification of these customers as well as initiation of a reporting mechanism to alert stakeholders when individual customer levels of interruption exceed desired set points.

Selection Criteria

Pepco identifies feeders not included in the Priority Feeder Program which also exhibit poor performance based on the feeder's individual reliability indices as well as the feeder's contribution to overall system reliability. Those feeders that exhibit the best opportunity for improvement of the overall system reliability are targeted for improvements. Additionally, sections of feeders which exhibit multiple interruptions for ostensibly avoidable causes are addressed.

Budget

The proposed budget calls for spending $50.0 million on feeder improvements over the next five years.

4.6 Selective Undergrounding

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 events resulting in the entire feeder being de-energized 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.

History

The concept or idea to reduce the amount of outages on the overhead system by converting the system to underground is not a new concept and has been discussed in the past at the state, municipal and local levels. The conclusion is that the high costs of undergrounding entire overhead facilities cannot be justified based on reliability gains alone. In addition, the primary driver for undergrounding existing overhead lines has been aesthetic considerations, not reliability benefits. See Pepco's Response to District of Columbia Public Service Commission Order No. 13830 in Formal Case No. 1026, 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.

Cost estimates for new underground construction are multiple times the cost of equivalent overhead construction. The cost to convert the existing overhead assets to underground will vary depending on the type of construction and the amount of overhead facilities placed underground. The $3,500,000 per mile cost covers converting only the mainline primary of the overhead feeder to underground whereas the $11,500,000 per mile cost reflects converting all existing overhead mainline primary, lateral primary taps, transformers and secondary mainline including service conductors. The additional cost the customers will incur to hire a licensed electrician to convert their existing overhead service to accept an underground feed is not reflected in the $11,500,000 per mile cost.

	Overhead	**Underground**
Cost per Mile	$300,000	$3,500,00 - $11,500,000

Short –Term Actions

Pepco will use the selection criteria (see discussion in "Selection Criteria" section which follows) to identify the feeders that qualify for the selective undergrounding program. Once the feeders are identified, Pepco will create a conceptual design to underground portions of the overhead system. Next, Pepco will start conducting field inspections to gather field data to validate the feasibility of the conceptual design. As part of this process, Pepco will apply for excavation permits in the public right-of-way. After the conceptual design is validated, a detailed cost estimate will be finalized for the construction work in the following year.

Long –Term Actions

The implementation or construction of the undergrounding of portions of the selected feeders will be spread out over a five-year period. During this five-year period, the necessary permits and easements will be obtained and construction will commence accordingly.

Selection Criteria

The criteria for determining which feeders shall be considered 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 = Feeders supplying critical customers (such as hospitals)

Conclusion

In the Pepco service territory, 60% of SAIFI is attributed to feeder lock outs for various reasons including tree-related issues. In situations where Pepco's normal feeder improvement tactics prove unsuccessful, undergrounding of portions of feeders will be considered as an option. By selectively converting mainline portions of the overhead system to underground, exposure to outage causes which can't be mitigated by less costly means is reduced. As previously stated, the process of targeted or selective undergrounding will be used as a last resort effort and will be used strictly for reliability improvement purposes only and not for aesthetic reasons.

