Technical Committee

January 17, 2013

Agenda

- Review of Shaw and Pepco Studies
- Review Selection Criteria
- Review Reliability Benefits from a Sample Five Year Plan
- Discuss Impact on Communication Facilities
- Review UFA's Urban Tree Program

What Is Different From The Shaw Study

- Pepco used many of the same assumptions that were used to develop the undergrounding option by Shaw
- Pepco was assisted in developing the model and assumptions by PA Consulting Group who has working for them the lead investigator from the Shaw project
- Pepco study analyzed the location of failures on each feeder relative to mainline, lateral or secondary AND weather in greater detail
- Shaw design was asked to improve reliability on "Blue Sky" days and during "Small Storm" events – *Major Storm Events were excluded* from the study
- Recent weather patterns indicate major storm events cannot be excluded
- The contracted study and outage data used was focused only on worst performing feeders – not the entire Pepco system and was then extrapolated on a mileage bases.

Pepco Performed a more Detailed Study

- Cost templates were developed for the required scenarios – examples:
  - primary voltage underground manhole and duct system
  - padmount transformers and switches
  - risers to supply transformers on poles
  - removal costs
- Cost were developed on the actual (current) arrangement of each feeder compared to using a few feeders to develop average cost and reliability improvements, including
  - urban, suburban, rural
  - type of digging
  - current regulations for construction and road openings
- Pepco designed for loop feeds (two ways to supply each transformer) compared to single radial feed in Shaw study. The Shaw design would not be accepted by Pepco as it retained significant overhead exposure and would result in increased number of long duration sustained outages.
- To prevent these long duration outages additional underground switches and cable are needed to develop the primary loop arrangement that is needed to maintain reliability.
- Pepco based the estimate on actual 2012 Washington DC construction cost - Shaw costs are 2006 dollars which allowed evaluation /comparison of earlier Pepco studies

How Do the Cost Vary From The Shaw Study

- To compare this two studies, we will look at Option #1 UG Mainline and retain OH Secondary. Pepco estimate in 2012 $ is $1.96 B. Shaw estimate in 2006$ was $1.1B – What are the major differences?
  - Inflation – historical construction inflation is 2.9%/year – results in 22.1% inflation (2006-2012) on the Shaw estimate.
  - Utility construction costs have exceeded these inflation numbers due to the surge in copper prices (cables and transformers and switches) and fuel prices for construction vehicles – included in Pepco calculations.
  - Pepco's solution targets all weather conditions – calls for the removal of primary sections left in the air under the Shaw proposal. Requires UG switches to replace OH switches $ 50M
  - Pepco's solution to remove all primary from the overhead poles requires the placement of transformers on the ground or in vaults with separate secondary risers to supply the overhead secondary–- $250 - $300M
  - Pepco will build a looped feed system UG as opposed to radial – able to restore customer if there is a cable failure prior to repairs - $175 - 200M
  - Pepco, knowledgeable of the terrain added difficulty factors for construction – blasting, boring and road-opening construction hour restrictions - $150 - $200 M
- Results in the SHAW plan if upgraded and inflation adjusted ≈ $1.8B

- Primary selection criteria is based on reliability benefits
- Ranking method select feeders that improve both frequency and duration of outages and obtain the largest reduction in the minutes of interruption for the dollars spent to underground
- Primary selection criteria will develop a ranking of all feeders so that the feeders with the greatest overall benefits are undergrounded first