Budget

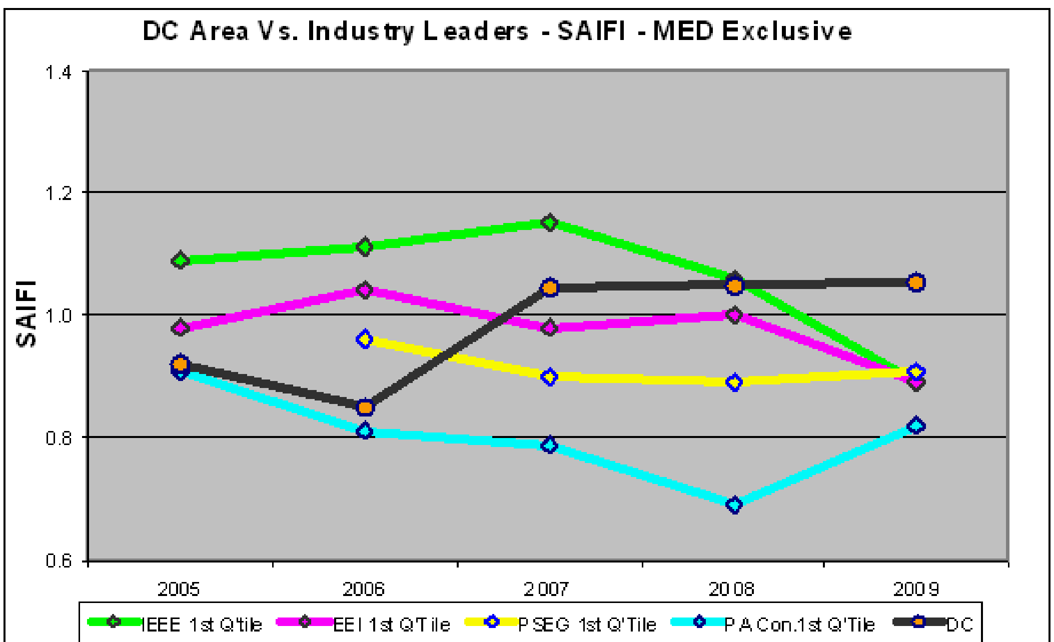
The annual budget of $10 million will be used to convert portions of overhead system to underground.

5. RELIABILITY COMPARISONS

Pepco voluntarily participates in industry benchmarking studies to assess its reliability performance in outage frequency and duration and employs industry best practices in an effort to achieve first quartile reliability performance among its industry peers as indicated in these evaluations.

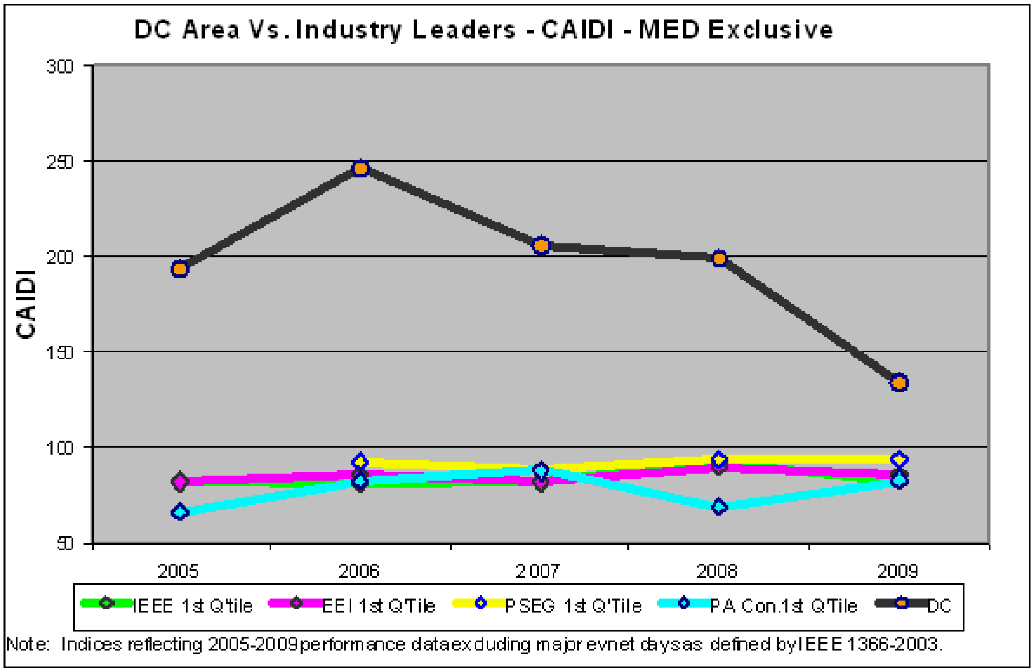
The intrinsic nature of these voluntary assessments exhibits the necessity to understand what such industry comparisons indicate. Quartile rankings in benchmarking studies are simply a quantitative indicator of performance ranking and do not account for the qualitative performance of the system. The actual difference between best in class and worst in class outage frequency performance in most benchmarking studies is considerably narrow, often consisting of an average of less than one outage per year per customer. Benchmarking studies also do not account for the fact that no two utilities are the same in weather exposure, tree canopy, system configuration, or accessibility. Finally, while Pepco tries to participate in benchmarking studies that feature a significant sample size of participants, study results are subject to inherent fluctuations based on the voluntary participation of the same sample set year over year. Therefore, Pepco utilizes the results of theses benchmarking studies as an indicator only, and not the sole arbiter of its performance within the industry.

In the District of Columbia, Pepco reliability performance has consistently ranked in the first or second quartile in SAIFI in industry benchmarking studies over the past five years.



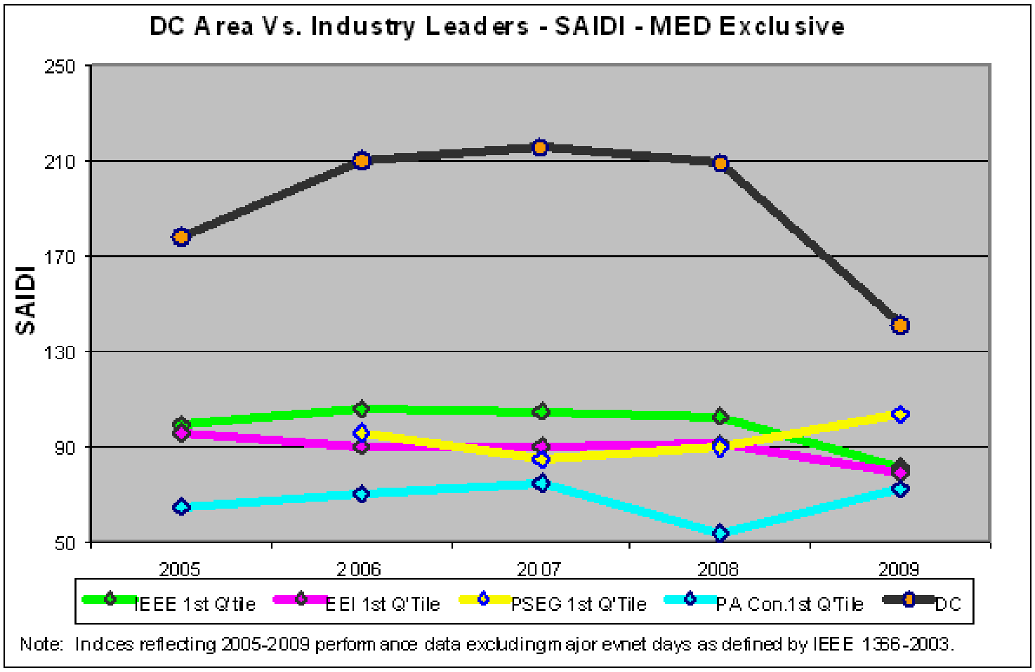
Note Indices reflecting 2005-2009 performance data excluding major evnet days as defined by IEEE 1366-2003.

With respect to CAIDI in the same studies, the District of Columbia generally ranked in the third or fourth quartile over the past 5 years, but is improving in line with the company's aspiration for first quartile performance as evidenced by a reduction of over 45% in DC CAIDI since peaking in 2006. Pepco's most recent (2009) CAIDI performance in the District of Columbia was the lowest in the past five years.



A PHI Company

In SAIDI, the District of Columbia generally ranked within the third quartile over the same time period, but is improving in line with the company's aspiration for first quartile performance as evidenced by a reduction of almost 35% in DC SAIDI since peaking in 2007. Pepco's most recent (2009) SAIDI performance in the District of Columbia was the lowest over the past five years.



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6. PATH TO FIRST QUARTILE PERFORMANCE

In Order No. 15568 issued by the DCPSC, Pepco is directed to "submit a continuous improvement plan, including resourcing, specific performance targets and milestone dates to achieve the reliability and outage restoration performance of the best (quartile) performing (comparably) utilities in the Benchmarking Studies.