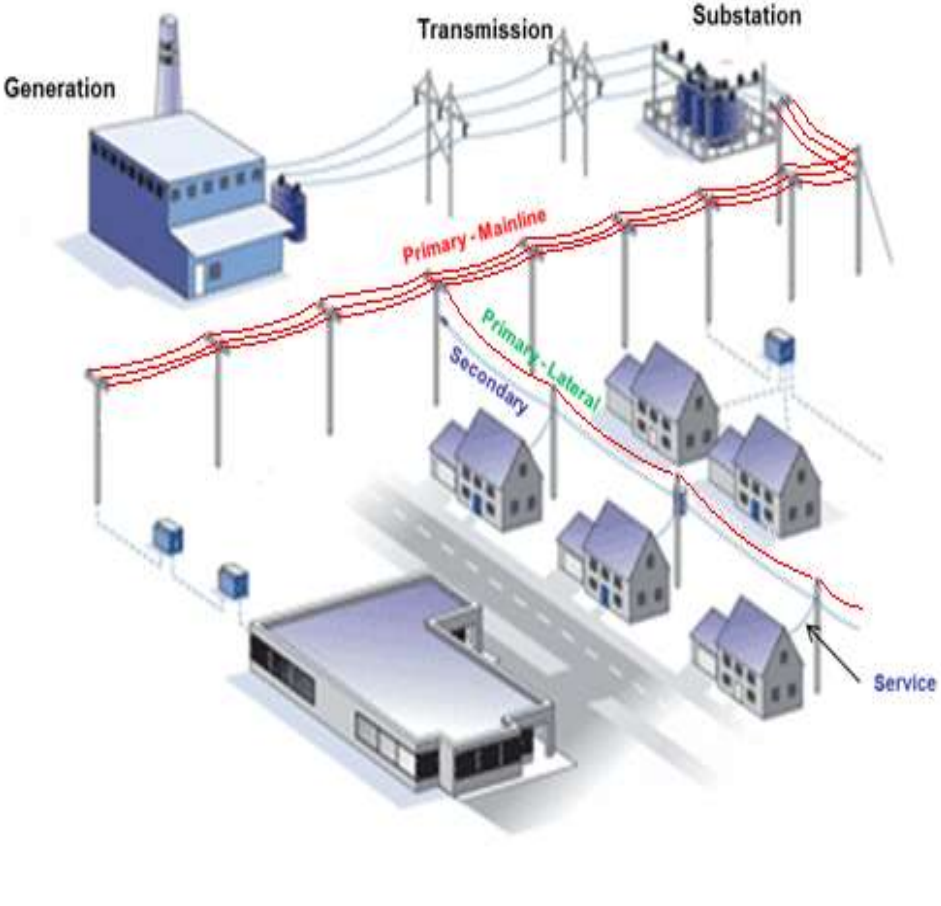
Primary Selection Criteria	
SAIDI	Selection of feeders that result in the greatest reduction in duration of outages once the feeder is undergrounded
SAIFI	Selection of feeders that result in the greatest reduction in frequency of outages once the feeder is undergrounded
Customer Minutes of Interruptions per Cost of Undergrounding	Achieve the greatest reduction in the minutes of interruptions for every dollar spent to underground

- Secondary evaluation is used to determine the sequence of undergrounding the feeders selected by the primary selection process
- This is important so that proper coordination is made with other infrastructure projects and so that communities are not impacted with multiple construction projects at the same time
- Secondary criteria helps to select the feeders that benefit the community and take into consideration the non reliability criteria

Secondary Evaluation Criteria	
Value of Service	When two or more feeders within a ward are scheduled for undergrounding, the order or sequence to perform that work can take into consideration the economic benefits of reduced outages – the feeders with the highest economic impact during an outage would be the first to be undergrounded
Utility Coordination with DDOT	Coordination of undergrounding projects with major road reconstruction work and other utility projects to achieve cost reduction benefits from reduced paving cost and efficiencies of scale in work being performed
Community Impact	Major road or utility construction work can have a significant impact on a community and economic impact on businesses. Limiting feeder undergrounding projects at any one time to no more than one project per ward can help to reduce this impact
Customer Impact	Evaluation of customer supplied from each feeder so that the prioritization of work takes into consideration the number of public service facilities (fire and police), health care and customers with special needs for electric service are considered when scheduling the order of feeders to be undergrounded.

Recommended Undergrounding Scenario

Scenario 3: Undergrounding Mainline and Laterals with OH Secondary.



- Scenario 3 is the preferred scenario because it has the best balance between cost and reliability improvement.
- This scenario would eliminate overhead causes of outages on the primary feeders.
- It eliminates the events that occur on blue sky days, normal storm days or during major storms on the mainline and lateral primaries.
- Padmount transformers will be used that are fed underground from the mainline and lateral switch holes
- Secondary will be routed from the padmount transformers to rise up on existing poles to supply the existing overhead secondary.