In order to achieve first quartile reliability performance status on all three standard indices in the District of Columbia, as indicated by the aggregate benchmarking results and Pepco's 2009 performance, Pepco would need to attain the following reliability indices in the District of Columbia:

SAIFI – 0.95 or 10% improvement over 2009 performance
CAIDI – 85 minutes or 37% improvement over 2009 performance
SAIDI – 90 minutes or 36% improvement over 2009 performance

Pepco's aspirations in reliability as well as the expectations of the Public Service Commission of the District of Columbia are significant and should not be considered an easily achievable task. According to the results from the most recent IEEE survey (2009 data), which had one of the broadest participation rates (107 utilities), a total of only 10 (9%) of utilities surveyed achieved first quartile ranking in **all three** reliability indices - SAIFI, SAIDI, and CAIDI, and none of these are located in the Mid-Atlantic region.

It should be noted also that due to their inherent mathematical relationship (CAIDI = SAIDI / SAIFI), disproportionate reductions in frequency and duration of outages, both improving reliability, can have a negative effect on CAIDI. Utilities embarking on reliability improvement initiatives have often found that through their initial efforts, usually focused on reducing large scale feeder outages and inexpensive fault mitigation projects, they improve in SAIFI… but CAIDI worsens. Therefore, the impression that CAIDI is a qualitative measure of a utility's reliability is problematic. As a measure of operational efficiency, CAIDI can be an indicator, but only when comparing utilities with similar weather exposure, tree canopy, system configuration, and accessibility.

Therefore, Pepco proposes:

1) To work to reduce its SAIFI within the District of Columbia toward achieving the 5 year average first quartile performance threshold from the IEEE benchmarking study by the end of 2013.
2) To work to reduce its SAIDI within the District of Columbia toward achieving the 5 year average second quartile performance threshold from the IEEE benchmarking study by the end of 2013. (Considering the significant portion of the Pepco system that is comprised of underground

infrastructure requiring longer repair times, coupled with traffic congestion across the District which negatively impact travel and troubleshooting time.)

This timeline is primarily driven by the necessity for Pepco to fully deploy its distribution automation and infrastructure over the next several years in order to realize the expected benefits in outage duration and frequency. The use of IEEE Benchmarking Survey results is based on the large sample size in the IEEE survey and the use of 5 year averages to determine performance threshold targets is intended to further normalize the impact of variations in sample sizes and benchmarking survey participation.

Pepco believes that it is reasonable to recover costs incurred to implement the proposed reliability improvement programs outside of the regular base rate case process. Accordingly, it is proposed that a mechanism to recover costs employing a tracker or infrastructure investment recovery methodology be employed.

Through the judicious application of the initiatives and projects highlighted within this Comprehensive Reliability Plan, coupled with favorable conditions for regulatory recovery of the capital investment required, Pepco believes it can achieve continuous improvement in reliability within the District of Columbia and reach these frequency and duration targets by the end of 2013.

7. CONCLUSION

Additional actions can and are being taken to further improve the reliability of Pepco's distribution system. These actions include increased efforts to prune or remove trees and vegetation affecting power system performance, the installation of faulted circuit indicators and distribution automation equipment to reduce the time required to restore customers, replacement of aging infrastructure, application of industry best practices to improve 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

Glossary of Terms & Definitions

Distribution Related Terms

Circuit/Feeder	Electrical system consisting of main line conductor/wire that is the distribution source of electricity to areas served by the distribution system.
Circuit Mile	Physical miles of line multiplied by the number of circuits per line. For purposes of this survey circuit miles refers to both overhead and underground line. Can be either 1- or 3- phase lines.
Distribution	Voltage level is less than 69kV
Distribution Structure Miles	The total of overhead primary voltage pole miles and underground primary voltage trench miles. One linear mile counts as one mile, regardless of the number of circuits on the pole or the number of phases present. Secondary and service distances are not included.
Distribution Substation	Load serving station that is fed from transmission or sub-transmission.
Lateral/Tap Line	Branch line, sometime fused, that takes off of a main line of a distribution circuit or feeder for the purposed of serving electrical load unreachable from the main line
Preventive Maintenance	Maintenance based upon length of time or number of operations since last check generally before the equipment actually fails – condition-based.

Reliability Related Terms

Major Event	Designates an event that exceeds reasonable design and or operational limits of the electric power system. A Major Event includes at least one Major Event Day (MED).
SAIFI	System Average Interruption Frequency Index. Total No. of Sustained Customer Interruptions / Total No. of Customers.
Restoration	The restoration of service to blocks of customers in an area until the entire area is restored.