Undergrounding Scenarios

District of Columbia (All Outages Percent of overhead)	Cost ($Billions)	Outage Events	Customer Frequency	Customer Duration
3. UG main line and laterals w/OH secondary	$3.00	65%	97%	92%

District of Columbia (All Outages Percent of total)	Cost ($Billions)	Outage Events	Customer Frequency	Customer Duration
1. UG main line w/OH secondary	$1.93	4%	32%	31%
2. UG laterals w/UG secondary	$3.30	63%	26%	37%
3. UG main line and laterals w/OH secondary	$3.00	44%	56%	62%
4. UG main line and laterals w/UG secondary	$5.11	67%	58%	67%
5.* UG laterals w/OH secondary	$1.33	40%	24%	31%

- Recommended scenario will generally be the standard loop design for undergrounding to provide redundant paths to supply customers
- Alternate options will be considered for selected areas as the final designs are developed
- Consideration that could result in alternate design are streetscape projects, economic developments, or future infrastructure projects
- When future projects could result in all overhead equipment being removed then additional conduits can be built to accommodate future undergrounding activities

Undergrounding Statistics and Impact

- Of the 600 DC feeders, 25 percent are overhead and account for 75 percent of the District's outages.
  - About 600 DC feeders serve over 256,000 customers.
  - Of these 600 DC feeders, 25% of the total feeder mileage is overhead and serves nearly 102,000 customers connected to the overhead portion
- Because most overhead feeders also have underground portions, some customers who already have underground service would still benefit from additional undergrounding.
  - Mixed feeders in DC that have both OH and UG portions serve a total of over 140,000 customers.
- On 31 feeders, about 45,000 customers served overhead see an average 1.24 million interruption minutes each year. With undergrounding, they could see a drop of more than 1 million minutes a year on average.
  - A typical five-year plan that involved 31 feeders would provide a 74% reduction in total feeder (OH & UG combined) customer outage frequency for the selected 31 feeders.
  - The 31 proposed feeders for undergrounding serve nearly 45,000 customers who would realize an average of 98% reduction in overhead related customer outage frequency

Impact on Communication Facilities

- Selected design will generally retain the poles therefore there would be no need to remove communication facilities
- When all electric facilities are converted to underground then all communication facilities are recommended to be converted to underground *
- Conduit capacity could be added for future undergrounding activities in selected areas where economic development or streetscape projects are anticipated
- Adding additional conduit capacity will add incremental cost but lower cost to construct now than at a future date as a stand alone project
- Undergrounding of communication lines would add significant additional cost - for example an estimate of the cost to underground the Comcast facilities would be:
  - Cost per mile - $544,320 (Total Construction Cost - $377,137,600)
  - Total Miles – 680 miles
  - Almost nominal impact on reliability measures
  - Balanced against increased repair times between accessing ariel and underground facilities
  - Cost do not include conduit lease fees

* Committee does not have consensus on this recommendation

UFA Tree Care Program

UFA is today focused on increasing the tree canopy from 30% to 40% through various efforts and policies. Some of these are described below:

- Tree Canopy Maintenance programs that care for the existing canopy in the District so that it can grow in a healthy manner. It is estimated that 50% of the canopy gain will be seen from canopy growth.
- Tree Planting programs are the source of the remaining 50% of the canopy growth. This year UFA will plant over 6,400 street trees to fill in open spaces citywide.
- Tree Canopy compensation programs provides inspection services through the DDOT permit office.
- Canopy Keeper programs that engage citizens to become tree keepers and water newly planted trees citywide.
- Canopy Education programs allow UFA staff to better inform the citizens about the benefits of trees.

Conflict Between Tree Growth Program And Electric System

- The goals to increase tree canopy and increase electric reliability are naturally in conflict
- New electric infrastructure requires taller poles and increased interference with tree canopy
- Increased tree canopy across the city will result in increased tree related outages and more storm damage
- Alternate methods of overhead construction would have minimal impact on reducing the risk to system reliability
- Today Pepco works around the goals to increase tree canopy by moving poles and wires to reduce direct contact but these poles and wires are at risk when trees fall during storms
- Undergrounding is the only option to reduce tree canopy impacts and tree related risk during storms

APPENDIX

As an example if you use the option to underground all of the primary and retain the secondary overhead what are some of the impacts ?

- Selection of undergrounding of primary but not the secondary reduces cost from $5.11 billion to $3.00 billion and still achieves the majority of the reliability benefits – 65% fewer outages, 97% improvement in frequency and 92% reduction in duration of outages
- Retaining secondary and services overhead maintains the need for poles and therefore no driver to underground communication lines
- Avoids the cost and inconvenience of replacing the service drop to customers homes.

What is removed

Primary OH Lines
Pole Mounted transformer

What remains

Aerial Secondary
OH Service to Customer
Cable TV
Telephone
Secondary Riser